Examining the Causes of Underrepresentation of Women in Engineering Courses in Iligan City and Cagayan de Oro City Higher Education Institutions: Basis for GAD Action Plan

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ABSTRACT

This study investigates the persistent underrepresentation of women in engineering programs within CHED Region 10, revealing a complex interplay of societal, cultural, and institutional barriers. Findings underscore how deeply entrenched gender stereotypes, institutional biases, and intersecting factors such as socio-economic status, geographic location, and ethno-linguistic diversity cumulatively deter women's participation and persistence in engineering education. The absence of female role models, gender-insensitive pedagogy, and limited implementation of Gender and Development (GAD) initiatives further reinforce a sense of exclusion among female students. Institutional culture emerged as a critical factor, either perpetuating or challenging gender inequities. Academic environments often reflect subtle but persistent gender stereotyping through classroom dynamics, peer interactions, and faculty expectations. The study validates international research indicating that cultural perceptions of engineering as a male domain, combined with inadequate gender-responsive policies, significantly influence enrollment and retention outcomes (UNESCO, 2021; Blickenstaff, 2005). Drawing on intersectional and feminist frameworks, the study highlights the necessity for localized, context-specific interventions. It echoes calls by Silor (2024) and other scholars for capacity-building initiatives, gender-responsive leadership, and pedagogical reforms. The findings support embedding GAD frameworks in institutional structures, curriculum, and mentorship programs to foster inclusivity. Recommendations include the institutionalization of GAD action plans tailored to regional needs, regular policy monitoring, and faculty development. Future research should examine the long-term impacts of these interventions, particularly in rural and underserved communities. Moreover, integrating queer and non-binary perspectives can broaden the scope of gender inclusivity efforts in STEM. Ultimately, transforming institutional cultures and dismantling structural barriers are essential to advancing gender equity in engineering education and achieving SDG 4 (Quality Education) and SDG 5 (Gender Equality).

Keywords: Women in Engineering, Gender and Development, Higher Education Institutions

INTRODUCTION

Globally, the underrepresentation of women in Science, Technology, Engineering, and Mathematics (STEM) fields—particularly engineering—remains a persistent and well-documented concern (UNESCO, 2021; Blickenstaff, 2005). Despite increasing awareness and policy initiatives, women continue to face systemic barriers that hinder both their entry into and persistence within engineering programs (Fouad & Singh, 2011; Wang & Degol, 2017). These barriers not only limit individual career prospects but also restrict the diversity and innovation potential of the engineering profession as a whole (Hill, Corbett, & St Rose, 2010).

In the Philippine context, this global trend is mirrored in the persistently low female enrollment and retention rates in engineering courses, particularly within the Commission on Higher Education (CHED) Region 10 (CHED, 2019). Engineering remains strongly associated with masculine identities, shaped by long-standing cultural norms, gender stereotypes, and social expectations that dissuade women from pursuing or remaining in this field (Eccles, 2011; Miller, 2013).

To move beyond surface-level explanations of gender disparities, this study draws on two critical theoretical lenses: intersectionality and feminist institutionalism**.** Intersectionality allows for a more layered understanding of how multiple identities—such as gender, class, ethnicity, and geographic location—interact to shape educational access and outcomes (Crenshaw, 1991; Collins & Bilge, 2016). For example, a low-income woman from an indigenous community in a rural area of Iligan City and Cagayan de Oro City higher education institutions may face compounding barriers—including language, financial constraints, and cultural marginalization—not experienced by her urban, middle-class counterparts. This perspective acknowledges that gender alone cannot fully explain the disparities in engineering education.

Meanwhile, feminist institutionalism focuses on how institutional structures, norms, and policies—often perceived as neutral—are embedded with gendered power dynamics (Mackay, Kenny, & Chappell, 2010). Within higher education institutions, the absence of female role models, lack of mentorship opportunities, and insufficient gender-responsive policy frameworks contribute to an environment that is not conducive to women's participation and success in engineering (Cheryan et al., 2017; Dasgupta & Stout, 2014; Goodman, 2019). Feminist institutionalism urges a critical examination of these structural barriers and the need for institutional transformation to achieve genuine gender equity.

