# The Academic Leadership for Women in Engineering Program: Impact on Personal Development, Leadership Advancement, and Networking

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# A Multifaceted Examination of ALWE's Influence on Personal Growth and Leadership in Engineering Academia

## Introduction

Research shows that we need more than a multifaceted approach to achieve gender equity in engineering – we need tailored and personalized responses to tackle specific challenges faced in male-driven and dominated fields. Numerous research studies suggest that effective interventions highlight the importance of programs that go beyond improving individual skill development to tackle systemic and institutional barriers [1]. Such a responsive approach involves the implementation of inclusive practices and fostering a space that values diversity and actively challenges and dismantles stereotypes and biases within the field [1]. Moreover, "innovations that respond to both global and local community needs are enhanced by diverse and well-prepared academic learners [2]." Such programs acknowledge the importance of skill enhancement, mentorship, and networking to promote women's career advancement in disciplines such as engineering [3].

Specifically, leadership within academia entails navigating gender biases and structural inequalities extending beyond managerial abilities [4]. Research shows that leadership programs that tap into high-impact practices that garnish specific sets of educational strategies— such as experiential learning opportunities, events, internships, and first-year experiences—have been shown to significantly benefit undergraduate student learning, engagement, learning, and retention [5]. For instance, high-impact programs significantly help learners reflect on their character strengths and weaknesses and allow them to take control of their successes as learners and engineering professionals [5].

Although evidence demonstrates that leadership development programs commonly described as expanding the collective capacity of organizational members enable groups of individuals to work together and engage effectively in a meaningful way both in leadership roles and processes, [6] they can also lead to a strategic response to tackle the specific challenges faced in male-dominated fields [7] and equip women with leadership skills and overcoming the unique obstacles they encounter[3]. Though academic research supports the effectiveness of such practices that advance organizational gender equity that can lead to positive organizational performance and innovation, [8],[9],[10] the academia sector has been slow to respond effectively to issues related to gender inclusivity.[14] Simply stated, "gender balance in academic leadership roles has shifted minimally over the past decade [10]."

For nearly two decades, scholars of academic leadership development have been calling for new processes that prepare, identify, and inspire diverse faculty for such leadership roles [11],[12]. Research indicates that leadership development in engineering academia evidence-based practices are recognized to be a critical factor for equipping engineers to be both leaders and innovators in the field [13]. However, research that examines the benefits and outcomes of leadership programs in engineering remains limited [19].

Research suggests that the traditional route that relies on on-the-job learning that is backed by peer mentoring and experience is no longer sufficient for the accompanying challenges faced by those pursuing roles in varying levels of academia, medicine, research, or STEM executives [10][12][14] [15]. Rather, what has been found to be essential in preparation for leadership roles in these areas has included workshops, societies [national programs addressing professional development via leadership continuum programs, and support groups within professional societies [10],[16],[17],[18],[19],[20],[21].

However, research indicates that "the strength and depth of program outcomes has yet to match the proliferation of programs; more tools and measurements are needed to judge their effectiveness" [10]. To address this research gap and add to the literature on leadership development programs, this study seeks to better understand how female engineering academics who participate in the Society of Women Engineers' Academic Leadership for Women in Engineering (ALWE) program experience the intricate aspects of personal development and gain competencies and knowledge skills for achieving leadership success.

## Literature Review

### *The Gender Pay Gap in Engineering Academia*

Recent studies have shed light on a concerning trend within the community; there is a noticeable disparity in both pay and promotions between genders, particularly among those with science or engineering doctorate degrees [22]. Research revealed that the gender pay gap for individuals with science or engineering doctorates is around 1.5 times greater in academia compared to industry [22]. The pay disparity increases midway through their careers – noting that women working in sciences earn significantly lower salaries compared to their male counterparts with a difference of approximately 2.7%– and this pay gap widens to 7.2% for women in academic science roles [22].

Female professors in the field of engineering earned, on average, 82% of what their male counterparts made in the period, and the gap disparity continues to exist across ranks, with female associate professors earning 85% and female assistant professors earning 89% of what their male colleagues, in similar positions earned [23]. These statistics reflect the broader issue of gender gap wage discrimination; however, research also points to more nuanced, subtle, systemic factors that starkly illustrate the undervaluation of women's work in academia and resource allocation. For instance, fields that were predominantly comprised of women received far less institutional support, which negatively impacted salary scales [24], and female faculty had 3% lower salaries than men after considering various professional and personal factors [25].

