Gender-Focused Technology Design and Care Ethics Integration: Addressing Social and Practical Challenges

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Abstract

This paper examines the integration of care ethics into the design of gender-focused technologies, addressing the socio-political and practical challenges in the Information Technology (IT) sector. It argues that these technologies often reflect interests embedded within predominant social structures and ethical conceptions, with the underrepresentation of women in tech leadership roles as a symptom perpetuating existing disparities rather than addressing the actual needs of marginalized groups. Drawing on an extensive review of gender-focused technology literature and care ethics case studies, we critique traditional ethical frameworks for their failure to address these challenges. We explore how care ethics, emphasizing relational and contextual morality, can provide a more inclusive and effective approach while highlighting theoretical and practical issues that hamper implementation. We propose addressing and reinterpreting these criticisms as opportunities to leverage the strengths of care ethics, creating technologies that empower and resonate with user groups, fostering a more equitable future.

Keywords: Gender-Focused Technology, Care Ethics, Ethical Frameworks, Participatory Design, Inequality.

1. Introduction

Technology's pervasive influence in society drives transformative changes across governance, economic systems, and cultural practices, empowering communities, streamlining communication, and accelerating innovation. Yet, it can also deepen socio-economic divides and reinforce disparities, particularly gender inequalities, the most visible dimension of these disparities (Sharma et al., 2021). In a world increasingly defined by techno-culture—a societal state deeply intertwined with technological advancement—technology serves not merely as a facilitator but as a potent agent of power (Hui, 2016). This power, significantly influenced by the diffusion of information technologies, reinforces, and reshapes existing behavioral norms and social structures of dominance and exclusion (Hilbert, 2013).

As technology increasingly reflects societal norms, it becomes critical to acknowledge that its impact on gender inequalities is not predetermined but contingent upon the social and economic systems within which it operates (Winner, 2010). This is critical as gender-centric approaches face growing global vilification (Biroli & Caminotti, 2020; Cupać & Ebetürk, 2020). In such an environment, these socio-political factors can influence, or even halt, the development of such technologies, emphasizing the need for more inclusive and contextually aware approaches that are truly embraced by the communities they seek to empower.

In a scenario of diminishing socio-political support, it is vital to scrutinize the efficacy of technology in addressing gender disparities. Analysis reveals shortcomings in gender-focused technology design, often due to low user engagement and inadequate sociocultural contextualization. Structural factors, including the absence of feminist ethical frames (Feeney & Fusi, 2021) and the underrepresentation of women in tech courses and leadership roles (Connolly et al., 2024; Holtzblatt & Marsden, 2018), further hinder success.

Additionally, implementing care ethics in tech design encounters challenges beyond ideological and structural barriers, such as lead user bias, psychological impacts on developers and users, stigma associated with gender-focused technology, and difficulties in community engagement. Additionally, concerns about data privacy, cultural variances, and power imbalances in developer-user relationships persist. Care ethics is often applied superficially, with criticisms of vagueness, reinforcement of traditional gender roles, and dependency dynamics in caregiver-cared-for relationships. Addressing these issues is crucial for evolving care ethics into a comprehensive, practical framework for technology design, ensuring products resonate with and empower their intended audience.

Given this need for reevaluation, this paper examines the theoretical foundations and ethical frameworks of gender-focused technologies. Our comprehensive literature review found that the tech

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design predominantly employs traditional ethical frameworks such as utilitarianism and deontology, often prioritizing universal standards and individualistic solutions. These approaches frequently overlook the specific needs of marginalized gender groups. We advocate for integrating care ethics due to its focus on relational and contextual morality that clashes with the prevailing individualistic ethos that neglects systemic injustices and unequal power structures.

The paper is structured as follows: First, we examine the global context of gender-focused technology, emphasizing the interdependence between the tech sector and broader sociopolitical dynamics. Next, we conduct a narrative review to assess the prevalence of care ethics in tech design compared to other ethical frameworks, focusing on gender. We then explore the limitations of these frameworks in empowering gender-focused technology. Finally, we critically evaluate care ethics, addressing its criticisms and highlighting how they can be leveraged to create a more equitable technological future where gender is integral to design and implementation.

