Assessing Disparities in Hybrid and Online-Only Local Support Communities

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HCI aspires to achieve equitable outcomes in our sociotechnical interventions. Prior work suggests that improved evaluation and reporting of intervention disparities can help achieve more equitable outcomes. We analyzed socioeconomic disparities in hybrid and online-only local support communities by quantitatively operationalizing the access-adoption-adherence-effectiveness (AAAE) framework. The hybrid intervention demonstrated statistically significant socioeconomic status (SES)-based disparities in adoption of community's asynchronous online platform, while the online-only intervention demonstrated statistically significant disparities in access and adherence to synchronous online classes. Our findings suggest that disparities in earlier elements of the framework "pipeline" may mask later disparities due to survivorship bias, highlighting the importance of comprehensively examining the four elements of the framework. Using the example of a parenting education community, we reflect on using the AAAE framework as a rigorous tool to evaluate a sociotechnical intervention's disparities, avoid survivorship bias, identify the most pertinent support needed, and aid efforts toward sustained and equitable outcomes.

CCS Concepts: • **Human-centered computing** → **Empirical studies in HCI**; **User models**; **Empirical studies in collaborative and social computing**; *Computer supported cooperative work*.

Additional Key Words and Phrases: Disparity, Parenting Education, Community, Social Computing, AAAE, Access-Adoption-Adherence-Effectiveness

ACM Reference Format:
Anjali Srivastava, Qiao Jin, Sabirat Rubya, Carrie Kistler, Diana Vuong, and Svetlana Yarosh. 2025. Assessing Disparities in Hybrid and Online-Only Local Support Communities. *Proc. ACM Hum.-Comput. Interact.* 9, 7, Article CSCW372 (November 2025), 29 pages. https://doi.org/10.1145/3757553

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ACM 2573-0142/2025/11-ARTCSCW372
https://doi.org/10.1145/3757553

1 INTRODUCTION

Disparities occur when one or more population subgroups face a pervasive inequality compared to the general population for a benefit or resource [28, 35, 92]. In HCI, disparities have often been discussed in the context of marginalized people, defined as "groups that experience socially stratifying processes of marginalization or exclusion from mainstream social, economic, cultural or political life" [60]. As remote and hybrid approaches expanded after the COVID-19 pandemic unfolded in 2020, the increased reliance on technology intensified disparities due to socioeconomic status, particularly within local communities. Individuals from economically disadvantaged backgrounds in these communities faced greater challenges adapting to the shift from in-person to remote formats, which impacted their access to education, healthcare, and employment opportunities, thereby exacerbating existing inequalities [40]. This phenomenon is termed "intervention generated inequalities" (IGI) [62, 98] to describe the "real and pernicious possibility" of technology interventions working better for "those that are already better off".

In this work, we use a local parenting education support community as an example to demonstrate a way for assessing disparities across two interventions (in-person and hybrid). We chose this focus because disparities in parenting education can have profound, far-reaching impacts on children and families, especially those who are marginalized or excluded from mainstream social, economic, cultural, or political life [53, 60]. Parenting education covers essential aspects of child-rearing such as health, nutrition, discipline, and education, leading to better parenting, understanding of child development, increased parental confidence, stronger peer support, and more access to community resources [88]. Children also benefit by developing improved communication, language, and social skills, along with a higher comfort level with school attendance. When disparities exist in parenting education, they can lead to unequal opportunities and outcomes for children, affecting their overall development, academic performance, and future prospects.

Prior calls have highlighted that reporting, understanding, and evaluating disparities are crucial for equitable access to services and opportunities across all societal sectors, ensuring community resilience and well-being [92]. Veinot et al. [94] developed the access-adoption-adherence-effectiveness (AAAE) framework and utilized it in health informatics areas as a structured method to understand and assess IGI. According to this framework, an intervention may exacerbate inequality if it is more readily accessible to, more frequently adopted by, more consistently adhered to, or more beneficial for socioeconomically advantaged groups, such as those with greater resources or education. Unlike other commonly used frameworks for assessing disparities, such as intersectionality [55, 79, 80, 83, 90], allyship [60], and the digital divide framework [75], which focus on ensuring that marginalized individuals and their intersecting identities are adequately represented, designing for social justice and balancing costs with benefits, AAAE emphasizes the systematic identification of how an intervention can intensify or mitigate inequality at each stage from access to effectiveness. Since same pitfalls can occur in technology-mediated solutions if the potential for IGI is overlooked, we decided to bring the AAAE perspective from the health informatics domain to HCI and CSCW to structurally evaluate intervention outcomes. By examining disparities at each stage, the AAAE framework enables us to identify areas where technology-mediated solutions risk reinforcing or exacerbating existing inequalities.

In our investigation, we collaborated with a local Early Childhood Family Education (ECFE) program in the diverse urban North American city of St. Paul, Minnesota to understand and evaluate socioeconomic disparities in formal parenting education and support settings before and during the pandemic. This program, like many educational initiatives, transitioned from a hybrid model combining in-person and online engagement to an exclusively online format due to state-mandated COVID-19 restrictions. Despite the world recovering from the pandemic now, the two technological

interventions we analyzed, hybrid and online-only[1], remain prevalent in parenting education settings. Thus, we conducted a large-scale study to analyze socioeconomic status (SES) disparities and applied the AAAE framework in a quantitative manner to assess disparities in access, adoption, adherence, and effectiveness among community members within both the hybrid and online-only ECFE interventions. Specifically, we are interested in two research questions:

- **RQ1**: What access, adoption, adherence, and effectiveness disparities are present in a hybrid intervention of a formal parenting education and support community?
- **RQ2**: What access, adoption, adherence, and effectiveness disparities are present in an online-only intervention of a formal parenting education and support community?

Our findings show that the hybrid intervention demonstrated statistically significant disparities in the adoption of the community's asynchronous online platform, while the online-only intervention demonstrated statistically significant disparities in access and adherence to synchronous online video-based community classes, and in adoption of the asynchronous platform. While we do not directly compare disparities between the two interventions due to differing comparison requirements, this natural experiment allowed us to consider potential differences between the two parenting education implementations in discussion.

Our contributions include (1) a quantitative empirical understanding of disparities in two real-world community-based interventions—hybrid and online-only—in the understudied context of a formal parenting education and local support community, (2) a quantitative operationalization of the AAAE framework and its application in the domain of parenting education and local support communities, (3) a methodological reflection on using the AAAE framework as a rigorous tool to evaluate a community-based intervention's disparities, avoid survivorship bias, identify the most pertinent support needed, and aid efforts toward sustained equitable outcomes within community-based interventions serving diverse communities.

2 RELATED WORK

2.1 Hybrid Learning and Support Communities

Current research has investigated support communities in both online-only (e.g., [39, 53, 103]) and in-person settings (e.g., [59]). In many cases, boundaries between online and offline spaces are blurred [63], leading to hybrid communities that aim to blend in-person and online community interactions. Strengthening connections and sustaining hybrid platforms can be supported by online interactions, representing offline activities online, emphasizing shared identity, reducing uncertainty, and fostering a sense of inclusiveness [11, 37]. In education, hybrid local communities have formed when traditional in-person classroom teaching has transitioned to blended learning [61]. Success has been found through the use of quality standards, mixed modalities, and active online and offline learning strategies, which allow for comparable student performance at similar levels of instructor interaction as before [71, 77]. Use of instant messaging for parent-teacher communication, in addition to in-person interaction (among parents of school-aged children), has been found to potentially compromise student privacy [44], highlighting the need to care for the security and privacy of these often vulnerable conversations. Some communities have transitioned from online-only to hybrid modalities (such as Meetup [2]), while others transitioned from in-person only to hybrid learning.

[1]The hybrid intervention made up of in-person synchronous and online asynchronous community engagement mechanisms, and an online-only intervention based solely on technology-facilitated remote synchronous and asynchronous engagement mechanisms.

[2]Meetup is a social media platform that organizes virtual and in-person events for people with shared interests, hobbies, and professions.

The COVID-19 pandemic triggered such transition from in-person (or hybrid) to online, which exacerbated existing educational disparities, particularly in access to learning technologies [38, 65, 67]. Low-income and minority students faced significant challenges in accessing hardware and software for remote learning [38, 52]. Studies suggest that the digital divide during the pandemic was more pronounced in terms of community and social support rather than economic means [38]. Researchers emphasize the need for CSCW experts to collaborate with learning communities, incorporating parent, teacher, and technology experiences in academic and community planning [4, 67]. Our studied community (ECFE) is one example that transitioned from being a blend of in-person and online over the past few years, to online-only during pandemic, and back to in-person and online blend post-COVID. In this study, we evaluated the disparities in both in-person and online parenting education and support communities, using the AAAE framework to assess disparities across multiple dimensions.

2.2 Role of Technology in Disparities

Numerous CHI and CSCW studies have examined the impact of disparities on technology-based systems in a variety of contexts [28, 29]. HCI for Development (HCI4D) has contributed methodological learnings through research within disparate, cross-cultural, resource-challenged, often non-western, geographical contexts [36, 55, 99]. Multiple studies have examined the impact of SES disparities on technology-based services and issues such as income management [94], wage theft [34], job search [70], family mobile use [41], computing education [95, 96], and healthy aging [46]. A review of parent-education technologies from 31 studies found a successful improvement in "parent knowledge, behavior, and self-efficacy" but showed a lack of adaptations for accessibility for underserved populations [20]. The use of information technology for parenting by economically depressed communities largely depends on their sense of community, equitable, meaningful communication, and ability to influence peers and other stakeholders of the parenting ecology [54]. Lower SES parents' concerns with "perceived lower technical skills" and "face saving" were found to reduce their ability to access free online information sources for their children, putting them and their families at a disadvantage [33]. These studies that highlight the importance of parental sense of community are based on informal support communities created for parents by parents. Our study builds upon this work by focusing on the understudied context of formal community-based parenting education and support setting, and we aim to examine the role of socioeconomic disparities in the community experiences within its hybrid and online-only variations.

Research on the role of technology in disparities has proposed frameworks on how to adopt a social justice orientation to design [22], and how to design with a focus on social justice [12, 21, 55, 60]. Frameworks have proposed considerations that foster inclusivity within the research community [23], and holistic, centered engagement of the marginalized populations being served [21, 30, 45, 60]. Intersectionality has been explored as a framework to address complex identities and discriminations [55, 79, 80, 83, 90, 101]. Pei and Crooks have proposed a focus on costs along with benefits of an intervention [75], and along with Liang et al. advocate doing an ongoing evaluation with participants about whether benefits are worth the cost [60, 75]. Frameworks mentioned above provide for how to design for social justice, how to qualitatively account for costs alongside benefits, and how to qualitatively evaluate the design for whether it is just (by asking if the individual needing justice is centered, and whether their complex identities are adequately represented). Since our goal was to conduct a detailed quantitative evaluation of whether formal parenting support communities, such as ECFE, meet diverse needs, we decided to adopt the AAAE framework of the health informatics domain [92], for its four-faceted approach to examine various aspects of the deployment and sustained use of an intervention. AAAE framework helps evaluate whether

an intervention is producing or exacerbating an inequality if it is more accessible to, adopted by, adhered to, or effective for, advantaged groups compared with disadvantaged groups.

2.3 Role of Technology in Parenting Education

Prior research has established the importance of formal parenting education and its impact on child outcomes [18, 53, 102]. The HCI community has also seen a growing interest in recent years around the support of parenting, including motherhood [13, 14, 31, 47], fatherhood [6–8], and parenting for special needs circumstances [3, 8, 25, 53, 85, 86, 89] through digital technologies. Existing interventions have addressed new mothers' physical, emotional, and sociological needs, such as an infant monitoring system [47], breast pumps that better fit into mothers' lives [31], and breastfeeding support systems that engage with the felt life of breastfeeding mothers [14]. Research on parenting for special needs such as Autism Spectrum Disorder or ADHD discussed design frameworks [86], information search and retrieval [85], behavioral needs assistance and support [3, 25, 89], and parental stress management and social support [10, 26]. Researchers found that new fathers manage online social judgment, form connections, and collectively advocate for better support for fatherhood using technology [6, 7, 50]. These studies indicate that appropriate technology interventions are beneficial and supportive for new parents of young children.

Studies on the design of parenting community-oriented sociotechnical systems recommend the need to be sensitive to the vulnerabilities faced by new parents. This can be done by facilitating safe, small group spaces [69, 91]. These spaces may either be digital [100] or face-to-face with local peer parents [72], where they can participate in meaningful interactions [100] about shared concerns. Being able to trust the content shared in these spaces [72], when exchanged under the guidance of a trained expert or moderator [96], is helpful as well.

