Designing for Intersections

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ABSTRACT
In response to the recent call for a more intersectionally-aware field of human-computer interaction (HCI), we aim to operationalize intersectionality for technology design in HCI. We develop our lens of intersectionality by drawing on the work of Rita Kaur Dhamoon, and use it to analyze data collected from a multi-sited ethnographic study of seven low-resource learning environments in the Indian states of Maharashtra, Tamil Nadu, and West Bengal. Our research contributions are threefold. First, we extend conversations in Intersectional HCI by expanding its scope from understanding users to recognizing social processes. Second, we emphasize the importance of factoring in both penalties and privileges when conducting research in underserved contexts. Finally, we engage situated comparisons as a methodology to identify pathways for designing interactive systems across intersectionally diverse environments.

Author Keywords
Intersectionality; HCI4D; Education; India

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H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

INTRODUCTION
The growing presence, power, and versatility of information and communication technologies (ICTs) in the Global South suggest tremendous potential for supporting diverse domains for development, such as health and education [20, 49, 50]. To harness this potential, researchers and practitioners in the field of ICTs and Development (ICTD) have proposed various innovative technology-enhanced interventions with some success [22, 56, 59, 72, 76]. However, technology design for diversely disadvantaged groups in the Global South tends to fall short of targeted impact [65, 72, 80]. One underlying reason is that most initiatives operate with partial understanding, at best, of the complexities of these groups' experiences [16, 50, 73]. Dwelling on constraints and deficits, they disregard potential that might be harnessed for realizing technosocial opportunities towards greater equity [43]. The question is still pending: *how might we study these diversely disadvantaged groups to imagine ways of integrating ICTs into the broader social and cultural fabric of their everyday contexts?*

We address the question above by focusing specifically on imagining context-appropriate roles for technology within *diversely* low-resource learning environments (LRLEs) located across India. To work towards a more holistic understanding that factors in the realities of learners' homes, schools, and communities [50], we engage deeply with the lens of intersectionality. Thus we focus on how *"the complex, irreducible, varied, and variable effects which ensue when multiple axes of differentiation—economic, political, cultural, psychic, subjective, and experiential—intersect in historically specific contexts"* [11].

Leveraging findings from our multi-sited ethnography across seven culturally and infrastructurally distinct LRLEs in the Indian states of Maharashtra, Tamil Nadu, and West Bengal, we unpack monolithic assumptions of what *"low-resource"* might entail. We analyze this data using Dhamoon's lens on *mainstreaming intersectionality* [28] for an enriched understanding of the realities of LRLEs. Dhamoon's proposal for intersectional-type analyses allows us to go beyond identifying power dynamics due to intersecting axes of differentiation such as gender, race, and education [26] to understanding the interacting cultural and historical processes and systems underlying these differences. It is in this interaction of processes, Dhamoon argues, that we can identify the *penalties* that individuals and communities endure, as well as the *privileges* they mobilize to resist modes of differentiation. Using Dhamoon's method of *situated comparisons*, we identify pathways for design based on how experiences from one LRLE might inform technology design for others.

Our research makes an important contribution to the ICTD community that routinely grapples with complex sociotechnical environments and multiple *isms* or systems of domination, engages with constraints and values assets-based approaches [53], and targets technology interventions (but could do so more holistically). We also contribute to feminist scholarship in HCI by extending recently introduced conversations on intersectionality in HCI that have thus far emphasized reshaping the collection and reporting of user data [71]. Specifically, we demonstrate how investigating and comparing sites of interaction between penalties and privileges can unearth novel pathways for technology design.

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RELATED WORK

We now situate our research in the education literature of ICTD, highlighting the need for design to better leverage the potential of LRLEs. We then describe how intersectionality assists to this end. To do this, we cover its origins and position our work within ongoing theoretical debates in feminist scholarship. We draw upon Yuval-Davis' practicable approach for devising intersectional policy initiatives [86] to structure and justify a methodology for using Dhamoon's intersectional-type analysis towards holistic design decisions for LRLEs and beyond [28].

Education and ICTD

Current education research in ICTD has largely focused on identifying or overcoming constraints in the learning environment, such as the lack of social infrastructure (in the form of teachers and parents), physical infrastructure, and financial resources for accessing and maintaining technology [83]. For example, several studies from 2004 onwards have engaged with the constraints of rural schools in India by deploying video-based instruction, mobile-phone based language learning [42, 41], and various technologies such as polling systems [23] and flash drive learning platforms [18]. Extensive work has been done on unsupervised and group learning techniques, modifying ICTs to overcome the cost of technology [48, 4, 38, 39, 62]. Education research in ICTD has also scaled up to overcome constraints. Breazeal et al. presented a novel platform hosted on mobile devices with a cloud backend to deliver educational content to marginalized children in different countries, with a focus on improving low literacy levels [12]. Cutrell et al. explored a blended learning initiative for an underserved context, combining online and in-person instruction as an alternative to a purely online classroom [25]. In 2016, Kazakos et al. presented the development of an interactive voice response system that enables real-time interaction and functions as a community radio [46].

While much prior research has been careful to introduce technology that is low-cost and usable in underserved communities, the focus on identifying constraints in learning environments presents challenges. This approach can require leapfrogging on the part of students and teachers and is not always sustainable [16, 24, 81]. Additionally, presenting more perceived constraints, such as users being slow to adopt or learn interventions due to lack of expertise or training, reinforce the idea that users are an obstacle to adoption [24]. Compounding this perspective, multiple studies have also emphasized that a lack of social infrastructure cannot simply be overcome by the addition of technological infrastructure to ensure learning [5, 33, 60, 83, 84]. These studies certainly caution against using ICTs as a short-term solution, but also leave us with only a partial perspective of what LRLEs might afford the agency to accomplish. Focusing on constraints also prompts the question of what action designers can actually take based on knowledge of such constraints. We sought to learn how using ethnographic data that captures the everyday constraints people face and how they resist them might be a step towards a more holistic approach to integrating ICTs into the broader sociocultural fabric of LRLEs [50].