Furthermore, research found that women in academia are less likely to be married with children than men and more likely to experience career interruptions – factors directly linked to their earning potential [26]. The lack of transparency during salary negotiations further contributes to this wage gap [26]. Researchers emphasized that women are less inclined than men to negotiate their starting salaries, resulting in a loss of over half a million dollars throughout their careers [27].

*Challenges Faced by Women in Engineering Academia*

The underrepresentation of women in engineering academia remains a multifaceted issue deeply ingrained in cultural, institutional, and various components of social dynamics. Research has consistently highlighted systemic barriers, including gender biases, which manifest in various forms, such as unequal access to resources, discriminatory hiring practices, and a lack of supportive policies for work-life balance [28]. According to researchers, "The clockwork of this career is distinctively male. It is built upon men's normative paths and assumes freedom from competing responsibilities, such as family, that generally affect women more than men" (p. 66) [29].

For instance, when examining the aspects, including age, work hours for both the participants and their partners, household responsibilities, number of children, and levels of stress related to both work and family life – research found gender and tenure status affect the experiences of academics who are parents – (N=of 179 women and 85 men in tenure track positions) [30]. It also investigated the support received from institutions and partners. The study found that women more often reported burdens when it came to household chores and taking care of children compared to their male counterparts [30]. Findings also indicated that professional lives had an impact on their family life – women mentioned that being parents limited their ability to travel for work purposes, coupled with academic stress and perceived support from spouses, which were factors contributing to family-related stress [30].

Additionally, research on how parenthood affects the careers of female scientists, specifically in terms of employment opportunities and geographical mobility, indicated that motherhood imposed geographical constraints on female scientists compared to male scientists due to parenting responsibilities [31]. These challenges are made worse by stereotypes and cultural expectations that frequently depict engineering as male-dominated [31]. This creates obstacles and a feeling of isolation for women [32]. Moreover, research has demonstrated that the scarcity of role models and mentors in leadership positions perpetuates a cycle of underrepresentation. Aspiring women in academia and professional settings often struggle to find the guidance and motivation they need within their fields [33].

*Leadership Development Programs*

Leadership development programs have emerged as a strategic response to empower women in academia. These programs are designed to equip women with leadership skills and address specific challenges they face in male-dominated fields [3]. The design of the ALWE program, in particular, acknowledges the complex interplay of skills development, mentorship, and networking required to advance women's careers in engineering academia. Similar programs are grounded in the understanding that academic leadership skills extend beyond conventional managerial capabilities and include the ability to navigate a landscape characterized by gender biases and structural inequalities [3], [34].

Leadership development programs in academia tailored for women are a strategic response to tackle the specific challenges faced in male-dominated fields [34]. Eagly and Carli (2007) suggest that the significance of these programs in equipping women with leadership skills and overcoming the unique obstacles they encounter acknowledges the importance of skill

enhancement, mentorship, and networking and also promotes women's career advancement in disciplines such as engineering [3], [24]. Successful women leaders in academia need to be equipped with skills that enable them to challenge and overcome the systemic barriers that have been found to challenge women's advancement [3], [24]. Effective academic leadership programs aim to foster competencies responsive to the unique dynamics and challenges within academic institutions, which can be quite different from those found in other types of organizations [34].

## Methodology

ALWE's core objective is to empower academic professionals, with a particular focus on women in engineering, by equipping them with essential tools and strategies for personal and professional growth. To evaluate the effectiveness of the ALWE program, we conducted an online post-event survey aimed at capturing participants' collective experiences. A post-event survey was administered via SurveyMonkey and gathered feedback after attendees participated in various ALWE-led workshops, including Strengths Discovery and Leadership Navigating Difficult Conversations and Challenging Dynamics in Academia, Academic Leadership for Women in Engineering, Group and Peer Coaching Workshop Negotiating Within Academia and Transforming Slide Design.

Our research methodology aimed to collect empirical data on the competencies and insights reinforced by ALWE participation. The post-event survey included questions pertaining to growth, leadership development, satisfaction levels, perceived relevance of the workshops, and the overall impact on participants' professional development. Participants (N=319) were asked to rate their responses using a Likert scale ranging from 1 (not very satisfied) to 5 (very satisfied). The survey also gathered qualitative open-ended questions from participants; however, to ensure unbiased results and accurately measure the direct outcomes of the ALWE events, this study does not capture the qualitative side stemming from the study. It's worth noting that ALWE recognizes the importance of narratives and the recommendations provided by participants, but our main focus for this study was to gain a better data-driven understanding of how ALWE impacts self-confidence, leadership skills, and overall empowerment among program participants.