While prior research has focused on parenting communities for parents by parents, little has examined a formal community-based parenting education and support setting, an opportunity identified by Nieuwboer et al. [73]. In our study, we examine one such local community, St. Paul ECFE, that offers formal parenting education and support opportunities through their face-to-face small group parenting support classes, and Parentopia, an online permission-protected community interaction platform. Both offer secure non-judgmental spaces for meaningful peer conversations and learning, guided by licensed parent educators and early childhood educators.

3 METHODS

3.1 Context of Investigation and Settings

Early Childhood Family Education (ECFE) is a parenting program available to all Minnesota families with children from birth to kindergarten entry. ECFE aims to strengthen the skills and resources of parents and families to create the most supportive environments for their children's learning and development. Our community partner is one of the St. Paul ECFE programs. In 2019-2020, it enrolled 1662 parents for parenting education and support classes. Before the pandemic (March 2020), it was organized in weekly two-hour ECFE in-person synchronous classes. The first hour is early childhood education for parents and children, facilitated by a licensed early childhood educator. The second hour is a small group discussion-based on parenting education and support within a guided peer learning and support community setting, facilitated by licensed parent educators. Parents register for the school year and may choose to attend one or more classes per week. Shortly after the World Health Organization declared the COVID-19 viral disease a pandemic [2], St. Paul ECFE, along with other ECFEs in Minnesota, replaced its in-person classes with synchronous online classes using systems such as Zoom in response to COVID.

In addition, this program provides asynchronous communication through Parentopia, an online platform for interaction and information exchange between weekly classes, and extends as a parent social networking site. To offer a secure place for parents, Parentopia restricts access to registered ECFE parents, and to classroom(s) groups they are registered for. This helps preserve the sense of small group privacy and community akin to an in-person small-group classroom setting. In 2019-2020, there were 1,153 Parentopia user accounts registered across 24 sites and 155 small group forums.

Thus, ECFE classes, together with Parentopia, offer a blend of synchronous and asynchronous educational interactions, providing continuous educator engagement and peer support. Building on this context, our research investigates two interventions:

- **Hybrid intervention** refers to the combination of in-person, synchronous ECFE classes complemented by asynchronous communication through an online platform, Parentopia. This setup provides both live face-to-face interaction with educators and peers in specific locations and ongoing online support and information exchange.
- **Online-only intervention** involves fully online synchronous classes using videoconferencing tools like Zoom, paired with asynchronous communication through Parentopia. This mode was adopted in response to the COVID-19 pandemic, allowing continued access to live classes and online support without physical presence.

3.2 Participants

Our research investigates hybrid intervention and online-only intervention with the ECFE program. Four of the ten ECFE sites in St. Paul (with related group forums) participated in our study. Participating classes included age-based classes (e.g., birth-kindergarten, birth years months, 3-year-old), Spanish language classes, and other topical classes such as Dads-only or African American Families. Each of the sites had one licensed parent educator, two or more licensed early childhood educators, and multiple teaching assistants. The diversity of St. Paul city and ECFE enrollment populations provided us with a varied sample of parents, enabling us to study socioeconomic status (SES) across three factors (see section 3.3.1). Participants with hybrid intervention consisted of people who attended in-person classes and used Parentopia during this period. The online-only cohort included some hybrid participants who transitioned to the online-only environment (while some dropped out due to access difficulties) and others who joined after the online-only transition began.

Participants in our research are parents or guardians (e.g., grandparents, aunts, uncles, friends of parents, or nannies) who attend ECFE with the children. We recruited parents/guardians for the social connectedness-related data collection through a survey (see section 3.3.2 Effectiveness). In the hybrid intervention, 303 participants completed the survey, while in the online-only intervention, 270 participants filled out the survey. The demographic composition of those participants is provided in Table 1. All study materials were approved by the University Institutional Review Board.

3.3 Measures and Framework

The goal of our two studies was to achieve a quantitative understanding of whether there were any disparities among the participants' community experiences based on their socioeconomic status (SES). For this we used the SES factors, education levels, Income-to-Needs Ratio (ITNR) levels, and language. To understand the role of disparities in the community experience, we adopted the AAAE framework [94]. Details of how we operationalized each element of the framework within the context of the two ECFE interventions are described below.

Table 1. Population Composition of Participants Recruited for the Social Connectedness Survey

		Hybrid (N = 303)	**Online-Only** (N = 270)
Parent Gender	Male	59	51
	Female	242	217
	Other	2	2
Parent Average Age	Male	37.23	38.18
	Female	35.51	35.66
	Other	28	28
Education Level	Low	67	55
	Medium	125	115
	High	104	95
	Prefer not to answer	7	5
Income-to-Needs Ratio	Low	67	42
	Low-Medium	66	75
	Medium-High	97	87
	High	34	30
	Prefer not to answer	39	36
Language	English	258	231
	Non-English	44	38
Years attended ECFE (avg.)		2.14	2.25
Number of Children (avg.)	All ages	2.003	2.081
	under 18 y.o.	2.003	2.059
	under 6 y.o.	1.502	1.533

3.3.1 Socioeconomic Status (SES) Measures. Following recommendations from Bornstein and Bradley [16], we measured three SES components—education level, ITNR, and language proficiency—and analyzed all framework elements accordingly. Education level was operationalized based on the years of education [24], with up to 14 years of education (consisting of high school and some college) defined as low education level, 16 years (with a 3- or 4-year college degree) as medium level of education, and 18 or more years of education as high level of education (involving some graduate education). Income-to-needs ratio (ITNR) was calculated by dividing the family's household income by the poverty threshold [93] for the corresponding family size and number of children below 18 [64]. ITNR was categorized into four levels, low, low-medium, medium-high, and high based on quartiles. Language was categorized into two categories—those whose primary language is English and those whose primary language is other than English.

3.3.2 Outcome Measures in the Context of the AAAE Framework. The AAAE framework evaluates interventions through four components: Access (availability of services), Adoption (uptake and integration), Adherence (sustained use), and Effectiveness (outcome success in real-world conditions) [94]. We chose to use the context of the AAAE framework because it allows us to comprehensively analyze disparities in both process and impact. We outline the outcome measures for each component as follows:

- **Access**: To examine whether parents with lower SES were less likely to have access to ECFE's parenting education and support community services, we analyzed *enrollment* within the ECFE classes, and *accounts* within the Parentopia platform, for disparity in access. For the

hybrid intervention, disparity in access to classes was operationalized as a comparison of demographics of ECFE enrollees against those of the whole city of St. Paul. For the online-only intervention, disparity in access to synchronous classes was operationalized as a comparison of demographics of those that attended online-only classes vs. those that did not.

- **Adoption**: To determine whether low SES parents adopted the ECFE community services for the hybrid and online-only interventions at the same rate as high SES parents, we examined *attendance frequency* in ECFE classes (for synchronous engagement) and *Parentopia usage* (for asynchronous engagement). Attendance frequency was operationalized as the total number of class sessions of a class attended by a participant divided by the number of sessions that class was held. Parentopia usage was operationalized as the number of views, posts and comments, and direct messages by the participant on the platform. Each feature was examined for whether it was used (how many participated), and if used, to what extent (how much usage).
- **Adherence**: To study whether parents with lower SES in education, ITNR, and/or language, were more likely to drop out of ECFE's parenting education and support community, we analyzed how parents dropped out of participation in each of the two interventions - hybrid and online-only. It is often not feasible to analyze behaviors of participants that drop out of an intervention study because the study is the sole source of information about the participants, and there is no information available for participants that drop out of the study. Siek et al. [84] reported that published papers typically do not report on dropout rates and the demographics of non-users and less-engaged users. In our effort, we collected information from multiple sources through our partnership with the ECFE program including attendance data to examine *dropout counts*. In our context, a parent was considered to have dropped out if they did not attend the last four sessions prior to the end of the intervention's time period.
- **Effectiveness**: To measure effectiveness, we defined social connectedness as the indicator because increasing social connectedness is one of the primary goals of ECFE. Prior work has also suggested that social connectedness with other parents and staff in parenting communities is important to well-being in early childhood parenting [22]. We operationalized the effectiveness of the hybrid and online-only interventions by examining *the change in parents' social connectedness*. Change in social connectedness was operationalized as the change in global social provisions score (GSPS) for parents' sense of connectedness with other parents, and their sense of connectedness with community educators and staff. GSPS was calculated using the Social Provisions Scale [22], consisting of 24 questions.

3.4 Data Collection

To study enrollment in synchronous classes for access, anonymized parent enrollment data for the school year 2019-2020 was obtained from the community partner (who provided it from Eleyo, their administrative system). This data consisted of two demographic elements, education level and primary language. For comparison, we obtained St. Paul demographics data from the American Community Survey [5]. For adoption, we obtained attendance data from the community partner from which we calculated both the number of classes attended and number of classes held. This was then used to calculate the attendance frequency. Adoption of asynchronous engagement mechanisms was also examined by studying whether and to what extent parents used various Parentopia features. For this, Parentopia usage data was collected through SQL queries for each intervention time frame. This data consisted of counts of views, posts and comments, and direct messages. For adherence, the weekly attendance data was used to calculate the dropout count for parents of various socioeconomic categories. Whether the parent dropped out or not was based on whether they attended classes for the last four weekly sessions of the parenting education class.

Effectiveness was measured in terms of the change in the global social provisions score (GSPS) over the timeframe of each of the two communities, hybrid and online-only. GSPS was calculated using the Social Provisions Scale (SPS) [22] through a questionnaire administered in person at the participating ECFE locations for the hybrid intervention related data collection, and online through email, Parentopia and text messages for the online-only intervention related data collection. The questionnaire packet also included demographic questions, and provided an informed consent document seeking permission for collecting Parentopia usage data.

3.5 Data Analysis

We organize our data sets into independent unpaired groupings based on the socioeconomic factors of education level (three levels - low, medium, high), ITNR (four levels, i.e. low, low-medium, medium-high and high), and language (two levels, i.e. English and Other than English). For data where normality and constant variance assumptions were met, independent samples t-test was used for the two level language data, and ANOVA for the three level education level data and four level ITNR data, with eta-square for effect size. These were followed by post-hoc tests with corrections for multiple comparisons (Tukey, and Scheffe for imbalanced factor level group sizes, where applicable) when main effect statistical significance (at significance level of 0.05) was detected. For data where either normality or constant variance assumptions were violated, data transformations (e.g. log or square root transformation) were done to determine if normality conditions could be met. If the assumptions for normality still did not hold, Mann-Whitney U test for two-level language data (with Rank-Biserial correlation for effect size), and Kruskal-Wallis with Dunn's post hoc tests with Bonferroni-Holm corrections for education level data (three levels) and ITNR data (four levels) were conducted. For enrollment analysis where we compared our community enrollment by education and language levels to corresponding population parameters from the American Community Survey, we conducted 1-sample proportions test with continuity correction, and used Cohen's h for effect size. Categorical data was examined using contingency tables to compare expected to actual counts, and analyzed with a chi-square test and/or Fisher Exact (for data sets with counts less than 5), and Cramer's V for effect size. When we found high similarity between the factor levels and no evident disparity (lack of statistical significance in the difference), we conducted equivalence testing [56] using the two one-sided test (TOST) method with equivalence ranges suitable for the domain/context, to determine whether there was statistically significant equivalence between them. Independent sample t-test was used in the TOST for normally distributed continuous data, one-sided Mann-Whitney U test for non-normal continuous data, and simple asymptotic interval test (SAI) for binomial data [15].

4 RESULTS

In this section, we present the results of our investigation into the role that SES disparities have played in different interventions of a formal parenting education and support community: (1) a hybrid intervention comprised of in-person classroom-based synchronous engagement, accompanied with online asynchronous engagement (Parentopia), and (2) an online-only intervention comprised of online, synchronous engagement using video-conferencing based meetings, accompanied with online asynchronous engagement (Parentopia). We adopt the AAAE framework to report our results.

4.1 Access

4.1.1 Hybrid. We examined ***synchronous classes enrollment*** for the hybrid intervention and found statistically significant differences based on education level and primary language compared with the demographics of the whole city. For education levels, the proportion of those with less

Table 2. Socioeconomic factor-based analysis of synchronous classes enrollment in the hybrid intervention. *p-value < 0.05, **p-value < 0.01, ***p-value < 0.001. Applicable to subsequent tables. +Test of English-speaking population not conducted, as that was not a disparity-related concern.