Intersectionality: from 1989 to 2018

Crenshaw introduced the term *intersectionality* to feminist theory in 1989 as a label for the pressing notion that critical theory and feminism should not be siloed from conversations about racism [85, 86]. Through the decades, intersectionality has been taken up widely by feminist scholars across the world and in work ranging from social movements and sociology to electoral behavior research [26, 35]. However, there are ongoing debates in feminist studies about the conceptualization of the theory itself [26]. We now carefully consider the intense debates on what intersectionality is and position our ideas about how intersectionality might be operationalized to inform design in HCI.

From its original conception, two strands of intersectionality have developed, each with different vocabularies and mechanisms. The first strand, used by feminist race scholars and focused on women of color, has been associated with the *systemic* approach [67], the *additive* approach [86], and the use of categories to classify identities [55]. This strand has been most popularized in the United States (and the field of HCI so far). This approach views systems of domination as having unilateral power over how people are socially divided and how they experience identities, leading to a sole focus on how identities bear oppression in the context being studied [67]. It necessitates the naming (black, Muslim, woman) and categorization (race, religion, gender) of identities to *divide and then add* their experiences to create an intersection.

The second strand of intersectionality used more generally by postmodern feminists has been associated with the *constructionist* approach [67], the *constitutive* approach [66, 86], and critiques of categories and classification processes [10, 55, 67, 77]. This strand problematizes the notion of static categories and the systems of power that get to create them; it focuses on the *construction* of identity and one's ever-changing relationship to power structures [51, 67]. In this approach, falling into a certain category does not determine one's experiences or the usefulness of intersectionality; people *construct* their identity through conveyance of their own unique experiences, which can include privilege, oppression, and resistance [67]. Prins suggests that, as a result, *"the scripts of gender, race, ethnicity and class play a constitutive role, but never in the same way, never as mere determining factors"* [67]. This strand of intersectionality aligns with Feminist HCI and Postcolonial Computing theories, which critique the way HCI and ICTD research tends to view culture as unchanging and generalizable across individual experience and time [6, 40]. In relating this perspective to design, the rejection of such categorization might make operationalization more difficult because there is no predefined starting point (such as categories) for studying people's unique experiences of identity [51]. However, we argue that this strand of intersectionality is apt for taking into account complexity and agency in operationalization—we align with Suchman's suggestion that we can still problematize the dominant system that creates and deploys categories [77] and the idea that we can more purposefully recognize an individual's cultural capital and ability to use it in different ways over time [85].

As this theoretical debate continues, there has been a growing body of work in HCI, including at recent workshops [31, 32, 74], that point to a burgeoning need for the operationalization of intersectionality for design. These works have looked at problems such as the design of gendered or racialized virtual agents [78], racial bias in technology use and creation [37], understanding technology and media consumption among diverse children and families [3], or how different identities access health information online [58]. Most recently, Blackwell et al.'s work on classifying online abuse point out how important it is for technology to take into account complexity of experience [9]. There has been work that takes this understanding of intersectionality's importance further [13, 71]. Notably, Schlesinger et al.'s call for Intersectional HCI in 2017 highlighted how we might better understand and represent the *"user"* in terms of the static identity categories they fall into, something which they show the HCI community has not been addressing properly [71]. Their work contributes to the practical application of intersectionality by engaging with step one of Yuval-Davis' proposed four-step methodology: collecting diverse and desegregated data about users [86]. In the next section, we detail how we aim to complete the remaining three steps (which we have adapted for HCI): contextually *analyze* complex experiences of identity, *review* systems to understand their role in users' experiences, and *implement* opportunities for design based on this data [86].

Designing for Intersections

To operationalize Yuval-Davis' blueprint for engaging the lens of intersectionality towards technology design [86], we considered the scholarship of Hancock, Prins, Ludvig, and Dhamoon [36, 67, 28]. In particular, we sought a constitutive approach that would allow us to engage with rich, multi-sited ethnographic data at the individual, community, and institutional levels of analysis. Dhamoon was a good fit [28]; Hancock focused on a quantitative approach that placed constraints on the kind of data we could analyze [36], and Prins [67] and Ludvig [51] focused only on the individual.

Dhamoon formulates an intersectional-type analysis that focuses on *processes of differentiation* (such as racialization and sexualization) and *systems of domination* (such as racism and patriarchy) [28]. She sees these processes as being interrelated; for example, imperialism cannot exist without sexism or class exploitation [28]. She also discusses how these interrelated processes take place at different levels (of the individual, community, and institution), manifesting differently at each [28]. Dhamoon emphasizes that these processes affect individuals variously—those seen as marginalized might still exercise *privilege*, and those seen as beneficiaries of systems of domination may also incur *penalties* [28]. This conceptualization serves us well because it *"denaturalizes what is taken as a given,"* allowing us to go beyond studying oppression to focus on the processes and systems *"in which meanings of privilege and penalty are produced, reproduced, and resisted in contingent and relational ways"* [28].

Due to the various complexities in these processes, researchers and practitioners must deconstruct assumptions around what differentiation looks like and the impact it might have. To this end, Dhamoon recommends conducting *situated comparisons* [28]. This could mean contrasting how different combinations of processes interrelate, how processes unfold at distinct societal levels, or how differentiation serves to uphold power structures [28]. Dhamoon's approach allows us to operationalize the last three steps of Yuval-Davis' blueprint by enabling us to *(1) analyze* ethnographic data that deconstructs the penalties and privileges in the sites we studied, *(2) review* the existing situation of the sites by comparing them, and *(3) implement* change through ideas for technology design that account for *"the different kinds of difference"* across sites [86].

RESEARCH APPROACH

Our research objective was to identify pathways for technology design that might stem from an enriched understanding of the *"different kinds of difference"* [86] present across the LRLEs we studied. To attain this enriched understanding, we chose the lens of intersectionality. We were particularly informed by the practicability of Yuval-Davis' approach towards devising implementable intersectional policy initiatives [86]. As such, our methodology consisted of the following: *(1)* collection of desegregated data through multi-sited ethnography, *(2)* contextual analysis of the data using Dhamoon's intersectional-type framework [28], and *(3)* situated comparisons across sites for imagining points of intervention. Below we describe our execution of these steps.