## Findings

The key takeaways from the research findings indicate that ALWE is an effective program for participants, especially women in engineering, who aim to improve their leadership skills and professional growth. The participants expressed confidence in applying the concepts learned from the program to their plans for development, with 40.74% reporting "extreme confidence," 44.44% reporting "high confidence," and 14.81% reporting "moderate confidence." ALWE proved beneficial in helping participants recognize how strengths contribute to work-life balance and overall well-being, with 40.74% expressing "confidence," 40.74% expressing "high confidence," 11.11% expressing "moderate confidence," and 7.41% expressing "slight confidence." Furthermore, ALWE empowered participants to articulate how their strengths support the achievement of goals, with 50.00% indicating "high confidence," 30.77% indicating

"extreme confidence," 15.38% indicating "moderate confidence," and 3.85% indicating “slight confidence.”

Participants also reported gaining skills in explaining the process of identifying their purpose as leaders, with 46.15% expressing "confidence," 26.92% expressing "extreme confidence," 15.38% expressing "moderate confidence," and 11.54% “slight confidence." When it comes to building connections with other participants in the program, 42.31% expressed a sense of "mostly confident," 38.46% felt "extremely confident," and 15.38% mentioned feeling "somewhat confident." Only 3.85% indicated being "slightly confident." Overall, 46.15% of the participants reported that the ALWE event surpassed their expectations.

**Discussion**

One of the standout outcomes of the survey is that a large majority of participants expressed high levels of satisfaction with ALWE. Most respondents stated they were either "very satisfied" or "extremely satisfied" with how the content impacted their development. This high satisfaction rate indicates that the program effectively meets participants' expectations and, on some level, provides participants with essential tools, resources, and skills to navigate various vignettes of their personal or professional endeavors. The positive feedback also indicates that the quality and relevance of various workshops and the content presented during events appeared to be applicable to participants. For instance, participants perceived ALWE as relevant to their current or future leadership roles in universities, and a significant amount of participants found the workshops to be "extremely relevant" while others considered them "quite relevant." This shows that ALWE effectively addresses the real-world challenges and demands faced by professionals, particularly women in engineering, thus validating its role in addressing critical issues within academia. The survey also evaluated participants’ confidence in applying the concepts learned during ALWE to their growth and development plans. The majority expressed confidence, with a percentage indicating they were either "very confident" or "mostly confident." This confidence in applying acquired knowledge and skills demonstrates the practicality and effectiveness of the program, suggesting that participants can readily apply what they've learned to advance their careers and apply what skills they gain from the workshop in real-life situations. Thus, this aligns with ALWE’s objectives – to provide female academics in engineering with the tangible skills and knowledge needed to pursue, acquire, and gainfully maintain institutional leadership positions at a university.

**Limitations and Future Research**

While the research findings suggest that ALWE has a positive impact on participants – several limitations should be taken into account when interpreting the results. Our study does include control groups to gather a wider range of qualitative data for a more comprehensive assessment of the program’s effectiveness. Additionally, this study does not account for factors that could have influenced participants' professional development or confidence, such as concurrent training or personal experiences outside of ALWE. The post-event survey only captures participants' experiences after attending ALWE events. It doesn't provide information on whether these experiences change over time or if participants' perceptions and confidence evolve as they implement what they've learned. The research primarily focuses on numerical

insights into satisfaction levels, relevance, and confidence. However, incorporating data such as open-ended responses could potentially provide deeper insights into participants' experiences and suggestions for program enhancement. It's worth noting that the survey data and findings may not be universally applicable beyond the context of ALWE events since various factors, including facilitator quality, curriculum learning design, or specific needs of women in engineering, can influence the program's success. Further research in the field of leadership development programs can deepen our understanding of such areas, thus enhancing the effectiveness of such initiatives. This can be achieved by conducting qualitative analyses, including interviews and focus groups, to gain nuanced insights into participants' experiences, challenges, and how they apply their acquired knowledge in their academic roles. Exploring the influence of participation in ALWE on the culture and climate within academic institutions is an area that has yet to be extensively studied. It would be valuable to assess whether such similar programs promote inclusivity, diversity, and a supportive environment for all learners. Additionally, future research could examine the growing trend of remote STEM work. Comparing the effectiveness of virtual learning events with personal workshops would provide insights into the advantages and challenges associated with each format as well as their overall impact.

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