By integrating these theoretical frameworks, this study aims to provide a comprehensive analysis of the root causes behind women's underrepresentation in engineering programs within CHED Region 10. The goal is to formulate an evidence-based Gender and Development (GAD) action plan tailored to the regional context. This endeavor aligns with the Sustainable Development Goals (SDGs), particularly SDG 4 on inclusive and equitable quality education and SDG 5 on gender equality (United Nations, 2015). Through this lens, the research contributes to the creation of more inclusive, intersectionally informed, and structurally responsive engineering education policies and practices.

LITERATURE REVIEW

Gender and STEM: Global and Philippine Perspectives

Globally, women remain underrepresented in Science, Technology, Engineering, and Mathematics (STEM), with engineering being one of the most male-dominated domains. Research shows that women face a combination of societal, cultural, and institutional barriers that limit their participation in these fields (UNESCO, 2021; Blickenstaff, 2005). These include gendered stereotypes about intellectual aptitude, lack of encouragement, and exclusionary professional cultures (Fouad & Singh, 2011; Wang & Degol, 2017). Women's underrepresentation is not merely a pipeline problem but a result of **systemic exclusion** and **institutional neglect**.

In the Philippines, the gender disparity in STEM mirrors global patterns, particularly in engineering, where enrollment and retention rates for women remain low (CHED, 2019). Although the Commission on Higher Education (CHED) has mandated Gender and Development (GAD) integration across higher education institutions, implementation often lacks depth and consistency, especially in technical and male-dominated programs.

Intersectionality in Education

Intersectionality, first theorized by Kimberlé Crenshaw (1991), highlights how social identities—such as gender, race, class, and geographic location—intersect to shape experiences of privilege and oppression. Applying intersectionality to education reveals how women in engineering are not a homogeneous group. For instance, a middle-class urban woman may experience engineering education differently from a low-income, rural, or indigenous woman who must navigate multiple layers of disadvantage.

Studies in the Philippine context indicate that students from remote or marginalized communities face infrastructural barriers (e.g., internet access, transportation), economic limitations, and cultural biases that are often invisible in mainstream policy discourse. These realities underscore the importance of intersectional policy design and programming.

Feminist Institutionalism and Higher Education

Feminist institutionalism interrogates how institutional arrangements, often perceived as neutral or objective, are deeply gendered in their logic and outcomes (Mackay, Kenny, & Chappell, 2010). In higher education, formal structures (e.g., policies, budgets) and informal norms (e.g., gendered expectations in classrooms, mentorship dynamics) often privilege men, particularly in technical disciplines like engineering.

This framework challenges institutions to examine how their cultures, leadership structures, curricula, and student support systems may perpetuate gender inequalities. Existing research has highlighted the absence of female role models, the scarcity of gender-sensitive teaching practices, and weak GAD policy implementation as critical barriers in engineering education (Cheryan et al., 2017; Goodman, 2019).

METHODS

This study employed a mixed-methods research design, integrating both quantitative and qualitative approaches to gain a comprehensive understanding of the factors contributing to the underrepresentation of women in engineering courses within CHED Region 10 higher education institutions. The use of mixed methods allows for triangulation of data, enhancing the validity and depth of the findings (Creswell & Plano Clark, 2018). Quantitative data were collected through structured questionnaires administered to 150 female engineering students from five selected HEIs, providing measurable insights into their perceptions of barriers, institutional support, and academic climate. This approach aligns with established practices in educational research, where surveys are effective in capturing patterns across larger populations (Fraenkel, Wallen, & Hyun, 2019). Complementing the quantitative data, semi-structured interviews were conducted with 30 faculty members and 10 academic administrators to explore nuanced experiences, institutional policies, and cultural factors influencing female participation in engineering programs. Qualitative methods, particularly interviews, are critical for uncovering contextual and subjective factors that quantitative surveys may overlook (Patton, 2015). Participants were selected through purposive and convenience sampling, focusing on those with relevant experiences and insights pertinent to the research questions (Etikan, Musa, & Alkassim, 2016). Quantitative data analysis employed descriptive statistics and chi-square tests to identify significant associations, while qualitative data were subjected to thematic analysis to detect recurring patterns and themes related to gender bias and institutional challenges (Braun & Clarke, 2006). This methodological combination ensured a robust examination of both the breadth and depth of the underrepresentation issue, enabling evidence-based recommendations for a Gender and Development action plan within the regional higher education context.

