Women, Engineering, and Society Understanding Gender Disparities in Engineering Education Research in the GCC

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Engineering has long been central to the Gulf Cooperation Council (GCC) countries' development strategies, as these nations work to diversify beyond oil economies and invest in building knowledge-based societies. At the heart of this transformation lies education, innovation, and human capital development, with engineering education serving as a cornerstone for workforce development, industry demands, and national self-reliance. While women's empowerment is a shared national priority across GCC countries, and there has been significant progress in female enrolment and graduation rates, women continue to face barriers to participation, advancement, and recognition in STEM fields.

This study investigates gender disparities in engineering education research across the GCC, examining whether national women's empowerment policies are reflected in publication patterns, collaboration, and research focus over the past two decades. Data were retrieved from Scopus, Web of Science, and The Lens, and analyzed through scientometric methods combining keyword analysis, trend-topic mapping, and multiple correspondence analysis, together with sentiment analysis of the most-cited studies.

The findings reveal that the body of research on gender disparities in engineering education remains limited but growing, with an annual increase of 2.93 per cent. The years 2021 and 2022 represented peaks in research output, coinciding with national reforms emphasizing women's empowerment and signaling the influence of policy in driving academic engagement. Despite this growth, the overall output of 144 publications over nearly twenty-five years underscores the modest depth of the field. In terms of regional contributions, Saudi Arabia and the United Arab Emirates dominate scholarly activity. However, collaboration remains largely siloed within national boundaries, with very little cross-border or international co-authorship, a contrast with global patterns where international collaboration is associated with greater visibility and impact. The analysis also reveals gender disparities in research leadership, with male authors comprising 62.5 per cent of contributors and women 37.5 per cent. Male-only teams are more frequent, while female scholars are underrepresented in leadership roles. The thematic analysis (Figure 1) shows that most research addresses pedagogy, digital education, professional skills, and workforce alignment, with gender often appearing as a secondary or peripheral variable rather than the central focus. Frequently recurring themes include engineering education, students, e-learning, petroleum engineering, and curricula, reflecting the intersection between education and workforce needs in the GCC. Gender-related terms such as women, female students, and gender equity are present but tend to occupy the margins of conceptual clusters, which indicates that although gender issues are acknowledged, they are rarely treated as the primary focus of scholarly inquiry. A chronological analysis of trend topics (Figure 2)

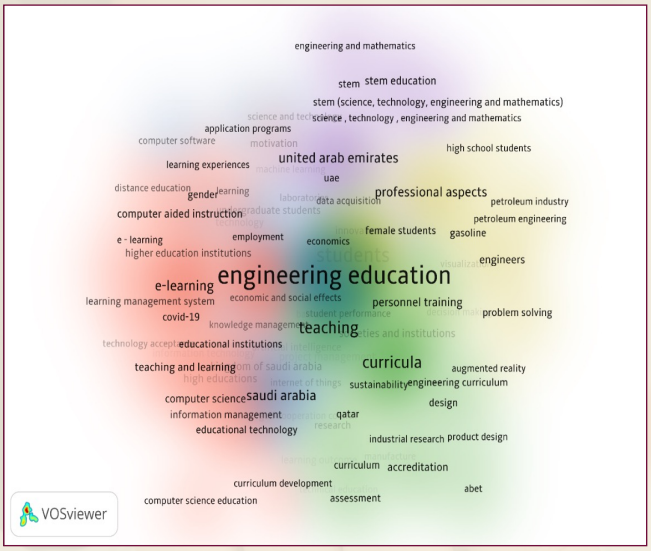

Figure1: Keyword Co-occurrences in Gender and Engineering Education Research in the GCC.

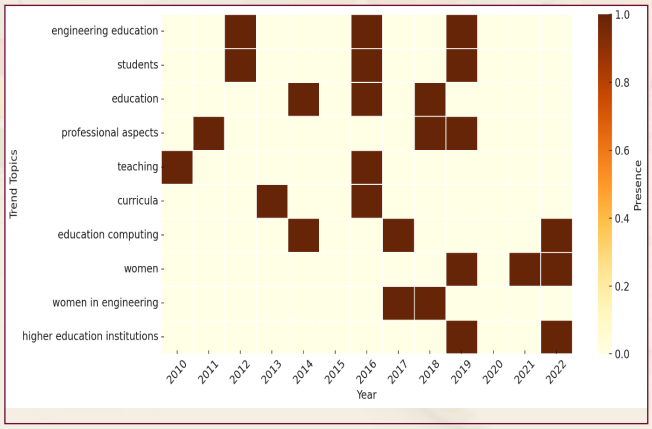

Figure2: Trend Topics over Time in Gender and Engineering Education Research in the GCC.