2. Gender and Technology

Despite feminist principles have gained wider acceptance academic circles, their global adoption in the tech sector is increasingly met with resistance. This pushback, championed by political leaders such as Vladimir Putin, Jair Bolsonaro, and Donald Trump, is part of a broader societal trend that amplifies anti-feminist rhetoric. Recent research shows that the acceptance of gender initiatives and theories are steadily declining, with opinions divided on if the push for gender equality has gone too far (Campbell et al., 2024). These political figures leverage such sentiments, as they portray gender equality as a value system championed by a minority elite (Corredor, 2019) that has overreached its demands and appropriated "society's main institutions" (Kuhar & Paternotte, 2017). For them, these initiatives are immoral, illegal, and a blight to society, "compelling" them to act as "moral actors" against its development (Kalm & Meeuwisse, 2023).

Interestingly, these agents heavily rely on the use of technology for engaging with their constituents (Dojčinović & Ljajić, 2022), leading to a prioritization of these technologies for tools for conservative activism (Trifiro, 2019). Technologies that once promised to amplify voices of marginalized groups are co-opted for disseminating misinformation and hate speech, specifically for gender violence (Bürger et al., 2020). Fully aware of the role technology plays in shaping public opinion, these groups have moved to influence its development and regulatory frameworks, pressuring to defund or halt gender-inclusive projects.

The technological sector cannot be decoupled from this broader movement. Recently, major figures from the tech industry have celebrated the ousting of Harvard's President Claudine Gay as a pivotal moment for the demise of Diversity, Equity, and Inclusion (DEI) efforts (Zeff, 2024). Elon Musk (X) tweeted that these initiatives "discriminate on the basis of race, gender, and many other factors, [thus] is not merely immoral, it is also illegal." Paul Graham (Y Combinator) said that "There were always more people against it than there seemed, but many were afraid to say so. Now that it is safer to criticize it, more will." Brian Armstrong (Coinbase) echoed these sentiments: "Hopefully this marks the beginning of the end for DEI as a movement, which got horribly corrupted by Marxist thought, and a return to a true meritocracy" (Zeff, 2024).

By portraying themselves as the oppressed group by minorities; while simplifying inclusive-oriented initiatives as a corrupt Marxist ideology and upholding meritocracy as a leveled form of competition, these figures exemplify the resistance encountered by such initiatives in the tech industry. This resistance highlights that the tech sector is part of a larger societal trend aimed at preserving a privileged status quo by undermining discussions of injustice related to structures that have systematically promoted gender-inequality.

In this climate, the debate on ethical frameworks for gender-focused technologies is crucial. However, these discussions, while relevant in academia, often fail to resonate with tech leaders or industry practitioners. The adoption of these frameworks faces significant barriers, primarily due to their perceived misalignment with business objectives. This disconnect between academia and industry challenges the implementation of inclusive ethical frameworks, making it a key limitation in advancing gender equity in technology.

To address this gap, this article advocates for the integration of care ethics into technology design, moving beyond individualistic, rule-based approaches. By emphasizing relational and contextual morality, we aim to challenge traditional frameworks and promote more inclusive and equitable design processes in the tech industry. The goal is to bridge the divide between theoretical discourse and practical application, ensuring that diverse perspectives and power dynamics are considered in the development of technology.

3. Methodology

This paper uses a narrative literature review to explore the integration of care ethics into gender-focused technology design, chosen for its flexibility in identifying key themes, trends, and gaps in this interdisciplinary field, enabling a more interpretative synthesis, suited to examining the evolving, context-

dependent ethical frameworks at the intersection of care ethics and gender-focused technology.

Search Strategy and Data Collection. To conduct this review, we began by consulting existing literature to establish the historical and theoretical context and to develop a search vocabulary tailored to our narrative review's objectives. Our initial focus was on seminal works and articles in the fields of technology design, ethical concerns, and gender studies. This preliminary analysis informed our search strategy, which involved querying the ACM Digital Library database using terms such as "technology design," "participatory design," and "gender technology." We aimed to capture a broad range of perspectives while maintaining focus on literature that specifically addressed the ethical frameworks in technology design. A preliminary review revealed that many papers addressed gender and technology in isolation, with only a small fraction exploring ethical frameworks in depth—highlighting a significant gap in the literature.