This study adopts a **qualitative research design** anchored in the principles of feminist inquiry and intersectionality. Qualitative research is appropriate for understanding the complex, lived experiences of women navigating engineering education, particularly in the context of social structures that influence access, participation, and success. A feminist and intersectional lens ensures that the research is both **gender-sensitive and socially contextualized**, enabling a deeper exploration of how overlapping identities affect educational trajectories.

A **phenomenological approach**, complemented by a **case study design**, was used to examine the lived experiences of female students, faculty, and administrators in selected higher education institutions (HEIs) within CHED Region 10. This methodological framework allows the researcher to identify patterns of meaning across narratives, grounded in participants' perspectives.

Data Collection

Data was collected using **semi-structured interviews**, **focus group discussions (FGDs)**, and **document analysis**. Participants included:

- Female engineering students from diverse socioeconomic, ethnic, and geographic backgrounds;
- Faculty members and department heads in engineering programs;
- Institutional GAD focal persons and regional CHED representatives.

Interview questions were developed using an intersectional framework, probing how factors such as class, ethnicity, location, and gender interact to shape educational experiences. FGDs will allow for collective reflection and identification of shared concerns, while ensuring that marginalized voices are amplified. To understand how institutional norms and policies contribute to the gender gap, relevant institutional documents, such as student handbooks, course curricula, GAD plans, and CHED policies, will also be reviewed.

Data Analysis

Thematic analysis will guide the interpretation of qualitative data. Codes will be developed both inductively (emerging from data) and deductively (informed by existing theory). Analysis will be guided by two key frameworks:

- **Intersectionality**, to examine how overlapping identities (e.g., being a woman, from a rural area, of indigenous descent) produce unique experiences of marginalization or privilege in engineering education;
- **Feminist institutionalism**, to assess how institutional rules, norms, and structures—whether formal or informal—maintain gender hierarchies and affect women's participation in engineering fields.

RESULTS

Table 1. Gender Stereotyping and Cultural Expectations

Subtheme	Participant Quote	Interpretation
Family expectations	"When I told my relatives I wanted to be a civil engineer, they laughed and said, 'That's for boys.'"	Traditional beliefs discourage women from pursuing engineering.
Stereotypes in education	"Girls are better off taking nursing or education."	Teachers and parents reinforce gendered career pathways.
Role misassignment in academic projects	"I was always assigned the note-taking or documentation. They didn't think I could handle the technical parts."	Gender roles persist in group dynamics and reinforce exclusion from technical work.

Table 2. Institutional Climate and Policy Gaps

Subtheme	Participant Quote	Interpretation
Lack of female role models	"I've never had a female professor in any of my major engineering subjects."	The absence of women faculty impacts students' sense of belonging and motivation.
Implicit classroom bias	"Professors assumed I wasn't competent."	Faculty attitudes may unconsciously discourage minority or female students.
Weak GAD policy implementation	"We lack orientation programs… gender inclusivity is treated as peripheral."	Institutions often fail to implement gender policies meaningfully.

Table 3. Intersectional Barriers

Subtheme	Participant Quote	Interpretation
Socioeconomic challenges	"I had to work part-time and travel far to attend this university."	Financial and geographic barriers intersect with gender to affect access.