		Education Level				Language	
		Less than high school graduate	High school graduate	Some college or associate's degree	Bachelor's degree or higher	English	Other than English
ECFE Enrollees' Demographic	Count	222	205	245	696	855	548
	Proportion	0.162	0.150	0.179	0.509	0.609	0.391
<city> Demographic	Count	26435	50235	62595	92337	135157	61443
	Proportion	0.114	0.217	0.270	0.399	0.687	0.313
p-value, Cohen's h		< 0.001***, 0.140	< 0.001***, -0.174	< 0.001, -0.219	< 0.001***, 0.222	NA+	< 0.001***, 0.164

Table 3. Socioeconomic factor-based analysis of Parentopia accounts (has Parentopia account) in the hybrid intervention.

	Education Level			ITNR				Language	
	Low (N=67)	Medium (N=125)	High (N=104)	Low (N=67)	Low to Medium (N=66)	Medium to High (N=97)	High (N=34)	English (N=258)	Other (N=45)
Count of Accounts	54	102	83	50	56	78	29	213	32
Expected Count of Accounts	54.098	100.929	83.973	54.057	53.25	78.261	27.432	208.614	36.386
p-value, Cramer's V	0.942, 0.02			0.427, 0.103				0.111, 0.103	

than high school education was found to be significantly greater in ECFE than in the whole city (Cohen's h = 0.14) while the proportion of those that were high school graduates was significantly less in ECFE than in the whole city (Cohen's h = -0.174). Proportion of those who had some college or associate's degree was also significantly less in ECFE than in the whole city (Cohen's h = -0.219), whereas the proportion of those with bachelor's degree or higher was significantly greater than in the whole city (Cohen's h = 0.222) (see Table 2). In other words, the hybrid intervention enrolled more participants at the higher and lower levels of education than the general population of the city. Proportion of non-English speakers in ECFE was also found to be significantly greater than in the city (p-value < 0.001) with a small effect size of 0.164. Overall, there was no disparity in access to synchronous in-person classes detected in the hybrid intervention, for either parents with a low education level or those whose primary language was not English.

For ***Parentopia accounts***, we found that parents with low ITNR and those who were non-English speakers had lower than expected counts of Parentopia accounts in the hybrid intervention (Parentopia accounts were 50 for low ITNR compared to expected count of 54, and 32 for non-English speakers compared to an expected count of 36). The counts of Parentopia accounts for parents of both low and high education levels, on the other hand, were similar to their expected counts (low education level parents had counts and expected counts of 54, and high education level parents had a count of 83 compared to an expected count of 84). To more conclusively establish that there was no disparity present in the education level and ITNR categories, we ran equivalence tests and found a 90% CI of -0.09 to 0.11 for education level and -0.24 to 0.03 for ITNR, which did not indicate equivalence at δ of 0.05. Thus, we cannot conclude whether disparity is present or absent in access to Parentopia in the hybrid intervention (see Table 3).

4.1.2 Online-Only. ***Synchronous classes enrollment*** in the video-based classes of the online-only intervention showed a statistically significant disparity for both education level and primary language. Parents with low educational attainment enrolled in statistically significantly lower count

Table 4. Socioeconomic factor-based analysis of synchronous class enrollment in the online-only intervention.

	Education Level			Language	
	Low (N=149)	Medium (N=334)	High (N=585)	English (N=733)	Other than English (N=417)
Count of Enrolled	99	246	513	624	296
Expected count of Enrolled	119.702	268.326	469.972	586.4	333.6
p-value, Cramer's V	< 0.001***, 0.211			< 0.001***, 0.17	

Table 5. Socioeconomic factor-based analysis of Parentopia accounts (has Parentopia account) in the online-only intervention.

	Education Level			ITNR				Language	
	Low (N=55)	Medium (N=115)	High (N=95)	Low (N=55)	Low to Medium (N=62)	Medium to High (N=87)	High (N=30)	English (N=232)	Other (N=38)
Count of Accounts	47	94	78	46	52	72	25	196	28
Expected Count of Accounts	45.453	95.038	78.509	45.833	51.667	72.5	25	192.474	31.526
p-value, Cramer's V	0.824, 0.038			0.998, 0.013				0.159, 0.100	

of 99 compared with the expected count of 119.7 (p-value < 0.001, Cramer's V= 0.211). Similarly, only 296 non-English speaking parents enrolled compared with an expected count of 333.6 (p-value < 0.001, Cramer's V= 0.17). The adaptation of ECFE as an online-only intervention appears to have amplified inequality in access to synchronous video-based online classes among parents with lower education level, and for non-English speaking parents (see Table 4).

We examined access to ***Parentopia accounts*** for the online-only intervention and found that parents with low education level and low ITNR had slightly higher than expected counts of Parentopia accounts. However, parents with high education level and high ITNR had counts close to that expected. To more conclusively establish that there was no disparity present, we ran equivalence tests and found no statistically significant equivalence, thus we cannot conclude whether the disparity is present or absent in access to Parentopia in the online-only community (see Table 5).

4.2 Adoption

4.2.1 Hybrid. ***Attendance frequency in synchronous classes*** for the hybrid intervention was found to be descriptively similar for parents from both high and low socioeconomic status for education level and language factors. The mean attendance frequency was 0.725 for low education level and 0.755 for high education level. Similarly, the mean attendance frequency was 0.748 for English speaking parents and 0.725 for non-English speakers, with no statistically significant difference in either. Attendance frequency for ITNR showed a statistically significant difference (p-value = 0.027) with a low effect size of 0.022, but pairwise comparisons using Dunn's test with Holm-Bonferroni correction indicated no significant differences in attendance frequencies between parents with low ITNR vs. high ITNR. To more conclusively establish that there was no disparity present, we ran equivalence tests and found statistically significant equivalence in attendance frequency in the hybrid intervention for all three factors, education level, ITNR and primary language with p-value being less than 0.001 for upper and lower bounds for all three (see Table 6).

For ***how many participated in Parentopia usage*** (views, posts and comments, direct messages) (Table 7), we found that parents of both low and high education level used those Parentopia features at counts lower than expected in the hybrid intervention but the differences were not statistically significant. Parents of low ITNR used Parentopia features at counts lower than expected, while those of high ITNR used features at counts higher than expected. There was a statistically significant

Table 6. Socioeconomic factor-based analysis of attendance frequency in synchronous classes in the hybrid intervention.

		Education Level			ITNR				Language	
		Low (N=61)	Medium (N=122)	High (N=67)	Low (N=60)	Low to Medium (N=64)	Medium to High (N=91)	High (N=32)	English (N=244)	Other (N=41)
Attendance Frequency (Mean, SD)		0.725, 0.176	0.74, 0.21	0.755, 0.215	0.697, 0.19	0.77, 0.198	0.751, 0.218	0.778, 0.167	0.748, 0.208	0.725, 0.176
p-value, eta-square		0.141, 0.003			0.027, 0.022				0.149	
Equivalence (Margin: -0.2, 0.2)	p-value (Upper Bound)	< 0.001***			< 0.001***				< 0.001***	
	p-value (Lower Bound)	< 0.001***			< 0.001***				< 0.001***	
	Equivalence Bound (Upper Bound)	0.093			0.130				0.087	
	Equivalence Bound (Lower Bound)	0.008			0.033				-3.40E-06	

Table 7. Socioeconomic factor-based analysis of Parentopia usage (how many users participated on views, posts and comments, direct messages) in the hybrid intervention.

	Education Level				ITNR					Language		
	Count, Expected Count			Difference	Count, Expected Count				Difference	Count, Expected Count		Difference
	Low (N=67)	Medium (N=125)	High (N=104)	p-value, Cramer's V	Low (N=67)	Low to Medium (N=66)	Medium to High (N=97)	High (N = 34)	p-value, Cramer's V	English (N=258)	Other than English (N = 45)	p-value, Cramer's V
Views	26, 27.841	56, 51.943	41, 43.216	0.623, 0.057	20, 28.17	30, 27.75	41, 40.784	20, 14.295	0.04*, 0.178	113, 104.733	10, 18.267	0.011*, 0.156
Posts and Comments	8, 10.412	23, 19.426	15, 16.162	0.463, 0.072	6, 10.913	13, 10.75	15, 15.799	9, 5.538	0.12, 0.149	43, 39.168	3, 6.832	0.134, 0.099
Direct Messages	8, 9.054	20, 16.982	12, 14.054	0.563, 0.062	4, 8.883	8, 8.75	15, 12.86	8, 4.508	0.082, 0.159	39, 34.059	1, 5.941	0.034*, 0.135

Table 8. Education level-based analysis of amount of Parentopia usage (how much usage on views, posts and comments, direct messages among users with non-zero usage) in the hybrid intervention.

	Low			Medium			High			Difference
	N	Mean	SD	N	Mean	SD	N	Mean	SD	p-value, eta-squared
Views	26	11.654	11.43	56	12.821	11.415	41	9.585	10.099	0.297, 0.022
Posts and Comments	8	2.215	1.126	23	5.565	6.43	15	4.667	7.771	0.733, 0.042
Direct Messages	8	2.75	2.315	20	4.6	5.236	12	4.667	6.358	0.829, 0.022

Table 9. Income-to-needs ratio-based analysis of amount of Parentopia usage (how much usage on views, posts and comments, direct messages among users with non-zero usage) in the hybrid intervention.

	Low			Low to Medium			Medium to High			High			Difference
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	p-value, eta-squared
Views	20	12.7	13.891	30	10.333	10.643	41	10.073	8.641	20	15.9	13.467	0.563, 0.039
Posts and Comments	6	2	1.265	13	6.385	7.805	15	3.667	3.599	9	6.444	9.799	.608, 0.059
Direct Messages	4	2.75	1.258	8	5.125	5.436	15	3.733	4.906	8	6.5	7.426	0.42, 0.057

Table 10. Language-based analysis of amount of Parentopia usage (how much usage on views, posts and comments, direct messages among users with non-zero usage) in the hybrid intervention. $^{+}$ Unable to perform the calculation because the number of observations for direct messages in languages other than English is less than 2.

	English			Other			Difference
	N	Mean	SD	N	Mean	SD	p-value, eta-squared
Views	113	11.23	10.798	10	14.5	13.352	0.31, -0.194
Posts and Comments	43	4.767	6.597	3	3.333	0.577	0.523, -0.225
Direct Messages	39	4.154	5.158	1	8	NaN^{+}	NaN^{+}

Table 11. Socioeconomic factor-based analysis of attendance frequency in synchronous classes in the online-only intervention.

		Education Level			ITNR				Language	
		Low (N=32)	Medium (N=86)	High (N=77)	Low (N=28)	Low to Medium (N=51)	Medium to High (N=75)	High (N=20)	English (N=188)	Other (N=8)
Attendance Frequency (Mean, SD)		0.693, 0.22	0.669, 0.28	0.675, 0.26	0.648, 0.239	0.693, 0.293	0.649, 0.255	0.739, 0.27	0.673, 0.263	0.696, 0.276
p-value, eta-square		0.984, 0.0009			0.33, 0.014				0.856, 0.0003	
Equivalence (Margin: -0.2, 0.2)	p-value (Upper Bound)	< 0.001***			0.018*				0.01*	
	p-value (Lower Bound)	< 0.001***			< 0.001***				0.03*	
	Equivalence Bound (Upper Bound)	0.089			0.23				0.125	
	Equivalence Bound (Lower Bound)	-0.100			<0.001				-0.175	

disparity for how many parents viewed (p-value = 0.04, Cramer's V = 0.178). Low ITNR suffered a statistically significant disparity in how many users viewed posts in Parentopia. Non-English speaking parents faced a statistically significant disparity for views and direct messages in the hybrid intervention, with view count being 10 compared with expected count of 18.267 (p-value = 0.011, Cramer's V = 0.156), and only one parent using direct messages compared with expected count of 5.941 non-English speaking parents (p-value = 0.034, Cramer's V = 0.135).

We separately analyzed ***how much of Parentopia usage*** by removing users with zero usage. Among parents that used Parentopia, those with low education level had higher average views compared with those with high education levels, but had lower average posts, comments and direct messages. To more conclusively establish that there was no disparity present, we ran equivalence tests but found no statistically significant equivalence, thus we cannot conclude whether disparity is present or absent. Those with low education level viewed more, but posted, commented, and messaged less. However, the results were not statistically significant (Table 8). Parents with a low ITNR had a lower average use compared to parents with a high ITNR in all Parentopia features (Table 9). To more conclusively establish that there was no disparity present, we ran equivalence tests but found no statistically significant equivalence, thus we cannot conclude whether the disparity is present or absent. Among non-English speaking parents that used Parentopia, parents had higher average views and lower average posts and comments. The non-English speaking parents who used direct messages had a higher average use of 8 messages compared with parents that spoke English who had 4 messages on average (Table 10).