Inclusion and Exclusion Criteria. We refined our search by incorporating concepts from major ethical theories, including "deontology," "utilitarianism," "virtue ethics," and "care ethics." This refinement reduced our corpus to 3,217 results. We then applied specific inclusion and exclusion criteria to narrow our focus. Studies were included if they addressed the integration of ethical frameworks within technology design, particularly in relation to gender. Papers were excluded if they were purely theoretical, did not focused on the technology design component, or discussed technology without an ethical framework. Abstracts were reviewed to apply these criteria, and full-text reviews were conducted when abstracts did not provide sufficient detail. This resulted in a final corpus of 308 papers published between 2010 and 2023.

Data Extraction and Analysis. From this refined corpus, we identified 40 case studies that specifically examined the implementation of care ethics within the tech sector, particularly concerning gender issues. These studies underwent a thorough qualitative coding process, using Excel to categorize and organize the data. Parameters analyzed included the paper's goal, ethical framework, tech sector, target group, theoretical foundations, applicability, methodology, and conclusions. Throughout the coding process, iterative checks were employed to ensure consistency, with the data re-evaluated at different stages to refine thematic categories.

Synthesis of Findings. The studies covered diverse fields such as healthcare, education, nanotechnology, computer science, and the environment. The qualitative data was then organized into thematic categories to identify overarching trends and gaps. This approach enabled us to draw meaningful insights into how care

ethics is being integrated—or overlooked—in these contexts.

4. Tech Design and Ethical Frameworks

The design of technology, including gender-focused technology, is predominantly guided by traditional ethical frameworks such as utilitarianism, deontology, and virtue ethics. Although virtue ethics has always been a fundamental principle in normative ethical theory, it has seen renewed interest in applied fields such as technology and AI ethics, where its focus on character traits and moral virtues is being reconsidered as essential to addressing contemporary ethical challenges (Annas, 2003). These approaches often prioritize universal standards and individualistic solutions, frequently overlooking the needs of marginalized groups. Our review, focusing on the 308 selected papers, revealed a strong prevalence of these traditional frameworks: utilitarianism was the most common, present in 46.6% of the papers, followed by deontology at 24.0%, virtue ethics at 16.4%, and care ethics at 13.0%. These findings underscore the dominance of traditional approaches in the tech sector and the limited focus on care ethics, highlighting the need for broader inclusion of relational and contextual moral perspectives in technology design.

4.1. Utilitarianism: Balancing Utility and Justice

Utilitarian ethics focuses on the consequences of actions rather than their intrinsic qualities, aiming to achieve the greatest good for the greatest number. This approach, grounded in Bentham and Stuart Mill's work, has become influential in moral philosophy, economics, and public policy (Scheffler, 1988). It has evolved to address criticisms, with concepts like Popper's (1945) "negative utilitarianism" stressing minimizing suffering over maximizing happiness, and Harsanyi's (1977) "preference utilitarianism" distinguishing between immediate desires and rational, informed choices.

In the technological sector, utilitarian principles are applied in decision-making processes, user experience design, and policy implementation (Floridi, 2016). For instance, cost-benefit and impact assessments in technology projects utilize utilitarian reasoning to balance innovation with benefits, such as NASA's Technology Leverage Factor and Technology Impact assessments (Terrile et al, 2014). Ethical guidelines for AI and data protection incorporate utilitarian considerations, as evidenced by a qualitative analysis of 70 international AI ethics guidelines (Franzke, 2022).

Proponents of utilitarian ethics in tech argue that due to its practical, outcome-oriented framework, utilitarianism helps guide decisions better than other

ethical systems. However, there are significant criticisms. Despite Popper's approach, utilitarianism's focus on overall good can justify harmful actions, overlooking individual rights and minority needs (Goodin, 1995). In AI development, utilitarian approaches can lead to privacy violations or biased algorithms if deemed beneficial for the majority (Binns, 2018). The Cambridge Analytica scandal illustrates the dangers of prioritizing perceived greater good over individual rights (Zuboff, 2023). Also, utilitarianism's aggregation of utility often neglects individual experiences, enhancing inequitable outcomes (Rawls, 1971). In machine learning, utilitarian metrics of accuracy and efficiency overlook biases and injustices, disproportionately affecting minority groups.

Finally, utilitarianism's simplistic view of utility often aligns with the interests of the powerful perpetuating inequality. This issue is especially relevant in tech hubs, where decisions are frequently dominated by a privileged, male-oriented perspective. As a result, utilitarianism may not be well-suited for gender-focused technologies, as it overlooks complex realities and may justify harm to minorities.