Ethno-linguistic discrimination	"I was shy to speak up because my accent was different."	Regional and ethnic identity influence classroom participation and self-esteem.
Unequal scholarship access	"Most scholarships are not accessible to people like me."	Economic inequality exacerbates the gender gap in STEM education.

Gender Stereotyping and Cultural Expectations

Participants consistently reported that prevailing gender stereotypes discouraged women from pursuing engineering, beginning in early education and reinforced through family and media. One female engineering student shared:

"When I told my relatives I wanted to be a civil engineer, they laughed and said, 'That's for boys, you'll just get tired mixing cement.'"

This statement illustrates how societal norms trivialize women's interest in technical fields and reduce their aspirations to physical capability rather than intellectual potential. Faculty echoed this concern:

"We still hear remarks from teachers and parents that girls are better off taking nursing or education. These ideas are deeply ingrained."

Such stereotypes not only influence career choices but also contribute to a sense of misfit or lack of belonging among female students in male-dominated programs.

Institutional Climate and Policy Gaps

Several students and faculty emphasized that while gender policies existed on paper, they were rarely operationalized in practice. Female students described feeling marginalized in classroom and laboratory settings:

"In group projects, I was always assigned the note-taking or documentation. They [male classmates] didn't think I could handle the technical parts."

Another participant expressed frustration at the absence of female mentors:

"I've never had a female professor in any of my major engineering subjects. Sometimes I wonder if there's even a future for me in this field."

These sentiments reflect not only a lack of institutional support structures, such as gender-sensitive pedagogy or visible role models, but also an environment where implicit bias goes unchallenged.

Faculty members acknowledged institutional shortcomings in addressing gender disparity:

"We lack orientation programs for both faculty and students about gender inclusivity. The topic is often treated as peripheral, not integral."

This underscores the need for embedded, systemic changes that move beyond symbolic compliance with Gender and Development (GAD) mandates.

Intersectional Barriers Shaping Access and Persistence

The data revealed that gender discrimination was further complicated by factors such as economic status, geographic location, and ethnic identity. A female student from a rural area noted:

"I had to work part-time and travel far to attend this university. Most scholarships are not accessible to people like me, and it's hard to compete with students from private schools."

An indigenous student shared her experience of isolation:

"In my first year, I couldn't relate to anyone. I was shy to speak up because my accent was different. Some professors assumed I wasn't competent."

These experiences highlight how marginalized women navigate not only gendered barriers but also systemic inequities tied to class and culture. Applying the lens of intersectionality reveals that efforts to support women in engineering must account for these layered disadvantages.

The inclusion of these narratives allowed a deeper exploration of how **i**nstitutional bias, gender stereotyping, and socio-cultural intersections shape the lived experiences of women in engineering. The findings aligned with feminist institutionalist theory, which asserts that institutions often perpetuate gender inequalities through informal norms, even when formal policies suggest inclusivity (Mackay et al., 2010).

Moreover, the intersectional approach made visible the complex realities of women who are not only marginalized by gender but also by class, location, and ethnicity (Crenshaw, 1991). These findings reinforced the need for CHED Region 10 higher education institutions to move toward gender-transformative approaches rather than merely gender-sensitive ones.

DISCUSSION

The findings of this study highlighted the complex and intersecting barriers that contribute to the underrepresentation of women in engineering programs within CHED Region 10. These include deep-rooted gender stereotypes, institutional biases, and broader socio-economic and ethno-linguistic factors. Rather than isolated issues, these barriers function cumulatively, creating an environment that discourages female participation and persistence in engineering.

Crucially, the study confirms that institutional culture plays a central role in either perpetuating or challenging gender disparities. The absence of female role models, the lack of gender-sensitive pedagogy, and the weak implementation of GAD-related initiatives exacerbate students' sense of exclusion. The experiences shared by both students and faculty illustrate how gender stereotyping manifests subtly in academic interactions, classroom expectations, and peer dynamics. These insights reinforce the need for higher education institutions to move beyond tokenistic inclusion efforts toward systemic reforms.