Data Collection

We studied seven disparate, geographically separated LRLEs in the Indian states of Maharashtra, Tamil Nadu, and West Bengal from June 2015 to July 2017 (see Table 1). To collect data from these settings, we chose Marcus' multi-sited ethnographic approach [52], which assisted us in examining how beliefs, experiences, and discourses around LRLEs varied (or not) across India. We selected our LRLEs because of the diverse struggles they face in supporting students' learning. They represent historically, culturally, and organizationally distinct contexts—from North to South India, public to NGO-run, rural to urban, and formal to after-school educational environments. Our choice was not shaped, however, by the processes of differentiation interacting with the LRLEs' work; these were uncovered only later, during data collection.

Our fieldwork included extensive participant observation and targeted interviews with teachers, parents, children, and other stakeholders present. In June 2015, we visited the villages of Uthiramerur, Vadanallur, and Kulathakarai in the district of Kancheepuram (Tamil Nadu). There we conducted participant observations for six weeks, held semi-structured interviews with five instructors and five staff members, and directly interacted with all 60 students (evenly distributed from third grade to sixth grade). From December 2015 to July 2017, we continued our fieldwork across sites in the states of Maharashtra and West Bengal. In Powai, we conducted 120 hours of participant observations and 58 semi-structured interviews (six staff, 12 teachers, six volunteers, 29 students, five parents). At Nehru Nagar, we observed and participated in four classroom sessions over two weeks. We later interviewed two teachers whose classrooms we had previously visited. In West Bengal, we studied two after-school centers near Kolkata: one in the suburb of Kamarhati and another

in the suburb of Baruipur (that catered to nearby villages). In Kamarhati, we interviewed six teachers and engaged with students. In Baruipur, we conducted 25 hours of participant observation and semi-structured interviews with three teachers, three staff members, ten mothers, and ten twelfth grade students. In addition, we conducted multiple group interviews with 40 other students. The data we collected was in the form of field notes, photographs, and audio recordings of interviews (that we transcribed).

Data Analysis

Following Yuval-Davis [86], we sought an intersectional approach for engaging in contextual analysis of our data. Relying on an inductive thematic analysis alone had the risk of flattening out the multiple dimensions of our data. A categorical approach to intersectionality—one that identifies how the intersection of categories of difference and identity (such as race, gender, and class) is engendering and reinforcing systems of domination and marginalization [55]—was not suitable for our purposes. A focus on foregrounding intersecting categories can certainly highlight inequities and limitations of current approaches to relevant issues pertaining to the user (*e.g,* unearthing how HCI research has acknowledged the user's identity [71] and making recommendations for improvement). Also, the creation of a system of categories can be the outcome of participatory design processes that acknowledge individual experiences and systems of social oppression [9]. However, when intending to achieve a holistic understanding of individuals and groups, such an approach tends to mostly emphasize the marginalized aspects of individuals and communities [36, 67, 27], diminishing the visibility of people's modes of resistance against penalties. Further, the static nature of categories can create issues for uncovering the dynamic, culturally- and historically-shaped everyday experiences of people and their contexts; categories can tell us the current status, but cannot explain the reasons underlying that status [36]. After extensive literature review, we found Dhamoon's ideas for mainstreaming intersectionality [28] more apt for our research goals, as explained earlier.

Drawing on Dhamoon's approach, we proceeded to unpack the degrees and forms of penalties and privileges already present in each LRLE [28], which in turn illuminated constraints for technology integration as well as assets we could mobilize for the same. We interpret penalties as the different disadvantages that individuals, communities, or organizations must grapple with on an everyday basis (*e.g.,* not being able to attend school due to having to work), and privileges as circumstances that individuals (could) harness to attain their goals (*e.g.,* having parents who care about one's well-being). The presence of privileges does not imply a lesser degree of penalties, and vice-versa (*e.g.,* a child may have parents who care about their well-being but who deemed that sending them to work instead of to school was in their best interest). To deconstruct penalties and privileges, we followed a two-step approach. First, we conducted an inductive thematic analysis of all data to identify common trends. Examples of themes that emerged were *"gender equity initiatives at school," "gendering of education,"* and *"technology use in the classroom"*. After iteratively distilling our themes, we arrived at four large themes that were transversal to our data: *"Issues of Gender"*, *"Parental Engagement"*, *"Everyday use of Technology"*, and *"Technology Adoption in the Classroom"*. From there, for each theme, we crafted narratives of the LRLEs we visited and then conducted narrative analysis [51, 67]. Our purpose was to deductively identify interacting processes of differentiation and systems of domination, and uncover how individuals (teachers, parents, children), communities (LRLEs), and organizations (non-governmental and governmental organizations) interacted with those, to uphold or to resist them. It was in those interactions that we were able to see the dynamically-shifting nature of penalties and privileges. This, in turn, highlighted both challenges to technology adoption and supporting structures for new technology designs.

State	School (Locale, Structure)
Maharashtra	Nehru Nagar (Urban, Formal) Powai (Suburban, After-School)
West Bengal	Baruipur (Rural, After-School) Kamarhati (Suburban, After-School)
Tamil Nadu	Kancheepuram (Rural, Formal)

Table 1. Field Sites

To identify processes and systems, we used Matsuda's recommendation to *"ask the other question"*: *"When I see something that looks racist, I ask, 'Where is the patriarchy in this?' When I see something that looks sexist, I ask, 'Where is the heterosexism in this?' When I see something that looks homophobic, I ask, 'Where are the class interests in this?"' [54].* This method highlighted the processes that were salient in our data, such as those relating to gender, caste, geography, and levels of education.

In our final step of analysis, we subjected our narratives from across sites to Dhamoon's method of situated comparisons [28]. This allowed us to better glean how the promises and pending challenges for teachers, students, parents, and LRLEs at one site might suggest points of intervention at others.