4.2. Deontology: Challenges of Inflexibility

Deontological ethics, rooted in Immanuel Kant's philosophy, emphasizes duties, rules, and obligations, focusing on the inherent morality of actions rather than their consequences. Contemporary deontological ethics has evolved to address criticisms of rigidity by incorporating pluralistic views, such as Ross's (2002) advocacy for multiple prima facie duties to address moral dilemmas on a case-by-case basis. These adaptations create a more adaptable framework, addressing complex moral issues (Scanlon, 2000), and helping to maintain deontological ethics' influence in fields like law, and public policy, where clear-cut duties and obligations are crucial for ethical decision-making.

In the tech sector, deontological principles are used in codes of conduct and regulatory frameworks. These principles stress ethical duties and rights, such as the obligation regarding user privacy and data security (Floridi & Taddeo, 2016) and ethical guidelines for AI development by focusing on the obligations of tech companies to respect user rights and follow specific rules. Proponents argue that the benefits of deontology in technology include providing clear and consistent ethical guidelines, which are invaluable in a rapidly evolving field, as its focus on a clear set of moral actions can limit discretionary power and encourage adherence to ethical standards, even when it is easier or more profitable to ignore them (Brey, 2012).

However, this approach has proven to be limited. Despite attempts to make deontology more adaptable, its inherent rigidity makes it difficult to navigate situations where duties conflict, and the inflexibility of its rules prevent needed adaptation (Alexander & Moore, 2016). This lack of contextual sensitivity can be problematic in the development of gender-focused technologies. Applying a standardized set of duties without considering the diverse and evolving needs of others can exacerbate existing gender disparities (Crosby & VanDeVeer 2000). Additionally, deontological frameworks often lack mechanisms for incorporating feedback from their users, a crucial feature for improving gender-focused technologies.

4.3. Virtue Ethics: Universal Values and Individualism

Virtue ethics, a branch of ethical theory focusing on the cultivation of virtues and character traits defining the kind of person one should aim to be, rather than prescribing specific actions or consequences (Hursthouse, 1999), has seen a striking revival in the last couple of decades after being academically ignored for over a century (Annas, 2003). This revival is evident in the tech sector, where scholars such as Shannon Vallor (2016) have championed its application. Vallor's framework, for instance, proposes a universal set of virtues identified from Aristotelian, Confucian, and Buddhist philosophy, assuming these virtues as applicable across diverse cultural and historical contexts. This assumption, common in virtue ethics systems (Swanton, 2003), is criticized for its arbitrariness and lack of philosophical and anthropological justification (Slote, 1993), which could lead to ethical systems that fail to resonate with or misinterpret the needs and values of diverse groups thereby perpetuating systems of oppression. For example, applying a standardized set of virtues predominantly derived from male-centric perspectives and historically used to justify gender and racial oppression, without considering cultural specificities and power imbalances, can result in technologies that fail to address these differences.

Scholars also argue that virtue ethics is too vague, lacking clear definitions and criteria for selecting virtues, often relying on a questionable notion of human nature (Annas, 2003). This ambiguity undermines its practical application, leaving room for subjective interpretation and inconsistency. Furthermore, virtue ethics' focus on individual moral growth rather than social interaction and context contrasts sharply with contemporary ethical theories and human development studies, which emphasize the importance of communal learning and social environments in shaping moral character (MacIntyre, 2007). While virtue ethicists often highlight traits like empathy and civility to counter

critiques of individualism, these virtues should not be viewed as individual traits developed in a self-sufficient manner. Instead, they should be cultivated within a social framework. This social embeddedness is crucial for ensuring that virtues are relevant and resonant with diverse cultural contexts and for addressing systemic issues, especially since, as Slote (1993, p. 5) has noted, virtue ethics historically "has a proven record of siding with anti-democratic social/political ideals," and other manifestations of conservatism.

5. Care Ethics: Relational Morality

Integrating care ethics offers a more inclusive and effective approach by prioritizing interdependence and social connectivity. This ethical framework requires a nuanced understanding of sociopolitical factors and power disparities, ensuring technologies are designed not only to avoid harm but to resonate with and empower users. This section explores care ethics, starting with its foundational principles and how it diverges from traditional ethical frameworks. We then examine predominant criticisms, arguing that many arise from misinterpretations and that a broader perspective reveals these critiques as opportunities. Finally, we discuss the implementation of care ethics in technology design, providing detailed insights and examples of its practical benefits and potential to foster more inclusive and equitable technologies.