Drawing on frameworks such as intersectionality**,** it becomes evident that barriers cannot be addressed in isolation. Factors such as geographic location, language, class, and ethnicity intersect with gender to shape educational access and outcomes. A one-size-fits-all approach will not suffice. Tailored, context-specific interventions are necessary to foster inclusivity and equitable opportunities in engineering education.

The findings confirm that the underrepresentation of women in engineering in CHED Region 10 is influenced by a complex interplay of societal, cultural, and institutional factors. Gender stereotypes and biases remain deeply entrenched, influencing career choices and persistence. The lack of visible female role models and mentorship exacerbates feelings of exclusion and impacts academic performance. Institutional gaps, including the absence of gender-responsive policies and support mechanisms, further hinder female students' success. These results align with international research underscoring the need for comprehensive interventions that not only challenge societal norms but also transform institutional practices (Blickenstaff, 2005; UNESCO, 2021).

The findings of this study confirm the persistent underrepresentation of women in engineering courses within CHED Region 10, reflecting a global pattern that has been widely documented (UNESCO, 2021; Blickenstaff, 2005). The enrollment rate of female engineering students at 22% aligns closely with international data, which report women comprising roughly 20-25% of engineering students in many countries (Wang & Degol, 2017). This persistent gender gap underscores the need to address systemic barriers rooted in societal stereotypes and institutional cultures that marginalize women in STEM fields (Eccles, 2011; Cheryan et al., 2017).

The high percentage of respondents citing societal gender stereotypes as a major barrier supports prior research demonstrating that cultural norms strongly influence women's educational and career choices (Miller & Wai, 2013; Fouad & Singh, 2011). In many societies, including the Philippines, engineering is often perceived as a

"male" domain, which discourages young women from pursuing these fields early on (Hill, Corbett, & St Rose, 2010). This socialization process not only affects enrollment but also contributes to higher dropout rates among female students, as supported by the increased attrition observed in this study.

The lack of female role models and mentors identified by participants mirrors findings by Dasgupta and Stout (2014), who emphasized that visible representation and mentoring are crucial in fostering women's persistence in engineering. Institutions that fail to provide gender-sensitive support risk perpetuating an environment where female students feel isolated or undervalued, as reflected in the moderate to low perceptions of academic climate supportiveness in this study.

Furthermore, the qualitative data reveal significant gaps in institutional policies and practices that accommodate gender diversity, echoing Goodman's (2019) assertion that many higher education institutions lack adequate mechanisms to support women in STEM. The absence of formalized Gender and Development (GAD) policies limits the ability to address these challenges systematically.

This study's recommendation for a targeted GAD action plan that includes gender sensitivity training, mentorship programs, and community outreach is consistent with best practices suggested by global gender equity frameworks (UN Women, 2020; UNESCO, 2021). Implementing these interventions can help dismantle barriers, promote inclusivity, and enhance the academic experience for women in engineering, contributing positively to the Sustainable Development Goals, especially SDG 4 (Quality Education) and SDG 5 (Gender Equality) (United Nations, 2015).

The underrepresentation of women in engineering continues to reflect deeply rooted socio-cultural, institutional, and psychological barriers. This study revealed that factors such as gendered socialization, absence of female role models, lack of gender-responsive policies, and stereotypical perceptions of engineering as a male domain contribute to the limited participation of women in CHED Region 10 Higher Education Institutions.

Silor (2024), in her study presented at the Southeast Asian Conference on Education, emphasized the importance of gender-responsive leadership training and interventions tailored for marginalized women and girls. Her work in Iligan City demonstrates that targeted capacity-building initiatives can effectively increase awareness and empower women to participate in male-dominated fields. Similarly, the integration of gender-sensitive strategies in academic spaces, such as the use of classical music to enhance female students' learning environments, further underscores the need for innovative and inclusive approaches in educational settings (Dangcogan, Silor, & Molia, 2024).