Self-Disclosure

Following Schlesinger et al.'s [71] recommendation that authors disclose aspects of their identity that influence their research, we clarify that Marisol (first author), Naveena, and Neha (advising author) are women of color from Ecuador, the United States, and India, with a shared commitment to feminist perspectives in HCI. Arkadeep and Aditya were responsible for all fieldwork and data collection, in the languages spoken at each site—also their native languages. Betsy originates from the United States (U.S.) and has extensive experience with researching LRLEs in the U.S. All authors worked together to ensure that our assumptions were double-checked.

AN INTERSECTIONAL-TYPE ANALYSIS

We now execute on the steps proposed by Yuval-Davis [86]. We present our *intersectional-type analysis* (as Dhamoon calls it [28]), and focus on foregrounding the *penalties* and *privileges* present in the LRLEs we studied. Our primary goal is to explore how these penalties and privileges might highlight constraints to account for and assets we might leverage

to imagine points of intervention. Our analysis is organized into four themes that were transversal to our empirical data. For each theme, we present narratives from the LRLEs we visited. In particular, we describe how individuals, communities, and institutions mobilize privileges to enact forms of resistance against penalties. We present four (out of several potential) *situated comparisons* that consider both challenges and forms of resistance across narratives. Finally, we propose pathways for technology design that account for both penalties and privileges.

The Importance of Addressing Girls' and Boys' Needs

The gendering of education was a salient process of differentiation across our sites, taking various forms and resulting in different penalties for girls and boys. Each of the LRLEs we visited chose to mobilize its privileges in different ways to help students resist the effects of gendering. Below we present and contrast the gender equity initiatives organized by two NGO-run after-school centers—Baruipur and Kamarhati—in rural and suburban West Bengal, respectively. Our analysis shows that, although boys are also impacted by gendering processes, LRLEs tend to focus their gender equity initiatives on girls alone. We conclude that conducting initiatives for granting boys opportunities for resistance as well is a pending challenge for NGO-run LRLEs. We envision ways in which technology might play a role in addressing such a challenge.

Baruipur is a girls-only LRLE that caters to villages near Kolkata. These villages have been historically affected by the sex trafficking industry [70], with many implications for girls' education. When abducted by sex traffickers, girls certainly end up missing educational opportunities. However, as one of the mothers we spoke to explained, parents' response to the danger of sex trafficking might also limit girls' educational opportunities: *"We have to raise the girls and then we run the risk of losing them to traffickers. It is better for us to marry them off as soon as possible."*. Cognizant of the penalties inflicted upon girls, Baruipur mobilizes its privileges as an NGO-run organization (such as provision of education, infrastructure, and volunteers) to grant its students various opportunities for resistance. It ensures that girls continue their education, learn to protect themselves, and imagine alternate futures for their lives. For example, the center sends its volunteers to nearby villages to provide girls with educational support; this helps the girls perform better academically and keeps parents motivated to send their daughters to school. Baruipur also offers the girls regular orientation on women's issues (*e.g.,* adolescent health, child marriage, teen pregnancy, and domestic violence) to help them gain self-reliance. Moreover, the center provides girls with vocational, computer, and English training to improve their chances of securing jobs after they have completed their schooling.

Baruipur's initiatives of resistance are forms of power that, when interacting with sexist discourses such as child marriage, shape girls' perspectives on their identities. Some girls we interviewed perceived marriage as restrictive and burdensome, sharing that they had discussed the topic of marriage with their parents and even changed their parents' convictions. These girls told us they now felt more confident about their abilities to attain day jobs and financially support their families and themselves. Some also expressed a desire to get a college education they could finance themselves. Baruipur's case demonstrates how gender equity initiatives need to acknowledge the different processes that inflict penalties on students (*e.g.,* gender violence, sexist discourses) and interact with them to help students realize that they are able to change their present and future.

Kamarhati, an after-school center run by an NGO in peri-urban Kolkata, struggles with boys' low attendance rates. Interacting processes and systems—such as the industrialization of the area, families' economic struggles due to casteism and capitalism, and the gendering of factory work as a male activity—have resulted in the burgeoning of early labor occupations for boys. This is a penalty that hinders boys' opportunities for an education. Teachers recognize this problem and make individual efforts to help students resist this oppressive power. Rakesh, a teacher at Kamarhati, recounted how he had made sure that his students continued to attend school by regularly talking to their parents to convince them about the advantages of attaining an education. However, Kamarhati as an institution limits its gender equity initiatives that aid boys specifically in imagining future selves through educational attainment. Rather, the LRLE aims to harness its educational and infrastructural privileges to counteract yet another form of power: the historic violence against women in the area. The center takes initiatives to instill gender norms in students that can protect girls in the long run. For example, at Kamarhati, boys are encouraged to challenge gender stereotypes by having them participate in traditionally feminine activities such as cooking.

Our data shows that some NGO-funded after-school centers in India have educational, financial, and infrastructural assets, and social capital. They can potentially mobilize these privileges to conduct gender equity initiatives that empower students to construct new, alternative futures. Baruipur is an example of how an after-school center can address the many fronts that penalize girls' lives by providing the opportunity to grow through education. However, as our narratives show, systematically working towards granting opportunities for resistance to boys is still a challenge for LRLEs. Kamarhati's focus on helping girls resist gender violence takes away from devising other kinds of initiatives for boys that could systematically address the effects of child labor. After-school centers such as Kamarhati thus need support to *(1)* further explore the processes that engender penalties for both boys and girls, and *(2)* broaden boys' and girls' notions of future opportunities.

We now offer examples to illustrate how a situated comparison of the narratives above can illuminate pathways for technology design that are not only sensitive to the unique penalties boys and girls confront when imagining positive futures but also still support sensitivity to the opposite gender. First, constructionist technologies that foster students' self-expression [63] can assist teachers at LRLEs to further understand the processes underlying gender-related penalties for boys and girls. From this understanding, these teachers

could devise mechanisms for mobilizing privileges. Considering that not all children attend school, one approach might involve opening co-located interaction spaces where boys and girls can engage in activities that challenge normalized perspectives on gender, perhaps through makerspaces [7]. This could also enable boys and girls to be more aware of gender equity issues. Second, technology could help LRLEs broaden boys' and girls' knowledge of alternative occupational options. For example, technology could play a role in connecting learners with professionals and students from other places (including urban areas in India, for example) who may have undergone similar challenges to pursue education. Learning from others' aspirations and discussing their process of constructing new identities can help learners envision greater possibilities for their futures.