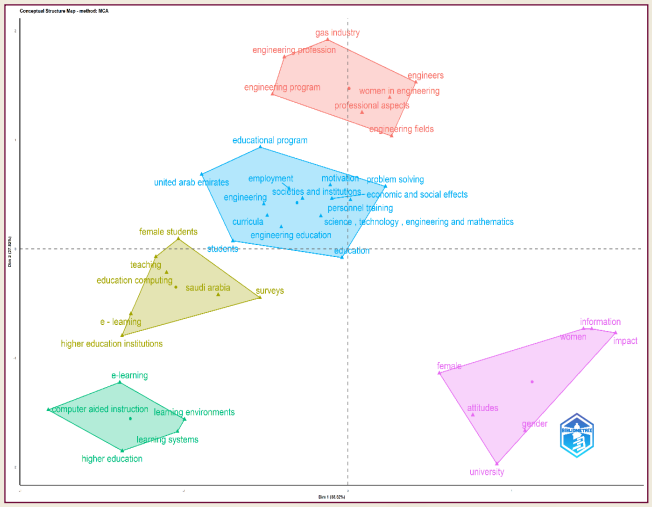

Figure 3: Factorial Analysis of Conceptual Structure in Gender and Engineering Education Research in the GCC.

shows sustained interest in engineering education, students, and curricula, with more recent attention to women and higher education institutions. Similarly, factorial mapping (Figure 3) identifies distinct clusters, including pedagogy, digital learning, professional skills, and gender-related themes, with gender often located on the periphery of the research landscape.

Furthermore, the sentiment analysis of highly cited studies shows that research tends to adopt a neutral, diagnostic tone, documenting disparities but rarely interrogating the systemic causes behind them. Highly influential works are often authored by male-dominated teams and frame gender as a variable within broader educational inquiries. Mixed-gender teams and female-led studies more directly address women's motivations, experiences, and participation in engineering education. High citation counts are associated with timely topics such as mobile learning adoption and student motivations to pursue engineering, indicating the influence of global and regional educational shifts on research visibility.

The findings underscore the need for regarding gender not simply as a demographic variable but as a systemic issue shaped by multi-level dynamics. Research should move beyond individual-level analysis towards examining broader system-level forces that shape gender issues. Adopting a systems-level approach is crucial for identifying conditions under which meaningful progress towards gender equality can occur. It is neither coincidental nor superficial that the Nordic nations of Iceland, Finland, and Norway consistently rank as global leaders in gender equality. Their success reflects decades of comprehensive and systemic efforts grounded in gender-inclusive policies across legal, economic, political, and cultural domains. While GCC nations have made strides in access and equity through female workforce participation and legal reforms, deeply rooted cultural norms remain. Progress could be strengthened by comprehensive legal frameworks, targeted programs such as gender quotas, and initiatives ensuring the transition of women from STEM education into the workforce. Government-led reforms should include equal pay, work-life

balance, awareness campaigns, gender quotas, and funding for women-focused STEM initiatives. At the institutional level, strategies to foster gender inclusivity include revisiting hiring and promotion practices, strengthening mentorship and professional networks, offering flexible work arrangements, and promoting leadership engagement.

Societal-level interventions are vital to dismantling gender stereotypes and fostering STEM engagement. Early exposure, visible female role models, and active methodologies support confidence and participation, while broader cultural shifts, including engaging men as allies, are necessary for sustained gender equity. Achieving equity is not solely a matter for women but requires reflection on teaching, leadership, and workplace practices to develop a more diverse and inclusive professional body.

In conclusion, this study reveals both progress and persistent gaps in gender equity within engineering education research in the GCC. While women's participation in higher education has expanded, their visibility in scholarly publishing and leadership remains limited. The field is modest in scale, nationally siloed, and male-dominated, with gender issues often appearing as peripheral rather than central themes. Addressing these gaps will strengthen the contributions of universities such as Qatar University in advancing national development goals, empowering women, and contributing to the creation of cohesive, balanced, and knowledge-driven societies.