4.2.2 Online-Only. ***Attendance frequency in synchronous classes*** in the online-only intervention was found to be descriptively similar across all three socioeconomic factors of education level, ITNR and language. Means of attendance frequency, for parents with low education level, low ITNR and non-English speakers were 0.693, 0.648 and 0.673, respectively, with no statistically significant differences. To establish that there was no disparity present we ran equivalence tests and found statistically significant equivalence for education level (p-value < 0.001 for both upper and lower bounds), and primary language (p-value of 0.01 and 0.03 for upper and lower bound respectively). ITNR was statistically significant in the lower bound (p-value = 0.001) but not in the upper bound (p-value = 0.108). Overall, adoption of ECFE's online-only intervention appears to be equivalent across parents of both low and high education levels, and among both whose primary language is English or non-English (see Table 11).

Regarding ***how many participated in Parentopia usage*** (Table 12), parents of low education level used features at a lower count than expected, while those of high education level used the features at a higher count than expected, except for direct messages. There was a statistically

Table 12. Socioeconomic factor-based analysis of Parentopia usage (how many users participated on views, posts and comments, direct messages) in the online-only intervention.

	Education Level				ITNR					Language		
	Count, Expected Count			Difference	Count, Expected Count				Difference	Count, Expected Count		Difference
	Low (N=55)	Medium (N=115)	High (N=95)	p-value, Cramer's V	Low (N=55)	Low to Medium (N=62)	Medium to High (N=87)	High (N=30)	p-value, Cramer's V	English (N=232)	Other than English (N=38)	p-value, Cramer's V
Views	26, 32.17	70, 67.264	59, 55.566	0.163, 0.117	24, 33.611	42, 37.889	56, 53.167	21, 18.333	0.022*, 0.203	147, 133.185	8, 21.815	<0.001***, 0.298
Posts and Comments	12, 16.189	34, 33.849	32, 27.962	0.307, 0.094	12, 16.923	24, 19.077	24, 26.769	12, 9.231	0.138, 0.154	75, 67.022	3, 10.978	0.004**, 0.187
Direct Messages	8, 9.054	20, 16.982	12, 14.054	0.563, 0.062	5, 4.231	4, 4.769	4, 6.692	5, 2.308	0.182, 0.144	16, 15.467	2, 2.533	0.981, 0.023

significant disparity for how many parents viewed (p-value = 0.022, Cramer's V = 0.203) based on ITNR, with 24 low ITNR parents viewing compared with expected count of 33.611, whereas 21 high ITNR parents viewed compared with an expected count of 18.333. There was a statistically significant disparity for how many parents viewed (p-value < 0.001, Cramer's V = 0.298), or posted and commented (p-value = 0.004, Cramer's V = 0.187), based on language, in the online-only community. 21.815 non-English speakers were expected to view, but only 8 did, whereas 147 English speakers viewed where only 133.185 were expected to do so. Three non-English speakers posted or commented where 10.978 were expected to, compared with 75 English speakers posting or commenting where 67.022 were expected to.

For ***how much of Parentopia usage*** among those that used Parentopia in the online-only intervention (Table 13), posts and comments and direct messages were similar for parents from both high and low education levels. Means of posts and comments were 2.5 and 2.532, for low and high education respectively with a p-value of 1.0. Means for direct messages were 2.2 and 1.8 for low and high education respectively with a p-value of 0.47. To more conclusively establish that there was no disparity present, we ran equivalence tests and found statistically significant equivalence in posts and comments ($p < 0.001$ for both upper and lower bounds, margin of equivalence -2 to +2), and in direct messages (p-value = 0.02 for both upper and lower bounds, margin of equivalence -2 to +2). There was similarity among parents that posted and commented with a mean of 2.0 for low ITNR parents compared with a mean of 2.42 for those with high ITNR (Table 14). To more conclusively establish that there was no disparity present, we ran equivalence tests and found statistically significant equivalence in posts and comments (p-value < 0.001 for both upper and lower bound, margin of equivalence -2 to +2). For language based analysis, among those parents that did view, there was disparity but it was not statistically significant (p-value = 0.06, Rank-Biserial = 0.395, see Table 15). Posts and comments were similar with mean for non-English speakers being 2.0, and that for English speakers being 2.67. To establish that there was indeed no disparity present, we ran equivalence tests and found statistically significant equivalence for posts and comments (p-value upper-bound = 0.049, p-value lower-bound = 0.004, margin of equivalence -2 to +2). Non-English speaking parents were less likely to use direct messages with a mean of 1.5 compared to a mean of 3.188 for their English speaking counterparts.

4.3 Adherence

4.3.1 Hybrid. ***Dropout counts*** for low SES were higher than their expected counts in the hybrid intervention across all three factors. Low education level dropout count was 6 compared with the expected count of 3.622; low ITNR had a dropout out count of 5 compared with an expected count of 3.28, and non-English speakers had a dropout count of 4 compared with an expected count of 2.673. No statistically significant differences were found for dropout counts in the hybrid

Table 13. Education level-based analysis of amount of Parentopia usage (how much usage on views, posts and comments, direct messages among users with non-zero usage) in the online-only intervention.

	Low			Medium			High			Difference
	N	Mean	SD	N	Mean	SD	N	Mean	SD	p-value, eta-squared
Views	26	16.885	12.606	70	18.043	11.028	59	21.492	14.032	0.297, 0.022
Posts and Comments	12	2.5	1.567	34	2.794	2.056	32	2.532	1.606	1.0, 0.006
Direct Messages	5	2.2	0.837	8	4.25	5.651	5	1.8	1.304	0.467, 0.089

Table 14. Income-to-needs ratio-based analysis of amount of Parentopia usage (how much usage on views, posts and comments, direct messages among users with non-zero usage) in the online-only intervention.

	Low			Low to Medium			Medium to High			High			Difference
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	p-value, eta-squared
Views	24	15.25	8.624	42	18.643	14.41	56	21.232	14.335	21	20.19	7.897	0.343, 0.027
Posts and Comments	12	2	1.044	24	2.917	1.909	24	2.917	2.263	12	2.417	1.311	0.927, 0.038
Direct Messages	5	5	7.314	4	2	1.414	4	2.25	0.957	5	2.4	2.4	0.935, 0.110

Table 15. Language-based analysis of amount of Parentopia usage (how much usage on views, posts and comments, direct messages among users with non-zero usage) in the online-only intervention.

	English			Other			Difference
	N	Mean	SD	N	Mean	SD	p-value, Rank-Biserial
Views	147	19.592	12.632	8	11.25	8.481	0.06, 0.395
Posts and Comments	75	2.667	1.818	3	2	1	0.688, 0.138
Direct Messages	16	3.188	4.086	2	1.5	0.707	0.3826

Table 16. Socioeconomic factor-based differences among parents who dropped out in the hybrid intervention.

	Education Level				ITNR					Language		
	Low (N=67)	Medium (N=125)	High (N=104)	Total (N=296)	Low (N=51)	Low to Medium (N=82)	Medium to High (N=97)	High (N=34)	Total (N=264)	English (N=258)	Other (N=45)	Total (N=303)
Count of Dropouts	6	3	7	16	5	4	6	2	17	14	4	18
Expected Count of Dropouts	3.622	6.757	5.622	16	3.284	5.28	6.246	2.189	17	15.327	2.673	18
p-value, Cramer's V	0.121, 0.119				0 .725, 0.071					0.365,0.052		

intervention, and the effect sizes were low with Cramer's V at 0.119 for education level, 0.071 for ITNR, and 0.052 for non-English speakers (see Table 16).

4.3.2 Online-Only. We found statistically significant disparity in adherence across all three SES factors of education level, ITNR, and language based on ***dropout counts***. Parents in the low levels of all the three SES factors dropped out at a higher rate than expected, with statistical significance across all factors (see Table 17). Parents with low educational attainment dropped out at a significant rate (p-value = 0.009) but their effect size was smallest (Cramer's V=0.19) among the three SES factors. Non-English speaking parents with low ITNR also dropped out with significance (p-value < 0.001), and the effect size was larger albeit still small for parents with low ITNR (Cramer's V = 0.278), while non-English speaking parents overall dropped out with a medium effect size (Cramer's V = 0.468). The adaptation of ECFE as an online-only intervention appears to have amplified the

Table 17. Socioeconomic factor-based differences among Parents who dropped out in the online-only intervention.

	Education Level				ITNR					Language		
	Low (N=55)	Medium (N=115)	High (N=95)	Total (N=265)	Low (N=42)	Low to Medium (N=75)	Medium to High (N=87)	High (N=30)	Total (N=234)	English (N=232)	Other than English (N=38)	Total (N =270)
Count of Dropouts	23	29	18	70	20.00	18.00	12.00	10.00	60	44.00	30	74
Expected Count of Dropouts	14.53	30.38	25.09	70	10.77	19.23	22.31	7.69	60	63.59	10.42	74
p-value, Cramer's V	0.009**, 0.19				< 0.001***, 0.278					< 0.001***, 0.468		

Table 18. Education level-based analysis of social connectedness in the hybrid intervention.

	Low			Medium			High			Difference
	N	Mean	SD	N	Mean	SD	N	Mean	SD	p-value, eta-squared
GSPS with Other Community Parents	15	8.133	9.884	58	5.276	9.975	50	5.62	11.607	0.648, 0.007
GSPS with Community Staff	15	6.867	7.14	57	4.053	9.555	47	4.979	9.721	0.576, 0.009

Table 19. Income-to-needs ratio-based analysis of social connectedness in the hybrid intervention.

	Low			Low to Medium			Medium to High			High			Difference
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	p-value, eta-squared
GSPS with Other Community Parents	15	3.8	7.163	34	4.706	9.183	45	4.822	10.321	15	11.533	16.256	0.141, 0.05
GSPS with Community Staff	14	3.786	10.282	34	3.5	8.192	43	4.209	8.405	15	9.4	13.298	0.215, 0.043

adherence inequality among parents with lower education level, lower ITNR, and for non-English speaking parents.

4.4 Effectiveness

4.4.1 Hybrid. ***Change in social connectedness*** of parents with other parents, and with staff, was positive and higher among parents with low education levels compared with parents of high education levels with mean GSPS (MGSPS) of parents with low education levels being 8.133, and that with high education levels being 5.62; MGSPS of staff with low education levels was 6.867 and that of staff with high education levels was 4.979 (Table 18). To more conclusively establish that there was no disparity present, we ran equivalence tests but found no statistically significant equivalence, and thus cannot conclude whether disparity is present or absent.

Change in social connectedness of parents with other parents, and with staff, was positive but lower among parents with low ITNR compared with parents of high ITNR (MGSPS of parents with low ITNR was 3.8, MGSPS of parents with high ITNR was 11.533; MGSPS of staff with low ITNR was 3.786 and MGSPS of staff with high ITNR was 9.4) (Table 19).

Change in social connectedness of parents with other parents, and with staff, was positive and similar among parents that spoke English compared with non-English speaking parents (MGSPS of English speaking parents with other parents was 5.746, MGSPS of non-English speaking parents was 6.2; MGSPS of English speaking parents with staff was 4.816, while MGSPS of non-English

Table 20. Language-based analysis of social connectedness in the hybrid intervention.

	English			Other than English			Difference
	N	Mean	SD	N	Mean	SD	p-value, Rank-Biserial
GSPS with Other Community Parents	118	5.746	10.544	5	6.2	13.535	0.749, 0.086
GSPS with Community Staff	114	4.816	9.502	5	3.8	3.962	0.868, 0.046

Table 21. Education level-based analysis of social connectedness in the online-only intervention.

	Low			Medium			High			Difference
	N	Mean	SD	N	Mean	SD	N	Mean	SD	p-value, eta-squared
GSPS with Other Community Parents	3	-8.333	6.028	40	0.475	6.664	33	-0.273	4.557	0.078, 0.081
GSPS with Community Staff	3	-0.333	2.082	40	-1.95	4.326	31	0.742	4.816	0.925, 0.081

Table 22. Income-to-needs ratio-based analysis of social connectedness in the online-only intervention.