Parental Engagement and the Alignment of Values

Across sites, we found that one of the main issues LRLEs face is in finding ways to engage parents in their children's education. Casteism interacts with gendering processes and lack of education to prevent parents from actively participating in children's academic activities. This can lead to several problems, from hindering learning at home to withdrawing children from school so they can be put to work or married early. We analyze how the after-school centers of Powai (suburban Maharashtra) and Baruipur (rural West Bengal) interact with the casteism that shapes parents' attitudes toward school. Our analysis highlights the relevance for LRLEs to understand parents beyond traditional assumptions around lower-caste groups and explore how to use parents' cultural values, beliefs, and aspirations as assets to improve children's educational opportunities. We also demonstrate, however, that such exploration can be difficult for LRLEs. Parents' values can entail both potential penalties and privileges for children's futures and it is up to the LRLE to decide how to interact with those values in ways that can help the children. Our analysis concludes that LRLEs need support in negotiating with parents a shared understanding of the benefits of supporting children's academic endeavors. Technology can have a key role in supporting that process.

Powai, a mixed-gender after-school center near Mumbai, is exemplary of the issues that arise when LRLEs clash with the values that casteism can engender. Most of Powai's parents are daily-wage laborers with limited capacity—and thus, willingness—to devote to children's education. The following account from Ishita, a mother, demonstrates this: *"I dont have time to focus on what my son does in school. I expect the school will do what it is supposed to do; why am I expected to intervene and supervise how my child is progressing? It's not the parent's job! Isn't that the teacher's job?"* However, casteism interacts with capitalism in an urban setting—where there is exposure to stories of academic success—to drive these parents to value education as a vehicle for upward mobility. One of the fathers explained his expectations: *"I want my son to have a different future, to do better than me. I did not have the opportunity to learn but I'm giving that opportunity to my child, I want my child to take advantage of it."* The expectation of moving away from their castes, thus, represents an important motivation to send their children to an after-school center. However, this support is weakened by the clash of values that occurs between parents and the teachers and administrators at Powai.

As an NGO-funded institution, Powai attracts instructors who hold progressive values around issues such as gender equity. These teachers' experiences with systems such as casteism and sexism motivate them to instill change in society. For example, many of them promote learning experiences where boys and girls can interact freely and be welcoming towards each other. Such progressive initiatives, however, go against parents' traditional values around gender, which frames the free interaction of single men and women as a social taboo [1]. A teacher explained: *"Parents don't always like this. So many parents go around with the opinion—I'm not going to send my daughter to Powai—the coordinator there gives children too much freedom or the coordinator lets boys and girls talk with each other..."* The case of Powai shows that by not exploring how parents interact with casteism on a daily basis, the center is unable to harness the privileges this system of oppression might produce. The center thus misses the opportunity to fully harness parents' willingness to support education to attain a better future for their children. Further, it shows the relevance of acknowledging traditional values, for though they stem from systems of domination such as patriarchy, can override pragmatic values such as support for children's education. This, in turn, represents a penalty for children when they miss out on educational opportunities.

Instead of assuming the values of low-caste parents as constraints, Baruipur tries to deconstruct the values that casteism engenders, to identify how parents' values can be leveraged as assets to support girls' educational attainment. There are two values that Baruipur uncovers as assets: parents' care for their children and collectivist values that drive them to seek the support of their children later in life. We now describe how Baruipur unpacks these values towards furthering its educational initiative. At first sight, one might conclude that parents at Baruipur do not care for the future of their daughters. On one hand—and in contrast to the urban parents at Powai—parents at Baruipur often disregard the education of girls as a sign of upward mobility. This is due to several interacting processes. For one, being of lower caste in rural settings gives these parents less exposure to stories of academic success. Further, patriarchal norms drive parents to assume marriage to be the only plausible future for their daughters. One of the mothers further explained: *"When [my daughter] started failing at school, we decided it'd be better for her to help us at home. It is safer for her and in that way she can be more prepared for when she gets married."*. A deeper engagement with the interactive processes underlying parents' actions allows us to see that, for parents at Baruipur, marriage is a form of protection. As we highlighted previously, the risk of sexual exploitation prevalent in the area [70] drives parents to marry their daughters earlier than laws allow. Despite the negative connotations around child marriage, in the case of Baruipur, it is itself a form of resistance drawing from parents' care for their children. Baruipur sees this care as a privilege parents mobilize, and, as we will show, uses it to motivate parents to support their children's education.

Baruipur also harnesses the collectivist values predominant in rural India. Via collectivism, parents expect to find support in their children later on in life [82]. Collectivism interacts with patriarchy, however, to determine that it is men and not women who will have the ability to take care of their parents when they age [17]. Baruipur mobilizes its infrastructure and volunteers along with parents' care and collectivist values to shape parents' minds about girls' abilities. The center offers girls vocational training for landing urban jobs to convince parents that girls can attain safe, prosperous futures and support their families. Further, it sends volunteers to visit parents at home and explain the benefits of supporting girls. One of the teachers shared: *"If your girl finishes school she can become a teacher in a tutor center, she can then earn money and support herself and you in your old age."* Kamini, a mother, explained how this changed her perspective: *"I have supported my child to become educated and now she is studying in a college to become a nurse. I hope she will take care of me in old age."* Baruipur's strategy demonstrates the relevance of further exploring the implications of being a low-caste parent. By identifying privileges within the values that casteism engenders, Baruipur is able to devise an educational initiative that is sustainable because it aligns with parents' values.

Research on parent-school relationships advises schools to foster a two-way connection between the home and learning environment so that parents feel welcome to engage in their child's education [15, 57]. Our narratives highlight, however, that LRLEs in India need a different approach. These schools need to show how students receiving an education can align with parents' values and aspirations. Baruipur's mobilization of care and collectivism as assets demonstrates that aligning with parents' values requires LRLEs to have a good understanding of parents' contexts and practices. Parents' rejection of Powai's gender sensitization initiative shows that LRLEs need to be able to negotiate a shared understanding with parents of how a change of practices can align with their values.