5.1. What is Care Ethics?

Care ethics can be broadly conceptualized as an ethical framework rooted in the feminist philosophical tradition that emphasizes the importance of relational and contextual morality (Gilligan, 1993). Instead of focusing on universal principles or the greatest good for the greatest number, care ethics centers on human relationships and the moral significance of caring, highlighting the imperative to respond to the needs of specific individuals within their social and unique contexts (Tronto, 1993; Noddings, 1984). It challenges the individualism inherent in traditional models by promoting a relational and context-dependent morality. It rejects abstract perspectives of ethics or virtues detached from society, acknowledging power imbalances and how it can shape values and rules, and the vulnerability in human life (Engster, 2019).

Care ethics demands a transdisciplinary approach, socially and culturally rooted (Held, 2006). Its broader implications extend beyond individual relationships, serving as a foundation for addressing political and social justice concerns (Tronto, 1993). This framework involves caring relationships and understanding those relationships within broader social structures, providing a critical lens for examining social inequalities. By emphasizing relationality and the moral significance of care, it offers a deeply attuned understanding of moral responsibility, recognizing individual and community experiences while avoiding homogenizing outcomes.

Initially developed from a gender perspective, care ethics have been adopted universally across several fields such as education, social work, environmental and animal ethics, nanotechnology, healthcare, and others. In education, Nel Noddings (1984) emphasizes the role of care in teaching and educational practices. In healthcare, care ethics informs patient-centered care approaches, emphasizing the importance of empathy on the patient-provider relationship (Engster, 2007). Furthermore, Vanessa Nurock (2021) discusses how care ethics can guide the responsible development of nanotechnologies by promoting relational and empathetic approaches. Tronto (1993) also argues that care ethics extends to political and environmental relationships, promoting an ethic of care that includes the well-being of the planet and future generations.

5.2. Addressing Criticism and Exploring Potentials

Recognizing and addressing the criticisms of care ethics is crucial for refining its application in technology design. These criticisms often overlooked in technological discussions, offer valuable insights for strengthening the ethical framework behind technology development. By tackling these issues, we can enhance the robustness and effectiveness of care ethics, leading to more inclusive and responsive technologies.

5.2.1. Traditional Roles, Private Sphere Constraints, and Emotional Toll. A pungent criticism of care ethics comes from Sandra Lee Bartky (1990), who argues that care ethics can reinforce traditional gender stereotypes and roles. Tronto (1993) amplifies this critique, emphasizing that the role of care should not be seen as something natural or instinctive to women but as a critical moral framework of all humans. Historically confined to women by patriarchal societies, the association of care exclusively with women reinforces existing power structures, isolating women from decision-making roles and limiting care's applicability to broader moral and political debates. Tronto (1993) encourages for including care ethics within public and political spheres, rather than confining it to private, domestic roles. By framing care as a political ideal, she argues that it encompasses qualities necessary for democratic citizenship, such as attentiveness, responsibility, competence, and responsiveness. Thus, care becomes a tool for analysis, revealing relationships of power and privilege while offering a strategy for

empowerment. This perspective shifts the debate from an individualistic perspective to a communal, highlighting existing inequities and providing a basis for change. It allows for a more inclusive and democratic approach, incorporating women and other traditionally excluded groups as actors.

Bartky (1990) emphasizes that although valuing emotional labor aims to elevate women's status, it can sometimes overlook the potential harm women may endure through this labor. She criticizes feminist theorists who celebrate female nurturance without critically analyzing the pitfalls of caregiving itself. This critique is supported by empirical evidence in tech design case studies, which highlight the challenges of engaging with others through care when designing technology. For instance, Spiel et al. (2018) discusses the complexities of applying care ethics in participatory design, particularly the challenge of balancing professional and personal conduct in the context of vulnerable researchers and marginalized communities. They describe the discomfort that arises from navigating ethical boundaries, the risks of over-planning, and the need for adaptability and safety measures. The study also notes that decisions, such as overriding initial refusals based on perceived benefits, can unintentionally cause harm. Spiel et al. (2018) underscores the importance of balancing partnership and care, asserting authority when necessary, and maintaining transparency, all while being mindful of the influence of researchers' gender expressions.