	Low			Low to Medium			Medium to High			High			Difference
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	p-value, eta-squared
GSPS with Other Community Parents	7	0.286	14.396	21	-0.762	4.742	33	0.394	4.046	8	-2	4.342	0.078, 0.081
GSPS with Community Staff	7	-2.571	3.735	20	0.7	3.701	33	-0.576	5.006	8	-3.75	2.765	0.925, 0.081

parents was 3.8 (Table 20)). To more conclusively establish that there was no disparity present, we ran equivalence tests but did not find any statistical significance, thus we cannot conclude whether the disparity is present or absent.

Overall, change in social connectedness in the hybrid intervention was positive and varied for the three socioeconomic factors, with the mean for low education level parents being higher, that for low ITNR being lower, and for non-English speaking parents being similar to their English speaking counterparts.

4.4.2 Online-Only. ***Change in social connectedness*** of parents with other parents was negative and lower among parents with low education levels (MGSPS of -8.333) compared with parents of high education levels (MGSPS of -0.273). Change in social connectedness of parents with staff was negative for parents with low education levels (MGSPS of -0.333) but positive for parents with high education level (MGSPS of 0.742) (Table 21). To more conclusively establish that there was no disparity present, we ran equivalence tests but found no statistically significant equivalence, thus we cannot conclude whether the disparity is present or absent.

Change in social connectedness of parents with other parents was positive and higher among parents with low ITNR (MGSPS of 0.286), whereas that of parents of high ITNR was negative and lower (MGSPS of -2.0). Change in social connectedness of parents with staff was negative for both, parents with low (MGSPS of -2.571) and high ITNR (MGSPS of -3.75) (Table 22). To more conclusively establish that there was no disparity present, we ran equivalence tests but found no statistically significant equivalence, thus we cannot conclude whether the disparity is present or absent.

Change in social connectedness could not be analyzed for the language factor due to lack of data points for non-English speaking parents.

Overall, the change in social connectedness in the online-only intervention, with other parents and with staff, was negative for both education level and ITNR, with two exceptions. High-education level parents saw a small positive change in their social connectedness with community staff, and low ITNR parents saw a small positive change with other community parents. The results were not statistically significant and thus we cannot conclude whether disparity was present or absent.

5 DISCUSSION

We conducted quantitative assessments of disparities in two interventions—hybrid and online-only—of a formal parenting education and support community. In this section we summarize our findings, discuss insights from our findings about disparities from these two community-based interventions, and reflect on the use of the AAAE framework, to provide recommendations and future directions for a quantitative examination of disparities in community-based interventions.

5.1 Summary of Findings

We examined disparity in access, adoption, adherence and effectiveness for both the hybrid (RQ1) and the online-only (RQ2) interventions. Table 23 summarizes the findings of our study, which demonstrate a disparity and which did not, and includes references to the pertinent result tables for further details.

Although our aim is not to directly compare disparities between the two interventions due to conditional restrictions that require different comparison subjects (such as evaluating disparities in access, see section 4.1), this natural experiment did provide us with an opportunity to reflect on possible differences between these two implementations of a parenting education community. It was observed that the online-only intervention amplified access inequality for synchronous classes among low education and non-English speaking parents. It also amplified adherence inequality for asynchronous classes, among parents of low socioeconomic status across all three SES factors. Both hybrid and online-only interventions showed a disparity in adoption of ECFE's online platform. Low ITNR and non-English speaking parents faced a disparity in adopting to Parentopia. And, while we cannot conclude whether disparity was present or absent, effectiveness of ECFE, operationalized as change in social connectedness, was found to be negative for both education level and ITNR, in the online-only community with two exceptions. There was a small positive change for high education level parents with community staff, and for low ITNR parents with other community parents.

5.2 Implications for Reducing Socioeconomic Disparities

While a quantitative comparison of the disparities in the two interventions was not an empirical goal of this work, the results provide an opportunity to contrast the experiences in the two interventions. From our findings, the online-only intervention presented more significant disparities compared with hybrid intervention, which we argue must take into account differing interventions when building local support communities. The disparities were particularly highlighted in access and adherence. For example, with online-only intervention, parents of lower education and non-English speakers participated at rates significantly below expected values, and parents from disadvantaged groups, especially non-English speakers and low ITNR parents, dropped out at a much higher rate. Investigating disparities is a necessary step toward more inclusive design in HCI, but we acknowledge that the task of resolving differences in the form of design is often less than straightforward. For example, our results only revealed the results instead of diving into the process of the results (e.g., through interviews or other qualitative methods). Despite this, in this section, we reflect on our findings for the four components of the AAAE framework and come up with research and design implications for identified disparities using the lens of inequities in costs

Table 23. Summary of Findings. In this table, Yes means we found disparities; No means we did not find any disparities through data analysis.

Framework Elem.	Outcome Measures	Hybrid	Online-only
Access	Synchronous classes enrollment	No, with statistically significant difference in favor of low SES parents [Table 2]	**Yes, with statistical significance [Table 4]**
	Parentopia accounts count	Results are inconclusive [Table 3]	Results are inconclusive [Table 5]
Adoption	Attendance frequency in synchronous classes	No, with statistically significant equivalence [Table 6]	No, with statistically significant equivalence [Table 11]
	Parentopia usage—How many participated?	**Yes, with statistical significance [Table 7]**	**Yes, with statistical significance [Table 12]**
	Parentopia usage—How much usage?	Results are inconclusive [Tables 8, 9, 10]	Results are inconclusive [Tables 13, 14, 15]
Adherence	Classes dropout counts	Results are inconclusive [Table 16]	**Yes, with statistical significance [Table 17]**
Effectiveness	Change in social connectedness	Results are inconclusive [Tables 18, 19, 20]	Results are inconclusive [Tables 21, 22]

vs. benefits [75]. Note that, although we discuss the research and design implications in this section based on the four elements of the AAAE framework, these implications might be effective across multiple elements, especially when viewing this framework as a pipeline (see Section 5.3.1).

Access. Our results show that there is statistically significant equitable access in the hybrid intervention for in-person classes (i.e. low SES parents accessed the classes at higher numbers than the general population of St. Paul). However, video-based classes had a statistically significant disparity in access in the online-only intervention (i.e., low SES parents accessed video-based classes at a lower count than expected). In Parentopia accounts, hybrid intervention provided inequitable access whereas online-only intervention provided equitable access (albeit without statistical significance). Compare with hybrid intervention, disparities in video-based online classes may stem from multiple challenges such as limited space, inadequate equipment [16], disrupted routines, and increased childcare duties [97]. These factors likely escalated the startup costs [75], preventing access for some low SES families. Lower usage of Parentopia among low SES families in the hybrid setting could be due to a lesser focus on online interactions given opportunity for face-to-face interactions, while the online-only model made specific efforts to facilitate equitable access to Parentopia, especially for low SES families.

To respond to access issues in computing interventions for local communities, future research should prioritize the identification and measurement of access barriers [57, 66, 82, 92], an area often overlooked in HCI and CSCW studies. This involves not only determining whether access issues exist, but also identifying which specific participant segments or outreach efforts are affected. Once these challenges are identified, solutions such as leveraging public institutions like libraries or schools to facilitate internet and device access, providing technical support, and adapting services for low-capacity devices or slow internet connections could mitigate barriers [92], especially when remote participation is the only option. Considering information accessibility is also important to solve this issue [32, 74]. For example, web-based systems could be designed to address access

issues by highlighting key information tailored to different audiences [81]. Additionally, as CSCW technologies evolve into large-scale information infrastructures, designers must consider for non-local constraints such as standardization and embeddedness to maintain accessibility [68].

Adoption. We did not detect any disparity in adoption of in-person classes in the hybrid or online-only interventions. But for Parentopia usage, in hybrid intervention, low SES parents showed lower than expected engagement. This disparity in adoption was more pronounced for parents with low education, lower income-to-needs ratio (ITNR), and non-English speakers, potentially exacerbated by access issues. Despite this, when low SES parents did use Parentopia, their interaction patterns varied—they viewed content more but engaged less through posts and comments compared to their higher SES counterparts. This echoed prior research that educated, and higher-income individuals are more likely to adopt new technologies [9]. Conversely, in online-only settings, their viewing decreased but their engagement levels matched those of higher SES parents. Several factors may have contributed to the lower adoption among low SES parents, including sufficient alternative peer interactions, preference for familiar online platforms, privacy concerns, and lack of technological support from ECFE or their social networks [92].

To address these challenges, future initiatives could include supporting educators to manage multiple communication channels, and adopting a community-based participatory design approach to involve all stakeholders in the design process [19, 49]. Designers should prioritize local-specific needs and cultural relevance depending on the user base. For example, in our case, in a city where 46% speak a non-English language, online platforms like Parentopia should support multiple languages and offer comprehensive staff training for technological assistance to parents. In addition, encouraging peer support can also facilitate more equitable platform adoption. For example, low-cost social media platform with peer support can promote adoption of new products by facilitating learning and alleviating uncertainty [104]. Peer support networks can be particularly helpful for those who may feel less confident or face obstacles in using the platform, ultimately leading to broader and more inclusive usage [58]. Ad hoc transient communities and peer matching algorithms can facilitate effective peer support in online learning environments [87, 105].

Adherence. Parents of the hybrid intervention had differences in adherence to in-person parenting classes across the three SES factors, but these differences were not statistically significant. In the online-only intervention, there was a statistically significant disparity in adherence across all three SES factors. This disparity may be attributed to the exacerbation of maintenance costs such as COVID-related material and mental stressors as time passed. It may also be due to progressively worsening community experiences with technology products such as Zoom due to ongoing tech unfamiliarity, and/or inadequate technology support from ECFE and/or their support networks. It may also be that benefits of participation were not commensurate with difficulties experienced (e.g. inadequate sense of community via a zoom class, and/or inadequate experiences for their children). Community-based programs like ECFE that integrate online platforms can improve attendance by providing flexibility to attend from multiple class offerings including late evening timings, secure class recordings to watch independently, and providing for the simultaneous engagement of "older" young children (ages 3 - 5) with teaching assistants to reduce home distractions. Educator training on conducting sensitive group conversations and building community online, engaging young children online, along with brief and universally appropriate [92] parent training for online community participation via tools like Zoom, may help enhance participation benefits.

Effectiveness. Change in social connectedness for the hybrid intervention was positive for all three socioeconomic factors, but varied. In the online-only intervention, change in social connectedness was negative for education level and ITNR, with two exceptions (data was not available for the language factor). Although presence or absence of disparity could not be concluded due to lack of statistical significance, with an increase in social connectedness across all SES, the

hybrid intervention fulfilled a critical ECFE goal. This may be attributed to connections experienced in the in-person parenting classes, and their extension through the complimentary online platform. The negative changes for education level and ITNR in the online-only intervention may be attributed to the reduced efficacy of video-based online classes to foster social connectedness among peer parents. This may be caused by inadequate training for educators in community building and participation on mechanisms like Zoom, and limitations experienced from device-based community engagement. And as noted, resource-constraints during COVID may further limit parents' ability or interest in social connectedness with program peers. In addition to suggestions for training for staff and parents, and identifying ways to engage young children (e.g., integrating children's voices into design and planning processes [27]), we recommend conducting community-based participatory design [19] with diverse parents and staff including those who have experienced ECFE during COVID, to identify novel ways to enhance community connectedness in both online-only and hybrid settings. In addition, local communities often have multifaceted objectives regarding what constitutes effectiveness. In our case, we focused on changes in social connectedness because a major goal of ECFE is to create a support network in which parents and staff can mutually share guidance as they navigate parenting. However, as an educational setting, ECFE could also use learning outcomes (e.g., parenting knowledge or skills) to measure effectiveness. Should future work prioritize these educational metrics, researchers would need to embed and design evaluation mechanisms directly into the technological intervention, thereby facilitating the collection of reliable data and enabling validation of the intervention's impact.

5.3 Method Reflections on Using AAAE Framework to Assess Disparities

We reflect on how the AAAE framework aids a comprehensive evaluation of disparities in a community intervention, with the four stages of the framework serving as a "pipeline" to facilitate understanding the impact of earlier stages on subsequent ones. We explain how this framework may also help target participant cost examination and support efforts.

5.3.1 Using AAAE Framework as a comprehensive tool for evaluating disparities. We recommend that the four elements of the AAAE framework may provide a comprehensive and accurate understanding of the equitability of all aspects of the intervention. If a study were to only examine one element, say effectiveness, which is not unlikely in computing studies, they risk reaching a conclusion different than when all elements of the framework are considered. In our research, we found statistically significant disparity in not just one, but two upstream elements of the online-only intervention, leading us to a very different conclusion than if we had only looked at effectiveness.