Pathways for technology design emerge in this regard. Easy-to-share videos with stories of students' and parents' alternative (positive and negative) futures can be one way to support parental engagement in these scenarios. Another way could be through simple visualizations showing parents information that they find valuable, such as the financial payoff of sending their children to school compared to how much they will make if their children go to work immediately instead. Technology could also help schools connect with parents whose children have pursued higher education so as to coordinate talks and personalized advising for those who are still supporting their children. These one-on-one interactions can help LRLEs better understand how interacting processes and systems of oppression shape parents' actions. Learning from others while building a community can help parents engage in ways they find valuable and feasible.

Improving Meaningful Connectivity

Previous work on digital inequities has suggested that meaningful digital connectivity—that is, the ability to engage technology and mobilize information resources to address everyday goals and concerns [45]—is a crucial component for addressing social marginalization [44, 64]. We sought to analyze the penalties and privileges students experience in terms of attaining meaningful connectivity. Our purpose was to imagine how those penalties and privileges could be translated into constraints and assets for technology-enhanced interventions. Our analysis of urban Mumbai (Maharashtra), where we visited two LRLEs, and the rural areas around Baruipur (West Bengal), where we visited several villages catered by one LRLE, confirm the rural/urban divide in access and meaningful connectivity. In particular, the interaction between two processes—the limited exposure to people and technology in rural sites and practices of sexualization—engender privacy-related penalties for young girls. These, in turn, hinder girls' ability to devise new uses for technology. From our analysis on these interacting processes, we identified, however, the following four assets for technology design to improve meaningful connectivity: *(1)* students' pollination of ideas, *(2)* parents' willingness to learn from teachers, *(3)* parents' interest in gaming apps, and *(4)* the transfer of knowledge between girls with limited internet access and individuals with easy access to mobile technologies.

As mentioned before, the parents we studied in Mumbai were seen as low-caste, daily-wage laborers. However, life in urban settings affords both parents and children a series of technology-related privileges that the children mobilize for resisting monolithic notions of being from lower caste. These forms of resistance entail different opportunities for meaningful connectivity. For example, we might consider that the forces of capitalist consumerism have made smartphones cheaper, engendering a privilege for low-caste families: they have now the possibility of accessing these devices and sharing them with children. Living in Mumbai also gives students exposure to diverse ways of using technologies, often leading to new technology-enhanced learning practices. Prabhu, a student from Nehru Nagar, one of the LRLEs we visited, explained: *"Outside the school I have friends who are going to other schools. They talked to me about a YouTube channel for solving math problems, and when I had the chance, I used it on my Dad's phone."* As students grow older and gain access to their own phones, the exposure that their urban contexts afford shape their technology practices further. For example, Rohan, an eleventh grader in Powai, told us he had purchased a second-hand phone so he could join his classmates' WhatsApp group and chat with them. As a result of mobilizing these privileges, students in Mumbai were able to connect in meaningful ways. A teacher from Nehru Nagar shared how this connectivity took place in Mumbai: *"If they are told there is this project and you can use internet, they do use it. Nowadays a lot of them first try to use Wikipedia. They know that is a medium they can access (for information or general knowledge)."*

Regarding the use of other educational apps, we observed that—despite their urban exposure—parents were not aware of existing options. They preferred to use cellphones mostly for playing games (*e.g.*, Fruit Ninja and Subway Surfers) and accessing social media (*e.g.,* Facebook) instead. However, parents' relationship with teachers usually engenders a privilege, for teachers often make recommendations to parents and

children about novel uses of technology. Naresh, a parent, described further how he harnessed this privilege to learn new things: *"My son's teacher suggested I install an app for helping [my son] learn to pronounce English. I tried it out and now I use it regularly, it's pretty good!"* Teachers' knowledge about technologies for learning as well as parents' willingness to learn from teachers signal a key asset that technology-based interventions could leverage.

In the villages near Baruipur, the processes of sex trafficking, and gendering of technology access and use, interact with the technological isolation of rural sites to heavily constrain girls' engagement with technology. To resist sex trafficking and protect girls, parents and schools discourage them from using phones. Nipun, a teacher at Baruipur explained the rationale behind this practice:

> *"You get some missed call from an unknown person, then you ring back, and you talk, develop a relationship with that boy. Then that person calls you somewhere and you go there, and fall in trouble [alluding to sexual assault]. Moreover, we have got so many girls who have got trafficked due to mobiles!"*

Roughly a third of the girls we interviewed had mobile devices; among them, around 15% had smartphones. Internet costs and constrained access to cellphones limited technology use even further. Despite such issues of access, girls' interactions with teachers from NGOs from urban sites, who regularly visited the villages, gave them opportunities to learn about Facebook and WhatsApp. In this case, teachers mobilized their privileged access and education to support girls in resisting existing differentiations.

Despite the digital divide between rural and urban settings, our narratives highlight privileges for both kinds of locations that can be harnessed to foster meaningful connectivity. Further, juxtaposing Mumbai's forms of use with Baruipur's case illustrates how to grant rural children safer exposure to different technology practices. Our analysis suggests (at least) four pathways technology designers might take to support meaningful connectivity. First, drawing on students' knowledge-sharing practices, we suggest exploring how social computing can support the pollination of ideas between rural and urban students. Second, families' willingness to learn from teachers can be harnessed to develop applications through which teachers can send parents periodic suggestions about new educational apps. Third, parents' preference for gaming apps could also be leveraged to tailor popular mobile games for progressively leading parents and students to other kinds of technology uses. Fourth, girls' intermediated access to technology in Baruipur signals the need to consider women's safety when designing for intermediated internet access [69].