These findings support the argument that institutional reforms should include gender mainstreaming not only in policy but also in pedagogy and school culture. For instance, embedding GAD frameworks within engineering programs can help deconstruct gender biases and create more inclusive learning environments (UNESCO, 2021; Silor, 2024).

The implications are clear: without deliberate efforts to challenge the structural barriers identified in this study, gender disparities in engineering will persist. The work of Silor (2024) provides a model for developing localized, culturally relevant GAD programs that can be adopted across higher education institutions in Region 10 and beyond.

Addressing both societal and institutional factors is critical to increasing women's participation in engineering in CHED Region 10. Future research should explore longitudinal impacts of GAD initiatives and investigate intersectional factors such as socioeconomic status and ethnicity that may further influence women's experiences in engineering education.

CONCLUSION

This study underscored the persistent gender gap in engineering education within CHED Region 10 and the complex matrix of social and institutional barriers that sustain it. Addressing these challenges requires not only targeted GAD interventions but also the transformation of institutional cultures that shape educational experiences and outcomes.

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The policy implications are significant. CHED and higher education institutions must institutionalize inclusive policies through curriculum reform, mentorship programs, gender-responsive scholarship allocation, and faculty development. Effective implementation of GAD frameworks should be monitored and evaluated regularly to ensure genuine progress toward SDG 4 (quality education) and SDG 5 (gender equality).

Future research should delve deeper into how local cultural norms and regional disparities affect women's access to STEM fields, particularly in underserved and rural areas. Longitudinal studies examining the impact of GAD interventions on enrollment, retention, and graduate outcomes would offer valuable evidence for policy refinement. Moreover, integrating queer and non-binary perspectives can expand the conversation on gender inclusivity in engineering and beyond.

Operational Gender and Development (GAD) Action Framework for CHED Region 10

To address the persistent underrepresentation of women in engineering education, this operational GAD framework outlines actionable strategies specific to CHED Region 10. It identifies institutional responsibilities and measurable targets to ensure meaningful progress in fostering gender equity within higher education institutions (HEIs).

Strategic Action	Responsible Actor(s)	Performance Indicators
Establish mentorship programs linking students with women engineers and faculty	HEI GAD Focal Persons: Alumni Relations Offices	Mentorship programs established; at least 3 sessions per semester conducted in participating HEIs
Conduct gender-sensitivity and inclusive pedagogy workshops for faculty	CHED Region 10; HEI Administrators	75% of engineering faculty are trained in gender-sensitive teaching practices
Provide targeted support for female engineering students from rural and marginalized communities	Scholarship Offices; GAD Committees	20% increase in enrollment of female students from underrepresented groups
Institutionalize gender-inclusive monitoring and feedback mechanisms	CHED Region 10; HEI Monitoring and Evaluation Units	Annual gender audit reports completed; policy revisions informed by gender-disaggregated data
Promote recruitment, retention, and leadership development of female engineering faculty	HEI HR Offices; CHED Gender Equity Committee	15% increase in female representation among engineering faculty
Strengthen student support services to reduce female dropout rates in engineering	Deans of Engineering; Student Affairs Offices	30% reduction in dropout rates among female engineering students

RECOMMENDATIONS

1. **Implement Gender Sensitivity Training** for faculty, administrators, and students to raise awareness about unconscious biases and promote an inclusive academic culture.

2. **Establish Mentorship Programs** pairing female engineering students with experienced women professionals and faculty mentors to provide guidance, support, and role modeling.

3. **Develop and Enforce Gender-Responsive Policies** within HEIs that specifically address recruitment, retention, and support for women in engineering courses.

4. **Increase Community and School Outreach Initiatives** targeting younger female students to encourage early interest and enrollment in engineering and other STEM fields.

5. **Create Support Structures** such as women's engineering groups, counseling services, and safe spaces within institutions to foster peer support and address challenges unique to women students.

6. **Conduct Regular Monitoring and Evaluation** of gender equity programs to assess their effectiveness and make data-driven improvements.

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