As we applied the AAAE framework, there appeared to be an implicit sense of a pipeline to the framework where each element depended on the one before it. If some participants suffered a disparity in one of the elements, the other "downstream" elements no longer applied. For example, when non-English speaking participants of the ECFE online-only intervention suffered a disparity in the "access" element (i.e. they did not or could not access the online-only ECFE), then "adoption of", "adherence to" and "effectiveness of" that intervention were not applicable for that participant segment. Similarly, when low education level participants of online-only ECFE suffered an adherence disparity, they were able to access and adopt the intervention, but chose to or had to drop out, creating a disparity in "adhering to" the intervention, making the downstream element of "effectiveness" not applicable. We suggest that the four elements of the framework be considered as dependent on the one before it, and not as disconnected elements to be evaluated independently. Treating the AAAE framework as a "pipeline" also provides the ability to detect and avoid survivorship bias [1]. If researchers only examine later stages (such as "adherence" or "effectiveness"), they risk overlooking individuals who already fell out of the pipeline due to earlier

barriers (e.g., poor language access, lack of digital literacy), thus results of the intervention may be overly optimistic. For community-based interventions in particular, this has implications that excluding those who dropped out or never started can mask the very disparities such programs aim to reduce. By tracking each stage from access onward, researchers could gain a more accurate picture of which populations are being served, who is slipping through the cracks, and how the intervention might be improved to ensure the equity.

5.3.2 Using AAAE Framework to target participant cost examination and support efforts. Our current effort demonstrates how a quantitative evaluation using the AAAE framework enables the determination of which (if any) elements or stages of the pipeline have disparities. This insight may help identify relevant participant costs [75] to target pertinent supportive actions. If there is an access or adoption disparity, participants may be faced with startup costs such as hardware acquisition and internet connectivity costs, along with a steep learning curve that may lead to excessive reliance on support networks, for assistance and pooled resources. There may be a need to examine if the intervention itself is contributing to disparities at various stages of the pipeline. For example, the intervention may not have robust other language online interfaces or class offerings. This was reflected in our results as a disparity in adherence for language SES factor. This speaks to the need for the program/intervention to examine and address issues in its design, services, or policies that may be contributing to disparities in its use. Adherence and effectiveness disparity may be caused by the ongoing challenge of maintaining digital access including financial constraints leading to outdated aging devices, as well as the continual need for technical support, learning, device upkeep, and emotional management for sense of excessive reliance on support networks. To mitigate an adherence and effectiveness disparity, and support sustainable engagement, would require the interventionist to address these ongoing maintenance and affective challenges, including providing a safe space for the participants to ask for both material and emotional assistance.

5.4 Limitations and Future Work

In this section, we outline the limitations of this study and explore potential ways to extend our work. First, our study utilized quantitative methods, which limited our ability to delve into the underlying reasons for the observed disparities in the online-only setting of the ECFE program. However, disparities were less pronounced in the hybrid setting, which benefited from existing support structures that promoted more equitable experiences. While some studies [33, 34] have found reasons for inequalities suffered by lower SES parents in accessing free internet based technologies, they involve informal peer learning communities for parents. The follow-on work we propose would build upon these findings by examining why a formal, expert-facilitated parenting community may be subject to disparities when provisioned online-only, despite providing non-disparate hybrid community experiences.

Second, our analysis treated each SES factor independently based on established SES measurement practices [17]. However, the complexities of social identities suggest the need for an intersectional approach in future studies. Future research should consider employing an intersectional framework [78, 80, 83, 90, 101] to provide a more nuanced understanding of how combined factors like race, gender [48, 55], and SES interact and evolve over time, affecting experiences within diverse demographic communities. This intersectional approach could address the limitations posed by treating SES components in isolation and the static nature of SES categorization in longitudinal studies.

Third, this study indicates the value of technological interventions considering all aspects - access, adoption, adherence and effectiveness - in evaluating their sustained impact upon the populations they aim to serve. Without doing so, they may be creating a partial picture at best, and

an incorrect picture at worst, of the true effectiveness of their interventions. This is not easy to do, as our own study has shown—Each aspect of the framework may require its own data collection and analysis, and effort to ensure its completeness and accuracy. We encourage researchers to quantitatively examine the impact of their community interventions on disparities in their target communities, following the examples we have described, ensuing an examination of all aspects of this framework. Specifically for community interventions in parenting education communities, participatory research can be done to further examine the reasons behind the disparities identified, and involve all stakeholders of the community.

In addition, as this work was conducted during the global COVID-19 pandemic in 2020, there was a "planetary pivot" to digitally mediated remote education [99], where erstwhile hybrid or in-person education systems were forced to transition to online-only learning, creating an extreme but unique opportunity to advance digitization due to an immersive exposure to the digital environment [86]. However, the pandemic potentially exacerbated disparities in the online-only settings due to shifts in community dynamics and increased social distancing, reduced in-person interactions [51], reduced self-efficacy, and learner control, inability to maintain social ties [42, 76, 86]. Despite these challenges, we believe our results provide valuable insights into disparities by operationalizing the AAAE framework in two different intervention settings, even after the quarantine. We encourage the use of this framework in examining the impact of disparities among participants of any community-based intervention. We also encourage future research to replicate this study within a community-based participatory design [43, 53]. Such design would include all stakeholders of the formal parenting education and support ecology, including parents, educators, administrators, and younger children, from both marginalized and not marginalized segments of the target population. It would ensure a dialog that brings out ideas where the former, being centered in the design process, asserts their needs/costs, the latter recognizes them [23], and together the design is closer to being equitable for the real world where both exist.

6 CONCLUSIONS

In this study, we explore socioeconomic disparities within a formal parenting education and support community. Utilizing the AAAE framework, we analyzed two interventions: hybrid (in-person synchronous classes with asynchronous online communication platform Parentopia) and online-only (online synchronous classes with asynchronous online platform Parentopia). Our results show significant SES-based disparities in the adoption of Parentopia in the hybrid intervention, whereas the online-only intervention exhibited significant disparities in access, adherence, and adoption, exacerbating social inequalities. Moreover, we found that early disparities in the framework can mask later ones due to survivorship bias, underlining the need for a thorough examination of all framework elements to accurately assess intervention equity. Our contributions are threefold: (1) We provide a quantitative empirical analysis of disparities in two community-based interventions; (2) We operationalize the AAAE framework quantitatively to the domain of parenting education and support; (3) We offer methodological insights into using the AAAE framework to identify disparities, prevent survivorship bias, and promote equitable outcomes in diverse community settings.

ACKNOWLEDGMENTS

This research was supported by the University of Minnesota College of Education and Human Development (CEHD) Research Acceleration Jump Start Grant. We thank our community partners at the St. Paul ECFE for their invaluable support and collaboration throughout this study. We also thank the undergraduate and masters students of the UMN ProDUCT lab involved in this project for their contributions to this research.

REFERENCES

[1] 2025. COVID-19 pandemic in Minnesota. Wikipedia, The Free Encyclopedia. Retrieved on August 14, 2025, from https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Minnesota.

[2] 2025. Early Childhood Family Education (ECFE) in Minnesota. Help Me Grow MN. Retrieved August 14, 2025, from https://helpmegrowmn.org/HMG/HelpfulRes/Articles/ECFEMN/index.html.

[3] Bushra Alkadhi, Ghadah Alnafisi, Layan Aljowair, Leena Alotaibi, Nouf Alduaifi, and Raghad Alhumood. 2020. Co-design of Augmented Reality Storybooks for Children with Autism Spectrum Disorder. In *HCI International 2020 – Late Breaking Papers: Universal Access and Inclusive Design (Lecture Notes in Computer Science)*. Springer International Publishing, Cham, 3–13. https://doi.org/10.1007/978-3-030-60149-2_1

[4] Julet Allen, Fowzia Mahamed, and Ken Williams. 2022. Disparities in education: E-learning and COVID-19, who matters? In *The Implications of COVID-19 for Children and Youth*. Routledge, 4–6.

[5] American Community Survey. 2021. CHARACTERISTICS OF PEOPLE BY LANGUAGE SPOKEN AT HOME - TableID S1603. United States Census Bureau.

[6] Tawfiq Ammari and Sarita Schoenebeck. 2015. Understanding and Supporting Fathers and Fatherhood on Social Media Sites. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15)*. Association for Computing Machinery, Seoul, Republic of Korea, 1905–1914. https://doi.org/10.1145/2702123.2702205

[7] Tawfiq Ammari and Sarita Schoenebeck. 2016. "Thanks for Your Interest in Our Facebook Group, but It's Only for Dads": Social Roles of Stay-at-Home Dads. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW '16)*. ACM, New York, NY, USA, 1363–1375. https://doi.org/10.1145/2818048.2819927

[8] Tawfiq Ammari, Sarita Schoenebeck, and Meredith Morris. 2014. Accessing social support and overcoming judgment on social media among parents of children with special needs. In *Proceedings of the international AAAI conference on web and social media*, Vol. 8. 22–31.

[9] Rico Amoussouhoui, Aminou Arouna, Sacha Ruzzante, and Jan Banout. 2024. Adoption of ICT4D and its determinants: A systematic review and meta-analysis. *Heliyon* (2024).

[10] Sam A. Ankenbauer and Alex Jiahong Lu. 2020. Engaging Offline Communities Online Amid COVID-19: A Case Study of Independent Theaters. In *Conference Companion Publication of the 2020 on Computer Supported Cooperative Work and Social Computing (CSCW '20 Companion)*. Association for Computing Machinery, New York, NY, USA, 209–213. https://doi.org/10.1145/3406865.3418323

[11] Mariam Asad. 2019. Prefigurative Design as a Method for Research Justice. *Proc. ACM Hum.-Comput. Interact.* 3, CSCW (Nov 2019), 200:1–200:18. https://doi.org/10.1145/3359302

[12] Mariam Asad, Lynn Dombrowski, Sasha Costanza-Chock, Sheena Erete, and Christina Harrington. 2019. Academic Accomplices: Practical Strategies for Research Justice. In *Companion Publication of the 2019 on Designing Interactive Systems Conference 2019 Companion*. ACM, San Diego, CA, USA, 353–356. https://doi.org/10.1145/3301019.3320001

[13] Madeline Balaam, Rob Comber, Ed Jenkins, Selina Sutton, and Andrew Garbett. 2015. FeedFinder: A Location-Mapping Mobile Application for Breastfeeding Women. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (Seoul, Republic of Korea) *(CHI '15)*. Association for Computing Machinery, New York, NY, USA, 1709–1718. https://doi.org/10.1145/2702123.2702328

[14] Madeline Balaam, Judy Robertson, Geraldine Fitzpatrick, Rebecca Say, Gillian Hayes, Melissa Mazmanian, and Belinda Parmar. 2013. Motherhood and HCI. In *CHI '13 Extended Abstracts on Human Factors in Computing Systems (CHI EA '13)*. ACM, New York, NY, USA, 3215–3218. https://doi.org/10.1145/2468356.2479650

[15] Lawrence Barker, Henry Rolka, Deborah Rolka, and Cedric Brown. 2001. Equivalence Testing for Binomial Random Variables. *The American Statistician* 55, 4 (Nov 2001), 279–287. https://doi.org/10.1198/000313001753272213

[16] Marc H. Bornstein and Robert H. Bradley. 2014. *Socioeconomic Status, Parenting, and Child Development*. Routledge.

[17] Sally Bowman, Clara Pratt, Denise Rennekamp, and Michaella Sektnan. 2010. Should we invest in parenting education. *The ford family foundation's enhancing the skills of parents program II, Summary: 2006-2009* (2010).

[18] Lauren Britton, Louise Barkhuus, and Bryan Semaan. 2019. "Mothers as Candy Wrappers": Critical Infrastructure Supporting the Transition into Motherhood. *Proc. ACM Hum.-Comput. Interact.* 3, GROUP (Dec 2019), 232:1–232:21. https://doi.org/10.1145/3361113

[19] Ned Cooper, Tiffanie Horne, Gillian R Hayes, Courtney Heldreth, Michal Lahav, Jess Holbrook, and Lauren Wilcox. 2022. A systematic review and thematic analysis of community-collaborative approaches to computing research. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*. 1–18.

[20] Sasha Costanza-Chock. 2018. Design justice: Towards an intersectional feminist framework for design theory and practice. (2018).