Towards Meaningful Technology Integration

The use of technology for teaching and learning is steadily increasing worldwide [8, 34]. However, achieving meaningful technology integration in learning environments—that is, using technology in the classroom so that young people achieve empowered forms of learning [79]—remains a challenge [29, 34, 75]. To better understand where technology deployment initiatives in schools fail or succeed, we analyzed the LRLEs in Kancheepuram (rural public schools), Powai, and Baruipur. These LRLEs represent a range of organizational structures, contexts (rural, peri-urban, urban), and levels of technological engagement. Our analysis shows that the paternalism of the government and NGOs as a system of domination was present across failed infrastructural deployments at the schools. Paternalism interacting with other processes, such as the rural versus urban gap, takes away from the motivation to enact change and flexibility to appropriate initiatives. However, our analysis unearths privileges that teachers in rural and urban settings harness to counteract the effects of paternalism. We conclude that bottom-up approaches where integrations are informed by the knowledge and needs of teachers and students—rather than imposed by schools or other organizations—can engender meaningful integrations for the learning environment and beyond.

Kancheepuram's case foregrounds the challenge with top-down technology integration initiatives. Further, it helps inform the changes needed in how technology is integrated so as to properly take into account teachers' support. In Kancheepuram, several key processes interact and often conflict with each other to shape teachers' attitudes towards their job. On the one hand, the government's paternalism and restricted exposure to diversity in rural settings impacts teachers' motivation for conducting and supporting important changes in the classroom. For example, teachers are required to fulfill goals imposed by the government (*e.g.*, a state-mandated curriculum) while their salary and access to educational resources (*e.g.*, labs, libraries) are always constrained by the government's budget. On the other hand, the closeness of teachers to students and their families engenders an interest for children's well-being, and thus, a willingness to go the extra mile for them. For example, their care for children motivates them to go around the village 30 minutes before school starts to remind parents to send their children to class, and even offer to drop children home after school ends. Teachers also expressed their care by identifying priorities for the school to offer a better education, such as a library and science lab.

In our visit to Kancheepuram, we learned that such care for children, however, was not sufficient to engage teachers in an NGO-run technology-integration initiative. In trying to understand why that was the case, we identified key aspects to consider for harnessing teachers' care towards children as an asset for future technology-integration initiatives. Again, several interacting factors led to the failure of the technology-integration initiative. Amongst them was a paternalistic approach towards technology introduction. The initiative entailed the provision of technological infrastructure (tablets with educational materials and a WiFi router for internet access) and training for teachers to learn how to apply educational technologies in the classroom. However, the initiative did not stem from teachers' but from the NGO's assessment of educational needs in rural contexts. The teachers thus felt that their perspectives and preferences in terms of what the school needed were being disregarded. Moreover, the initiative disrupted teachers' everyday lives by demanding that

they arrive 30 minutes early to charge their devices. Given that public school teachers already operate under low motivation, they decided to reject the initiative entirely. Teachers' participation (or lack thereof) in this process of technology integration suggests two factors as key for harnessing teachers' care for children as assets in such initiatives: *(1)* the initiative needs to match teachers' assessments of what is valuable in the learning environments where they work, and *(2)* the new practices the initiative demands must align with teachers' operational, everyday practices.

As mentioned before, being in an urban environment is a privilege that the students in Mumbai mobilized to counteract the effects of casteism interacting with classism. As an NGO-run after-school center, Powai (near Mumbai) also holds privileges (*e.g.,* progressive teachers, flexibility to design a new curriculum, and the ability to secure technology resources with more ease than a public institution). Motivated to help students further resist fixed notions about their future, the center fosters technology use in ways that students and teachers value. Dr. Usha, the Powai coordinator, explained the school's vision of technology integration:

> *"My students should take the initiative to pursue their interests. I give them the freedom to use the WiFi, and explore the internet whenever they want. Yes, we maintain some discipline with regards to what they browse, but we still give them that opportunity to explore."*

Powai leveraged its privileges to equip one lab with five desktop computers, one printer, five tablets, and a WiFi network. It had two classrooms, each with a wall-mounted television and a desktop whose screen could be projected onto the TV. Support from the school allowed teachers to pursue bottom-up approaches of technology deployment in the classroom. For example, one teacher would use the TV or tablet to stream YouTube videos related to the topic she was teaching at least twice a week, to supplement her lessons. She paused each lecture at least once to Google images (*e.g.,* Mount Everest) related to the lesson (*e.g.,* geography) so that students could use the tablets to connect better with what they were taught. This bottom-up integration also changed students' self-perception as technology users: now they had the ability to decide which projects to engage in. For example, we observed that some students started scanning YouTube for Do It Yourself (DIY) tutorials on topics such as movie animation and graphics, cooking recipes, and making toys.

Baruipur sought a different bottom-up approach to technology integration. As mentioned before, the after-school center mobilizes its privileges to help rural girls resist the interaction of sexism, gendering, and patriarchy. Towards that pursuit, the center has helped girls develop different aspirations for their future, including using technology for furthering their careers and lives. Motivated by girls' requests to receive computer training, Baruipur decided to conduct an exploratory initiative for 40 girls to receive computer and spoken English classes for one day a week through six months. The training entailed learning basic computer skills such as typing and using Microsoft Office. Due to lack of resources in rural settings, the Baruipur LRLE does not have computers for students, nor teachers for computer training. However, the center was able to harness its funding to rent time and space in a nearby local computer learning center and hire the training services of another center in Kolkata. Girls had to travel from different villages to Baruipur to receive this training.

This initiative's bottom-up nature—for it was motivated by the students' interests—allowed the girls and the center to construct their own values around a technology-supported education. It also drove them to reflect on ways in which it could be improved. After the training, a few of the girls had secured jobs as store attendants in retail outlets in the nearby city of Kolkata. We interviewed a few who had started working. These girls were not satisfied with their jobs and felt strongly that *a different kind of* computer training could have helped further:

> *"They taught us very basic computers, not enough for most of the work which is based on computers. If we had been given more of computer training as opposed to retail training it would have been better. They are giving us jobs at very good places but we are lagging because of our insufficient computer training."*

Baruipur's example highlights that bottom-up approaches can help resist complex interacting process and systems, including the lack of exposure to technology in rural settings. It also reveals how it is possible for modes of resistance to shape the self-perceptions of students and their sense of empowerment.