I propose that Bartky's (1990) critiques should be understood not merely as a potential issue, as dealt with in case studies, but as inherent aspects of care ethics that should be accounted for and that can be leveraged for positive change. By recognizing the universality of care ethics while acknowledging its potential moral and emotional toll associated with its application, any ethical framework that uses care ethics must expand to include mechanisms for supporting every individual not just the focus group. This perspective transforms the critique into an opportunity to develop care further, integrating safeguards and support systems that mitigate what were unpredictable challenges involving any tech design, making them even more inclusive and effective.

5.2.2. Dependency and Power Imbalances. Another significant concern with care ethics is its association with dependency, which critics argue can perpetuate power imbalances and reinforce notions of vulnerable dependence. Peter Allmark (1995) contends that care ethics' focus on the carer's intentions can lead to subjective caring that may not prevent harm, potentially resulting in paternalistic and controlling behavior. Helga Kuhse (1997) adds that good intentions in care can overshadow the autonomy and preferences of the cared-for, creating an imbalance where the caregiver's perspective becomes oppressive. This inherent power differential in care underscores that ethical care requires more than good intentions; it must also consider the outcomes and ensure that it supports the autonomy and empowerment of the cared-for individuals.

Kittay (2011) offers a nuanced perspective that reinterprets these criticisms. She argues that dependency is a natural part of human life and not inherently negative. Recognizing dependency as a shared human condition can promote empathy and the development of supportive social structures. Kittay (2011) emphasizes that dependency is shaped by broader economic, political, and social forces, and understanding these factors is crucial for addressing power imbalances in caregiving relationships. By valuing care labor and recognizing its essential role, care ethics can challenge oppressive attitudes and reduce the stigma of dependency—an overwhelming feeling in an individualistic and competitive society. This promotes a more inclusive and compassionate society.

Reframing dependency as a fundamental aspect of human existence rather than a limitation, advocates for a reevaluation of societal norms that prioritize independence. Care should be viewed as a valuable resource for a fulfilling life, impacting communities, public policy, resource gaps and tech development. This perspective shifts the user-tech relationship towards a more collaborative and reciprocal model rather than one that is individualistic or exploitative.

5.2.3. Is care too abstract and broad concept? A practical approach. Care ethics is sometimes criticized for vagueness and a lack of robust theoretical foundation. Critics argue that care ethics is associated with values from virtue ethics, like attentiveness and responsibility, without providing a solid framework for substantial moral judgments. This misinterpretation overlooks the relational nature of care ethics, which involves multiple agents in practice rather than individuals striving to perfect their moral capacities (Leget et al., 2019). Such reductionism risks turning care ethics into a subsection of value propositions arbitrarily applied across contexts. This ambiguity often leads to misunderstandings, confining care ethics to sectors like healthcare and nursing ethics, ignoring its broader applicability.

To address these critiques, it is essential to expand our theoretical understanding within political and institutional contexts. Care ethics inherently involves analyzing conflicts such as differing needs, the balance between self-care and care for others, and power inequalities. It is both culturally specific and universal, reflecting varied constructions of adequate care. Therefore, it should be viewed not merely as an

individualistic or dyadic relationship but as a social and political practice. Without comprehensive training, there is a risk that care ethics will be inconsistently or superficially applied, undermining its potential benefits. To mitigate these challenges, it is crucial to develop adaptive ethical guidelines, invest in thorough training programs, and encourage collaborative design processes involving diverse stakeholders. This approach ensures that the relational and contextual nuances of care ethics are effectively integrated into technology design.

Despite being central to human life, care is ideologically marginalized, challenging societal power structures and necessitating a rethinking of moral and political life. Leget et al. (2019) suggest reframing care ethics to better capture its interdisciplinary nature and societal relevance. Viewing care ethics through the lens of "moral ecology" implies that moral practices are formed by normative expectations, negotiated responsibilities, and the lived realities of those involved in caring relationships. This perspective shifts the focus from abstract theorizing to understanding morality via actual practices, relationships, and contexts. Walker's (2007) assertion that "morality itself consists of practices, not theories" reinforces this view, emphasizing that ethical thinking and actions should be grounded in real-world experiences.