[21] Judith A. Crowell, Jennifer Keluskar, and Amanda Gorecki. 2019. Parenting behavior and the development of children with autism spectrum disorder. *Comprehensive Psychiatry* 90 (Apr 2019), 21–29. https://doi.org/10.1016/j.comppsych.2018.11.007

[22] Carolyn Cutrona and Daniel Russell. 1983. *The Provisions of Social Relationships and Adaptation to Stress*. 37–67.

[23] Debora de Castro Leal, Angelika Strohmayer, and Max Krüger. 2021. On Activism and Academia: Reflecting Together and Sharing Experiences Among Critical Friends. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. ACM, Yokohama, Japan, 1–18. https://doi.org/10.1145/3411764.3445263

[24] David S DeGarmo, Marion S Forgatch, and Charles R Martinez, Jr. 1999. Parenting of divorced mothers as a link between social status and boys' academic outcomes: Unpacking the effects of socioeconomic status. *Child development* 70, 5 (1999), 1231–1245.

[25] Beth A. DeHoff, Lisa K. Staten, Rylin Christine Rodgers, and Scott C. Denne. 2016. The Role of Online Social Support in Supporting and Educating Parents of Young Children With Special Health Care Needs in the United States: A Scoping Review. *Journal of Medical Internet Research* 18, 12 (2016), e333. https://doi.org/10.2196/jmir.6722

[26] Nicola Dell and Neha Kumar. 2016. The Ins and Outs of HCI for Development. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, San Jose, California, USA, 2220–2232. https://doi.org/10.1145/2858036.2858081

[27] Victoria Derr. 2015. Integrating community engagement and children's voices into design and planning education. *CoDesign* 11, 2 (2015), 119–133.

[28] Michael A. Devito, Ashley Marie Walker, Jeremy Birnholtz, Kathryn Ringland, Kathryn Macapagal, Ashley Kraus, Sean Munson, Calvin Liang, and Herman Saksono. 2019. Social Technologies for Digital Wellbeing Among Marginalized Communities. In *Companion Publication of the 2019 Conference on Computer Supported Cooperative Work and Social Computing* (Austin, TX, USA) *(CSCW '19 Companion)*. Association for Computing Machinery, New York, NY, USA, 449–454. https://doi.org/10.1145/3311957.3359442

[29] Catherine D'Ignazio, Erhardt Graeff, Christina N Harrington, and Daniela K Rosner. 2020. Toward equitable participatory design: Data feminism for CSCW amidst multiple pandemics. In *Companion Publication of the 2020 Conference on Computer Supported Cooperative Work and Social Computing*. 437–445.

[30] Catherine D'Ignazio, Alexis Hope, Becky Michelson, Robyn Churchill, and Ethan Zuckerman. 2016. A Feminist HCI Approach to Designing Postpartum Technologies: "When I first saw a breast pump I was wondering if it was a joke". In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI '16)*. Association for Computing Machinery, New York, NY, USA, 2612–2622. https://doi.org/10.1145/2858036.2858460

[31] Tawanna R. Dillahunt and Joey Chiao-Yin Hsiao. 2020. Positive Feedback and Self-Reflection: Features to Support Self-efficacy among Underrepresented Job Seekers. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3313831.3376717

[32] Emma Dixon, Jesse Anderson, Diana Blackwelder, Mary L. Radnofsky, and Amanda Lazar. 2022. Barriers to Online Dementia Information and Mitigation. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA, Article 513, 14 pages. https://doi.org/10.1145/3491102.3517554

[33] Lynn Dombrowski, Adriana Alvarado Garcia, and Jessica Despard. 2017. Low-Wage Precarious Workers' Sociotechnical Practices Working Towards Addressing Wage Theft. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (Denver, Colorado, USA) *(CHI '17)*. Association for Computing Machinery, New York, NY, USA, 4585–4598. https://doi.org/10.1145/3025453.3025633

[34] Lynn Dombrowski, Ellie Harmon, and Sarah Fox. 2016. Social Justice-Oriented Interaction Design: Outlining Key Design Strategies and Commitments. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems (DIS '16)*. Association for Computing Machinery, New York, NY, USA, 656–671. https://doi.org/10.1145/2901790.2901861

[35] Michaelanne Dye, Neha Kumar, Ari Schlesinger, Marisol Wong-Villacres, Morgan G. Ames, Rajesh Veeraraghavan, Jacki O'Neill, Joyojeet Pal, and Mary L. Gray. 2018. Solidarity Across Borders: Navigating Intersections Towards Equity and Inclusion. In *Companion of the 2018 ACM Conference on Computer Supported Cooperative Work and Social Computing* (Jersey City, NJ, USA) *(CSCW '18 Companion)*. Association for Computing Machinery, New York, NY, USA, 487–494. https://doi.org/10.1145/3272973.3273007

[36] Catherine D'Ignazio, Erhardt Graeff, Christina N. Harrington, and Daniela K. Rosner. 2020. Toward Equitable Participatory Design: Data Feminism for CSCW amidst Multiple Pandemics. In *Conference Companion Publication of the 2020 on Computer Supported Cooperative Work and Social Computing (CSCW '20 Companion)*. Association for Computing Machinery, New York, NY, USA, 437–445. https://doi.org/10.1145/3406865.3418588

[37] Jenny Fisher, Jean-Charles Languilaire, Rebecca Lawthom, Rense Nieuwenhuis, Richard J. Petts, Katherine Runswick-Cole, and Mara A. Yerkes. 2020. Community, work, and family in times of COVID-19. *Community, Work and Family* 23, 3 (May 2020), 247–252. https://doi.org/10.1080/13668803.2020.1756568

[38] Enrico Gandolfi, Richard E Ferdig, and Annette Kratcoski. 2021. A new educational normal an intersectionality-led exploration of education, learning technologies, and diversity during COVID-19. *Technology in society* 66 (2021), 101637.

[39] Yujia Gao, Jinu Jang, and Diyi Yang. 2021. Understanding the Usage of Online Media for Parenting from Infancy to Preschool At Scale. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI '21)*. Association for Computing Machinery, New York, NY, USA, Article 183, 12 pages. https://doi.org/10.1145/3411764.3445203

[40] Radhika Garg. 2021. "It Changes so Often": Parental Non-/Use of Mobile Devices While Caring for Infants and Toddlers at Home. https://doi.org/10.1145/3479513

[41] Lorna Gibson and Vicki L. Hanson. 2013. Digital Motherhood: How Does Technology Help New Mothers?. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13)*. ACM, New York, NY, USA, 313–322. https://doi.org/10.1145/2470654.2470700

[42] Jiangtao Gong, Zheng Yao, Zhicong Lu, Qicheng Ding, yu zhang, Liuxin Zhang, and Qianying Wang. 2021. All in One Group: Current Practices, Lessons and Challenges of Chinese Home-School Communication in IM Group Chat. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI '21)*. Association for Computing Machinery, New York, NY, USA, Article 346, 12 pages. https://doi.org/10.1145/3411764.3445436

[43] Karen Hacker. 2013. *Community-based participatory research.* Sage publications.

[44] Cristin M. Hall and Karen L. Bierman. 2015. Technology-assisted interventions for parents of young children: Emerging practices, current research, and future directions. *Early Childhood Research Quarterly* 33 (Oct 2015), 21–32. https://doi.org/10.1016/j.ecresq.2015.05.003

[45] Christina N. Harrington and Anne Marie Piper. 2018. Informing Design through Sociocultural Values: Co-Creation with Low-Income African-American Older Adults. In *Proceedings of the 12th EAI International Conference on Pervasive Computing Technologies for Healthcare*. ACM, New York, NY, USA, 294–298. https://doi.org/10.1145/3240925.3240966

[46] Gillian R. Hayes, Donald J. Patterson, Mohan Singh, Dana Gravem, Julia Rich, and Dan Cooper. 2011. Supporting the transition from hospital to home for premature infants using integrated mobile computing and sensor support. *Pers Ubiquit Comput* 15, 8 (Dec 2011), 871–885. https://doi.org/10.1007/s00779-011-0402-4

[47] Stephanie A. Hayes and Shelley L. Watson. 2013. The Impact of Parenting Stress: A Meta-analysis of Studies Comparing the Experience of Parenting Stress in Parents of Children With and Without Autism Spectrum Disorder. *J Autism Dev Disord* 43, 3 (Mar 2013), 629–642. https://doi.org/10.1007/s10803-012-1604-y

[48] Julie S. Hui and Shelly D. Farnham. 2016. Designing for Inclusion: Supporting Gender Diversity in Independent Innovation Teams. In *Proceedings of the 2016 ACM International Conference on Supporting Group Work* (Sanibel Island, Florida, USA) *(GROUP '16)*. Association for Computing Machinery, New York, NY, USA, 71–85. https://doi.org/10.1145/2957276.2957290

[49] Malika Roman Isler and Giselle Corbie-Smith. 2012. Practical steps to community engaged research: from inputs to outcomes. *Journal of Law, Medicine & Ethics* 40, 4 (2012), 904–914.

[50] Jonas Kjeldmand Jensen, Tawfiq Ammari, and Pernille Bjørn. 2019. Into Scandinavia: When Online Fatherhood Reflects Societal Infrastructures. *Proc. ACM Hum.-Comput. Interact.* 3, GROUP (Dec 2019), 231:1–231:21. https://doi.org/10.1145/3361112

[51] Qiao Jin, Ye Yuan, and Svetlana Yarosh. 2023. Socio-technical Opportunities in Long-Distance Communication Between Siblings with a Large Age Difference. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI '23)*. Association for Computing Machinery, New York, NY, USA, Article 94, 15 pages. https://doi.org/10.1145/3544548.3580720

[52] Kazi Sinthia Kabir, Johanna Cohoon, John R. Lund, Jacqueline M. Chen, A.J. Metz, and Jason Wiese. 2025. Balancing Care Responsibilities with Remote Work. *Proc. ACM Hum.-Comput. Interact.* 9, 1, Article GROUP3 (Jan. 2025), 21 pages. https://doi.org/10.1145/3701182

[53] Parisa Khanipour Roshan, Maia Jacobs, Michaelanne Dye, and Betsy DiSalvo. 2014. Exploring How Parents in Economically Depressed Communities Access Learning Resources. In *Proceedings of the 2014 ACM International Conference on Supporting Group Work* (Sanibel Island, Florida, USA) *(GROUP '14)*. Association for Computing Machinery, New York, NY, USA, 131–141. https://doi.org/10.1145/2660398.2660415

[54] Parisa Khanipour Roshan, Maia Jacobs, Michaelanne Dye, and Betsy DiSalvo. 2014. Exploring How Parents in Economically Depressed Communities Access Learning Resources. In *Proceedings of the 18th International Conference on Supporting Group Work*. ACM, Sanibel Island, Florida, USA, 131–141. https://doi.org/10.1145/2660398.2660415

[55] Neha Kumar, Naveena Karusala, Azra Ismail, and Anupriya Tuli. 2020. Taking the Long, Holistic, and Intersectional View to Women's Wellbeing. *ACM Trans. Comput.-Hum. Interact.* 27, 4 (Jul 2020), 23:1–23:32. https://doi.org/10.1145/3397159

[56] Daniël Lakens. 2017. Equivalence Tests. *Soc Psychol Personal Sci* 8, 4 (May 2017), 355–362. https://doi.org/10.1177/1948550617697177

[57] Celia O Larson, David Schlundt, Kushal Patel, Linda McClellan, and Margaret Hargreaves. 2007. Disparities in perceptions of healthcare access in a community sample. *The Journal of Ambulatory Care Management* 30, 2 (2007),