Juxtaposing Baruipur's and Powai's bottom-up forms of resistance for students against the lack of motivation of Kancheepuram's teachers towards paternalistic initiatives suggests the need for a new perspective on technology integration. In LRLEs, integration might not necessarily entail large deployments of technology, which usually require major changes in practices and hard-to-obtain/maintain resources [30, 68]. Instead, integration could stem from teachers, students, and LRLEs, who need support in broadening their ideas about how to harness privileges such as care, assessment of students' needs, and personal technology use. One integration initiative could be to expand self-organized learning [56] to structured environments such as public schools. Another idea we find valuable—due to its special focus on teachers—could be to provide progressive, scaffolded support to teachers to develop their own strategies of how to introduce technology in the classroom (such as by regularly communicating suggestions to teachers' phones about what might be possible in the classroom, given existing resources, technology-based or not).

DESIGNING FOR INTERSECTIONS

Our paper develops conversations in Intersectional HCI that were begun by Schlesinger et al. at CHI 2017 [71]. We propose a focus on processes rather than users when imagining points of intervention. We also inform research on underserved contexts by proposing an approach that holistically engages both penalties and privileges. Finally, our intersectional-type analysis makes a methodological contribution to facilitate working across multiple intersections to identify pathways for technology design.

Intersectional HCI: From Users to Processes

We extend conversations in Intersectional HCI by contributing an approach that shifts focus from users' categories of identity (such as race or gender) to interacting processes. Examining these processes allows us to *(1)* challenge conceptions of the user as a static individual without agency, *(2)* look beyond the user at other levels of interaction such as the social and the organizational, and *(3)* recognize the influence of users' cultural/historical backgrounds on their actions.

The focus on dynamic processes of subject formation allows us to identify when individuals mobilize their agency to deploy different aspects of their identity. A focus on intersecting traits of the user's identity—as prior work on intersectionality in HCI has adopted [13, 58, 71]—runs the risk of representing users and their contexts as static entities with little agency [61, 67], needing to be "helped". In contrast, our approach's focus on processes lets us view users as possible creators of their own stories. Also, by recognizing how users respond to interacting processes of differentiation and systems of domination, new pathways for design that support resistance may emerge. This possibility aligns with the feminist quality of *advocacy* that Bardzell proposed for shaping interaction design [6]. In our work, exploring processes instead of users' identities allowed us to see the girls of Baruipur as agents of change, and further explore ways in which technology might support them in their resistance.

Looking at processes allowed us to go beyond identifying challenges individuals face to analyzing how—by interacting with *other* individuals or organizations—they resist or enact forms of power. When we focus only on individual traits, we may only see experiences of marginalization [19, 14, 67, 86], disregarding what people's everyday interactions with others can tell us about the feasibility of change. By contrast, our focus on processes allows us to identify what social relationships, values, and infrastructures are key for imagining points of intervention. This view can enable, in turn, the design of technologies that are *"ecologically appropriate"*—as Bardzell discusses them in her presentation of Feminist HCI [6]; that is, technology designed to consider the widest range of stakeholders, and the possible effects design artifacts can have in their broadest contexts. For example, by looking at the interaction between gendering practices and patriarchy affecting girls in Baruipur, we can see the importance of the NGO's relationship with the girls and consider ways for new technologies to harness that relationship.

Finally, by focusing on the dynamic nature of processes that take place in what Irani et al. call a *"generative"* view of culture [40], we can recognize the influence of users' cultural/historical backgrounds on their actions. We can also reflect on what interventions may be feasible for certain communities. For example, looking at parents' reactions to the interaction of practices of sexism and a traditional patriarchal system in Baruipur, we are forced to think deeper about parents' motives to marry their girls early, and then see that it is their care for the girls and the reliance on collectivist values that drives them to such decisions; these values must be taken into account when designing technology for this context.

A Holistic View Entails Both Privileges and Penalties

In response to feminist and critical perspectives that call for a holistic understanding of the everyday contexts of marginalized populations [21, 27, 85], we explored privileges and penalties prevalent in LRLEs across India [50]. Investigating privileges allows us to acknowledge the dignity of individuals and communities [2, 53]. Prior research has also critiqued the idea of needs-based problem-solving, arguing that labeling a community as riddled with problems that need fixing perpetuates the idea that problems cannot be solved from within [47, 53]. A lens that examines the ways in which individuals address the limitations they face on an everyday basis can reveal key supporting structures for new designs [3].

Our intersectional-type analysis highlighted the importance of recognizing both penalties and privileges for devising meaningful, sustainable interventions. For example, recognizing that girls in Baruipur face restrictions in accessing technology for safety reasons is key to identifying a possible problem space. However, this constraint by itself does not indicate how an environment might mobilize itself to tackle the problem. By identifying the interactions girls have with urban instructors as privileges, we can uncover more stakeholders to be taken into account for design, and redefine the problem space from *"girls need access"* to *"how might we make intermediated access safer for girls?"*. A holistic understanding through deconstruction of privileges and penalties may also benefit other fields that address concerns of vulnerable groups, such as health informatics and/or civic design.

Situated Comparisons Reveal Pathways for Design

By emphasizing similarities and differences across contexts, our situated comparisons—as recommended by Dhamoon [28]—allowed us to identify which processes were more salient where, and what pending challenges could be addressed, also highlighting how one group's acts of resistance could help identify design opportunities for another. For example, our comparison of gendering practices across LRLEs recommended supporting collaboration in open spaces (*e.g.,* makerspaces) as an opportunity for NGOs to explore specific gender-related needs. Makerspaces can foster mixed-gender interactions that challenge normalized perspectives of gender. Also, by juxtaposing the Mumbai children's sharing of ideas with Baruipur's lack of exposure to diversity, we were able to devise new roles for social computing to enable students in rural areas to participate in activities for pollinating ideas. Situated comparisons thus helped us uncover penalties and privileges to unearth pathways for contextually relevant technology design across intersectionally diverse contexts, enabling contributions to the ICTD, HCI, and DIS communities.

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