5.3. Real-World Tech Application Challenges

This non-individualistic, socially and politically aware characteristic is one of care's most attacked and misunderstood aspects since it clashes with an ethos that privileges individualism and competition without recognizing its systematic injustices and unlevelled playing field. However, be it for ideological or restrictive theoretical interpretations, our analysis of case studies in the corpus reveals practical issues when adopting care ethics in technology design.

The following subsections offer an examination of the real-world challenges in applying care ethics to technology design, based on our analysis of 40 case studies from the 308 papers reviewed. These case studies cover sectors such as healthcare (30%), education (25%), nanotechnology (15%), AI and virtual reality (20%), and mobile health and assistive technologies (10%). The target groups included healthcare professionals (17.5%), technology designers and developers (30%), academics and researchers (20%), vulnerable and marginalized communities (22.5%), and specific user groups, including gig workers, elderly individuals, and disabled users (10%).

Grounded in specific findings, the discussions reflect the diverse theoretical frameworks that inform these studies, including feminist technoscience (25%), human-computer interaction (HCI) (40%), and science and technology studies (STS) (35%). These frameworks emphasize relationality, care, and the sociotechnical dynamics of power and gender.

In 68% of these studies, participatory design coupled with care ethics led to improvements in user satisfaction, technology adoption, and overall effectiveness. The remaining 32% conceded potential benefits but cited challenges in implementation due to institutional frameworks, resistance to change, and difficulty engaging with target groups.

Despite these positive outcomes, practical limitations emerged, highlighting the complexity of integrating care into technology design. These challenges can be grouped into three major categories: design issues (25%), contextual and social issues (35%), and ethical and practical challenges (40%).

5.3.1. Design Issues. One of the primary challenges in integrating care ethics into technology design is its inherent departure from the prevalent top-down approaches commonly used in the tech sector. These top-down approaches are characterized by centralized decision-making, often with minimal gender diversity and limited user involvement. While these methods are cost-effective and efficient, they frequently fail to capture the lived experiences and specific needs of diverse user groups, resulting in technologies that are less inclusive and less effective in the long term (Grates et al., 2019). Research indicates that these technologies typically have a short shelf-life due to the lack of user participation and appropriation, as users are aware of problems with existing technology. Conversely, participatory design approaches, especially when coupled with care ethics, actively involve users in the design process, ensuring that their voices and experiences shape the technology design. When technology is developed through this method, users overwhelmingly associate their experience with feelings of empowerment (Wilkinson & De Angeli, 2014).

Another significant issue is the reliance on lead users. For instance, Wilkinson & De Angeli (2014) showed how using care ethics could introduce lead user bias. The reliance on a specific group of users can skew results and fail to represent the broader user base, especially those with differing abilities or experiences. Similarly, studies using non-representative samples, such as university students, can limit the applicability and transferability of findings (Abu-Shanab & Al-Jamal, 2015). This challenge surfaces the issue of scalability, as personal and context-specific ethics are usually difficult to scale, causing implementation issues for large-scale technologies for diverse populations.

Finally, Mendez et al. (2017) highlight that while this approach enhances transparency, understanding, and trust, it also increases complexity and clutter for

both developers and users. This added complexity makes the task more laborious, as it requires manipulating individual data values which can potentially discourage exploration and iteration.

5.3.2. Contextual and Social Issues. Engaging with vulnerable communities requires a deep understanding of their specific needs and contexts, which care ethics advocates for through its focus on empathy and relational morality. However, the practical challenges of maintaining long-term engagement and balancing workloads, as highlighted in Braybrooke et al. (2021), demonstrate that while care ethics provides a valuable framework, it requires significant resources and commitment to implement effectively. This underscores the need for adaptable frameworks that can be customized to fit different cultural contexts without losing the core principles of care ethics.

The effectiveness of ethical frameworks can vary widely due to cultural differences and local practices. Sambasivan et al. (2017) emphasize the challenges posed by regional cultural variances in their study on gender equity in technologies for the Global South. As Botez (2000) points out when considering implementing care in the health sector, what works in one cultural context may not be suitable for another, necessitating adaptable frameworks that consider these differences.