142–149.
[58] Violet Lasdun. 2021. *Peer learning in a digital farmer-to-farmer network: Effects on technology adoption and self-efficacy beliefs*. McGill University (Canada).
[59] Patty Leijten, Karen Rienks, Annabeth P Groenman, Madhur Anand, Burcu Kömürcü Akik, Oana David, Rukiye Kızıltepe, Therdpong Thongseiratch, and Ana Catarina Canário. 2024. Online parenting support: Meta-analyses of non-inferiority and additional value to in-person support. *Children and Youth Services Review* 159 (2024), 107497.
[60] Calvin A. Liang, Sean A. Munson, and Julie A. Kientz. 2021. Embracing Four Tensions in Human-Computer Interaction Research with Marginalized People. *ACM Trans. Comput.-Hum. Interact.* 28, 2 (Apr 2021), 14:1–14:47. https://doi.org/10.1145/3443686
[61] David Muturia Lichoro. 2015. *Faculty preparedness for transition to teaching online courses in the Iowa Community College Online Consortium*. Ph. D. Dissertation. Iowa State University.
[62] Theo Lorenc and Kathryn Oliver. 2014. Adverse effects of public health interventions: a conceptual framework. *J Epidemiol Community Health* 68, 3 (2014), 288–290.
[63] Di Lu. 2016. Engaging Newcomers in Hybrid Communities. In *Proceedings of the 19th International Conference on Supporting Group Work*. ACM, Sanibel Island, Florida, USA, 491–494. https://doi.org/10.1145/2957276.2997024
[64] Vonnie C. McLoyd. 19980401. Socioeconomic disadvantage and child development. *American Psychologist* 53, 2 (19980401), 185. https://doi.org/10.1037/0003-066X.53.2.185
[65] D McMillin and O Baiocchi. 2020. CO-DESIGNING INNOVATIONS: CENTERING STUDENT VOICES IN REMOTE LEARNING. In *ICERI2020 Proceedings*. IATED, 6241–6243.
[66] Karen L Michaelson. 1996. Information, community, and access. *Social Science Computer Review* 14, 1 (1996), 57–59.
[67] Rebecca Michelson, Akeiylah DeWitt, Ria Nagar, Alexis Hiniker, Jason Yip, Sean A Munson, and Julie A Kientz. 2021. Parenting in a pandemic: Juggling multiple roles and managing technology use in family life during COVID-19 in the United States. *Proceedings of the ACM on Human-Computer Interaction* 5, CSCW2 (2021), 1–39.
[68] Eric Monteiro, Neil Pollock, Ole Hanseth, and Robin Williams. 2013. From Artefacts to Infrastructures. *Comput. Supported Coop. Work* 22, 4–6 (Aug. 2013), 575–607. https://doi.org/10.1007/s10606-012-9167-1
[69] Meredith Ringel Morris. 2014. Social Networking Site Use by Mothers of Young Children. In *Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing (CSCW '14)*. ACM, New York, NY, USA, 1272–1282. https://doi.org/10.1145/2531602.2531603
[70] Isabel Munoz. 2023. Identity, Marginalization and Precarity in Platform-Mediated Freelancing. In *Companion Proceedings of the 2023 ACM International Conference on Supporting Group Work* (Hilton Head, SC, USA) *(GROUP '23)*. Association for Computing Machinery, New York, NY, USA, 69–71. https://doi.org/10.1145/3565967.3571760
[71] Nannette P Napier, Sonal Dekhane, and Stella Smith. 2011. Transitioning to blended learning: Understanding student and faculty perceptions. *Journal of Asynchronous Learning Networks* 15, 1 (2011), 20–32.
[72] Nikki Newhouse. 2019. *Bump2Bump: Designing and evaluating technology to promote maternal wellbeing in the transition to motherhood*. Ph. D. Dissertation. UCL (University College London).
[73] Christa C. Nieuwboer, Ruben G. Fukkink, and Jo M. A. Hermanns. 2013. Peer and professional parenting support on the Internet: a systematic review. *Cyberpsychol Behav Soc Netw* 16, 7 (Jul 2013), 518–528. https://doi.org/10.1089/cyber.2012.0547
[74] Chris Norval, John L Arnott, and Vicki L Hanson. 2014. What's on your mind? Investigating recommendations for inclusive social networking and older adults. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 3923–3932.
[75] Lucy Pei and Roderic Crooks. 2020. Attenuated Access: Accounting for Startup, Maintenance, and Affective Costs in Resource-Constrained Communities. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. ACM, Honolulu, HI, USA, 1–15. https://doi.org/10.1145/3313831.3376587
[76] Daniela Popa, Angela Repanovici, Daciana Lupu, Mariana Norel, and Claudiu Coman. 2020. Using Mixed Methods to Understand Teaching and Learning in COVID 19 Times. *Sustainability* 12, 20 (Jan 2020), 8726. https://doi.org/10.3390/su12208726
[77] Laurie Posey and Christine Pintz. 2017. Transitioning a bachelor of science in nursing program to blended learning: Successes, challenges & outcomes. *Nurse Education in Practice* 26 (Sep 2017), 126–133. https://doi.org/10.1016/j.nepr.2016.10.006
[78] Lee Rainie. 2016. Digital Divides 2016. Retrieved July 2, 2021 from https://www.pewresearch.org/internet/2016/07/14/digital-divides-2016/.
[79] Yolanda A. Rankin and Jakita O. Thomas. 2019. Straighten up and fly right: rethinking intersectionality in HCI research. *interactions* 26, 6 (Oct 2019), 64–68. https://doi.org/10.1145/3363033
[80] Yolanda A. Rankin, Jakita O. Thomas, and Nicole M. Joseph. 2020. Intersectionality in HCI: lost in translation. *interactions* 27, 5 (Sep 2020), 68–71. https://doi.org/10.1145/3416498

[81] N.C. Romano, E.T. Loiacono-Mello, and S. McCoy. 2005. Information Systems Accessibility. In *Proceedings of the 38th Annual Hawaii International Conference on System Sciences.* 182–182. https://doi.org/10.1109/HICSS.2005.321

[82] Alison Salloum, Carly Johnco, Adam B Lewin, Nicole M McBride, and Eric A Storch. 2016. Barriers to access and participation in community mental health treatment for anxious children. *Journal of affective disorders* 196 (2016), 54–61.

[83] Ari Schlesinger, W. Keith Edwards, and Rebecca E. Grinter. 2017. Intersectional HCI: Engaging Identity through Gender, Race, and Class. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (Denver, Colorado, USA) *(CHI '17)*. Association for Computing Machinery, New York, NY, USA, 5412–5427. https://doi.org/10.1145/3025453.3025766

[84] K Siek, T Veinot, and B Mynatt. 2019. Research opportunities in sociotechnical interventions for health disparity reduction. Computing Community Consortium website. Published June 2019.

[85] Jane M. Simoni, Kimberly M. Nelson, Julie C. Franks, Samantha S. Yard, and Keren Lehavot. 2011. Are Peer Interventions for HIV Efficacious? A Systematic Review. *AIDS Behav* 15, 8 (Nov 2011), 1589–1595. https://doi.org/10.1007/s10461-011-9963-5

[86] Laurianne Sitbon and Margot Brereton. 2020. Co-design to Include Users with Intellectual Disability in Information Interaction Research. In *Proceedings of the 2020 Conference on Human Information Interaction and Retrieval (CHIIR '20)*. Association for Computing Machinery, New York, NY, USA, 481–483. https://doi.org/10.1145/3343413.3378019

[87] Peter B. Sloep, Liesbeth Kester, Francis Brouns, Peter van Rosmalen, Fred de Vries, Marcel De Croock, and Rob Koper. 2007. Ad hoc transient communities to enhance social interaction and spread tutor responsibilities. https://api.semanticscholar.org/CorpusID:28087088

[88] Camille Smith, Ruth Perou, and Catherine Lesesne. 2002. Parent education. *Handbook of Parenting Volume 4 Social Conditions and Applied Parenting* (2002), 389.

[89] Tobias Sonne, Paul Marshall, Carsten Obel, Per Hove Thomsen, and Kaj Grønbæk. 2016. An assistive technology design framework for ADHD. In *Proceedings of the 28th Australian Conference on Computer-Human Interaction (OzCHI '16)*. Association for Computing Machinery, New York, NY, USA, 60–70. https://doi.org/10.1145/3010915.3010925

[90] Elizabeth Stowell, Mercedes C. Lyson, Herman Saksono, Reneé C. Wurth, Holly Jimison, Misha Pavel, and Andrea G. Parker. 2018. Designing and Evaluating mHealth Interventions for Vulnerable Populations: A Systematic Review. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems - CHI '18*. ACM Press, Montreal QC, Canada, 1–17. https://doi.org/10.1145/3173574.3173589

[91] Nattaporn Thongsri, Chalothon Chootong, Orawan Tripak, Piyaporn Piyawanitsatian, and Rungtip Saengae. 2021. Predicting the determinants of online learning adoption during the COVID-19 outbreak: a two-staged hybrid SEM-neural network approach. *Interactive Technology and Smart Education* ahead-of-print, ahead-of-print (Jan 2021). https://doi.org/10.1108/ITSE-08-2020-0165

[92] Diego Trujillo-Pisanty, Abigail Durrant, Sarah Martindale, Stuart James, and John Collomosse. 2014. Admixed Portrait: Reflections on Being Online As a New Parent. In *Proceedings of the 2014 Conference on Designing Interactive Systems (DIS '14)*. ACM, New York, NY, USA, 503–512. https://doi.org/10.1145/2598510.2602962

[93] US Census Bureau. 2021. Poverty Thresholds. The United States Census Bureau. Retrieved from https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html.

[94] Tiffany C. Veinot, Hannah Mitchell, and Jessica S. Ancker. 2018. Good intentions are not enough: how informatics interventions can worsen inequality. *Journal of the American Medical Informatics Association* 25, 8 (Aug 2018), 1080–1088. https://doi.org/10.1093/jamia/ocy052

[95] Esteban Walker and Amy S. Nowacki. 2011. Understanding Equivalence and Noninferiority Testing. *J GEN INTERN MED* 26, 2 (Feb 2011), 192–196. https://doi.org/10.1007/s11606-010-1513-8

[96] Susan Walker. 2019. Parent and Educator Perspectives on the Benefits of an Online Space to Promote Offline Program Collaborative Learning.

[97] Jonathan A. Weiss, Suzanne Robinson, Stephanie Fung, Ami Tint, Philip Chalmers, and Yona Lunsky. 2013. Family hardiness, social support, and self-efficacy in mothers of individuals with Autism Spectrum Disorders. *Research in Autism Spectrum Disorders* 7, 11 (Nov 2013), 1310–1317. https://doi.org/10.1016/j.rasd.2013.07.016

[98] Martin White, Jean Adams, and Peter Heywood. 2009. How and why do interventions that increase health overall widen inequalities within populations? In *Social inequality and public health*. Policy Press, 65–82.

[99] Ben Williamson, Rebecca Eynon, and John Potter. 2020. Pandemic politics, pedagogies and practices: digital technologies and distance education during the coronavirus emergency. *Learning, Media and Technology* 45, 2 (Apr 2020), 107–114. https://doi.org/10.1080/17439884.2020.1761641

[100] Marisol Wong-Villacres, Carl DiSalvo, Neha Kumar, and Betsy DiSalvo. 2020. Culture in Action: Unpacking Capacities to Inform Assets-Based Design. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3313831.3376329

[101] Marisol Wong-Villacres, Upol Ehsan, Amber Solomon, Mercedes Pozo Buil, and Betsy DiSalvo. 2017. Design Guidelines for Parent-School Technologies to Support the Ecology of Parental Engagement. In *Proceedings of the 2017 Conference on Interaction Design and Children - IDC '17*. ACM Press, Stanford, California, USA, 73–83. https://doi.org/10.1145/3078072.3079748

[102] Susan Wyche, Nightingale Simiyu, and Martha E. Othieno. 2016. Mobile Phones as Amplifiers of Social Inequality among Rural Kenyan Women. *ACM Trans. Comput.-Hum. Interact.* 23, 3 (Jun 2016), 14:1–14:19. https://doi.org/10.1145/2911982

[103] Zeynep Yildiz, Doga Gatos, Özge Subasi, Asim Evren Yantac, and Kemal Kuscu. 2019. Examining Online Practices of an Autism Parent Community in Turkey: Goals, Needs, and Opportunities. In *Proceedings of the 2019 on Designing Interactive Systems Conference* (San Diego, CA, USA) *(DIS '19)*. Association for Computing Machinery, New York, NY, USA, 373–384. https://doi.org/10.1145/3322276.3322344

[104] Wanqing Zhang, Pradeep K Chintagunta, and Manohar U Kalwani. 2021. Social media, influencers, and adoption of an eco-friendly product: Field experiment evidence from rural China. *Journal of Marketing* 85, 3 (2021), 10–27.

[105] Wenbing Zhao, Xiongyi Liu, Shruti Shah, Issac Baah, Abhi Patel, and Nicholas Wise. 2021. Peer Support in Smart Learning and Education. *2021 IEEE SmartWorld, Ubiquitous Intelligence & Computing, Advanced & Trusted Computing, Scalable Computing & Communications, Internet of People and Smart City Innovation (SmartWorld/SCALCOM/UIC/ATC/IOP/SCI)* (2021), 598–605. https://api.semanticscholar.org/CorpusID:244405906

Received October 2024; revised April 2025; accepted August 2025