As mentioned as a theoretical issue of care, the emotional and psychological impacts on both researchers and participants are another significant concern. For example, Cochrane et al. (2022) noted that conducting first-person research requires the researcher to engage in emotionally triggering activities, potentially leading to distress if not managed carefully. This is particularly relevant in the development of technologies that must be initially tested by clients and users. While the first-person design researcher approach ensures methods are first assessed using the researchers' own bodies and emotional experiences, it raises questions about how much emotional labor can be ethically asked from participants. Additionally, the study highlighted how participants felt uncomfortable using the technology in public, underscoring the social consequences of publicly utilizing certain technology. This highlights another ethical concern: the reluctance and stigma participants face when using assistive technology even if developed under a care framework.

5.3.3. Ethical and practical challenges. The implementation of care ethics in tech design often encounters ethical dilemmas that cannot be fully addressed by broader ethical frameworks. The need for in-situ ethical judgments highlights the limitations of applying care ethics without an adaptable guideline that can address micro-ethical issues (Spiel et al., 2018).

Moreover, the practicalities of ensuring transparency and balancing commercial interests with ethical considerations suggest that while care ethics offers a valuable perspective, it must be complemented by other ethical frameworks to navigate tech design.

Privacy and commercial sensitivities also play a crucial role. Studies often face restrictions due to commercial interests, limiting the sharing of detailed experimental findings and affecting research transparency. However, these studies consistently highlighted the transformative potential of participatory design, particularly when grounded in care ethics, to create functional and meaningful technology. Mendez et al. (2017) point out that while this approach enhances transparency and trust, it increases complexity, making the development and user interaction more laborious.

Addressing power dynamics within participatory design processes is critical. Ensuring true equity in participation and avoiding the replication of harmful hierarchies requires sensitive facilitation. Light & Akama (2014) discuss the difficulties in organizing and maintaining community engagement while balancing designer influence and participant autonomy in a distributed and heterogeneous socio-technical context. They recommend focusing on enabling participants to envision and enact their desired social structures, rather than prescribing specific outcomes.

6. Final Considerations

This paper examined the integration of care ethics within the design of gender-focused technologies through a comprehensive literature and case studies review, highlighting both the potential and the challenges of this approach. Our analysis underscored the significant benefits of participatory design grounded in care ethics, including enhanced user satisfaction, sense of empowerment, and increased technology adoption rates. These positive outcomes show that incorporating care ethics into technology design can lead to more inclusive and responsive solutions that resonate with users' experiences and cultural contexts.

However, the implementation of care ethics in technology design is not without its challenges. Our global context analysis illustrated how socio-political factors significantly impact the development and acceptance of gender-focused technologies. The technological sector is deeply intertwined with broader societal dynamics, where resistance to gender-focused initiatives and the underrepresentation of women in the academy and tech leadership roles perpetuate existing disparities, serving as a symptom of this broader framework. Additionally, despite being central to human life, care ethics is ideologically marginalized, challenging societal power structures and necessitating

a rethinking of moral and political life. Our review also identified several practical and ethical limitations related to care ethics. These challenges necessitate ongoing reflection, adaptability, and sensitivity to diverse contexts to create technologies that are both inclusive and effective. It becomes worrisome how alternative ethical frameworks have consistently declined in publications since the pandemic.

By reinterpreting theoretical criticisms, we propose viewing them as opportunities for better understanding care ethics' potential. For instance, the critique regarding the vagueness of care ethics can be seen as a call for more robust frameworks that integrate relational and contextual nuances. The issue of dependency can be reframed to emphasize recognizing interdependence and developing supportive structures. These perspectives highlight care ethics as a transformative framework for tech design and socio-political transformation. An interdisciplinary approach is essential for developing adaptive ethical guidelines, training programs, and design processes that integrate care ethics into technological development.

Despite these limitations, the transformative potential of participatory design and care ethics remains evident. By addressing the practical challenges and ethical considerations identified in our review, designers can create technologies that not only function effectively, but also empower and include marginalized groups. This approach is crucial in a global context where gender-focused initiatives face increasing resistance and where technology's role in shaping social dynamics is more significant than ever. Care ethics has the potential to drive the development of technologies that promote empowerment and justice, especially in an age where technology including AI poses risks related to transparency, data usage and potential biases.

Future research should focus on developing adaptive ethical guidelines, comprehensive training programs, and collaborative design processes to mitigate the identified challenges. Additionally, empirical studies that explore the long-term impacts of care ethics in technology design are essential to further refine and validate this approach. By embracing the relational and contextual nuances of care ethics, the technology sector can move towards creating more equitable and just solutions that address the needs of all.

7. References

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