STRATEGIES FOR EMPOWERING AND RETAINING WOMEN IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) FIELDS: A SYSTEMATIC LITERATURE REVIEW

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Abstract

Despite the increasing integration of women into Science, Technology, Engineering, and Mathematics (STEM) fields, gender disparities persist, particularly in engineering disciplines. Research indicates that women are significantly underrepresented in engineering roles across various nations, with cultural, institutional, and educational barriers contributing to these disparities. Efforts to address these issues have included educational reforms, mentoring programs, and policy changes, yet challenges remain in achieving gender equity and retaining women within these fields. This study aims to explore and evaluate the effectiveness of initiatives aimed at improving gender equity in STEM education and careers. The research seeks to answer how different strategies, such as peer mentoring and inclusive curriculum designs, impact women's recruitment, retention, and advancement in engineering. The ultimate goal is to identify practices that can significantly reduce gender gaps in STEM disciplines. This study employs a systematic literature review to assess the impact of gender equity initiatives in STEM fields. The review synthesizes existing research findings from multiple global contexts, evaluating the success and scalability of various interventions. Sources include academic papers, reports on educational programs, workplace studies, and direct feedback from participants in gender-focused initiatives. This approach aims to gather comparative insights into effective practices for promoting gender equity in STEM. Anticipated outcomes of this study include identifying key factors that contribute to successful gender equity programs in STEM. These may include the critical role of institutional support, the effectiveness of mentoring networks, and the importance of culturally sensitive curriculum reforms. The study is expected to provide a set of validated approaches that can be adopted and adapted by educational institutions and corporate entities alike. The review is anticipated to conclude that a multifaceted approach, combining top-down policy changes with bottom-up educational and cultural reforms, is most effective in promoting gender equity in STEM. These strategies are likely to be more successful when they are integrated into the core mission of institutions rather than implemented as peripheral programs. Recommendations focus on long-term commitments to these changes and the continuous assessment of their impact on reducing gender disparities.

Keywords: Gender Equity, STEM education, Engineering and Built Environment, Institutional Transformation.

1. INTRODUCTION

The underrepresentation of women in engineering and the built environment is a well-documented issue that persists despite numerous efforts to address it. Women face multiple barriers, including cultural stereotypes, lack of mentorship, and an unfriendly workplace environment. This paper aims to systematically review existing literature to identify and

analyse strategies that have been successful in empowering and retaining women in the field of Engineering and Built Environment. Therefore, the research question here is: what strategies have been successful in empowering and retaining women in engineering and the built environment, and how have these strategies addressed the barriers women face in these fields?

Women worldwide have achieved considerable progress in higher education and the fields of Engineering and the Built Environment in recent decades. However, their retention in Engineering and the Built Environment remains low. Studies indicate that women's participation in STEM fields is influenced by multiple factors, including societal norms, educational practices, and workplace cultures (Kwak & Ramirez, 2019). The importance of gender diversity in these fields cannot be overstated, as diverse teams have been shown to drive innovation and improve problem-solving (Borrego, Foster & Froyd, 2014). According to Bilimoria and Liang (2012), gender equity is critical for enhancing the performance and creativity of Engineering and Built Environment, thereby contributing to broader societal and economic benefits that align with the United Nations Sustainable Development Goals.

2. BACKGROUND OF THE STUDY

The Engineering and Built Environment fields are essential for technological progress and infrastructural growth of any country across the world. Irrespective of continuous efforts to advance gender equity, these fields have historically been male-dominated, leading to a notable gender imbalance even in recent years. Women are a critical, yet underutilized talent pool whose participation is vital for fostering innovation, increasing productivity, and cultivating a more inclusive professional atmosphere (Ijagbemi et al., 2017). It is crucial to address the challenges that women encounter in these industries to both attract and retain talented women, ensuring their long-term career satisfaction and progression. Even though there have been advancements in increasing the inclusion of women in Engineering and the Built Environment, significant gaps remain to this day. Recent data reveals that women constitute less than 22.4% of the workforce in these fields on a global scale, with even lower percentages in key leadership roles that hold the power to make necessary changes (Alshdiefat et al., 2024). Even with the small number of women representatives in this field, they still exit the jobs unhappy due to dissatisfaction over pay and promotion opportunities (Hunt, 2016; Maurer et al., 2021). This lack of representation is linked to various barriers, such as societal stereotypes, organizational biases, and a scarcity of role models and mentors. These obstacles can discourage women from entering or staying in these professions, resulting in high turnover rates and depletion of potential talent (Al-Haj Ali & Hijazi, 2020).

Throughout history, societal expectations and educational methods have played a role in creating gender gaps within the Science, Technology, Engineering, and Mathematics (STEM) fields. Engineering and its related disciplines have long been seen as male-dominated, with educational programs and work environments reflecting this bias. Women pursuing careers in these fields have often encountered obstacles such as restricted access to education, a lack of guidance, and discrimination in the workplace (Amon, 2017). Despite women currently earning 50% and 36% of bachelor's and doctoral degrees in Engineering and Built Environment, they

remain underrepresented at almost all levels spanning from academic faculty to administration including industry and government (Shannon Watt, 2010).

The Sustainable Development Goals (SDGs) were launched by the United Nations in 2016 with the vision that they will promote social development, economic development, and environmentally sustainable development with the motto, "Leave No One Behind". In particular, we zoom into SDGs' goal 5, which states that; "Achieve Gender Equality and Empower All Women and Girls" as the UN understands the benefits of having women as active contributors to the economy of the world and it is worth noting that Gender equity is amongst the furthest goal to reaching its realization. Zooming into a case study in Nordic countries juxtaposed with South Korea which is doing rather poorly is that gender equality can be reached through concerted efforts for education, employment, and empowerment of women consistently.

3. METHODOLOGY

The research methodology employed for this study is a systematic literature review, which provides a rigorous and replicable approach to synthesizing literature (Okoli, 2015). It is important in summarising the empirical evidence related to past studies that helps in suggesting possibilities for further research in the same area (Nena et al., 2022). Among the literature reviews, the systematic approach is preferred over the traditional approaches due to thoroughness, ease of replication, and rigor (Jesson et al., 2011; Snyder, 2019; Ramabodu and Nena, 2024). Moreover, there are several methodologies for carrying out systematic literature reviews.

In this study, the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement template (Moher et al., 2015) is used to explain the overall process of selection and exclusion of articles for the review of strategies for empowering and retaining women in engineering and built environment. The complete process of PRISMA for this systematic review is shown below in Figure 1 which includes both peer-reviewed literature and non-peer reviewed such as white paper reports. The main objective of this paper was first to investigate different strategies for empowering and retaining women in engineering and built environments and secondly, to identify possible future research agendas.

3.1 Search Strategy

A systematic search strategy was used to identify relevant literature available on this topic. With this, a comprehensive literature search was conducted across multiple databases, including Scopus, Web of Science, and Google Scholar, to identify relevant studies on the empowerment and retention of women in engineering and the built environment. Keywords used included "women" AND "STEM" AND "gender disparity" AND "engineering" AND "retention strategies" AND "women empowerment" AND "higher education" following the Boolean operator search technique (Aliyu, 2017). The search span was from the year 2004 to 2024 which was carried on 24 of July.

3.2 Quality Assessment

The study is based on academic peer-reviewed papers, reports on educational programs, workplace studies, and direct feedback from participants in gender-focused initiatives. 2001 duplicates were removed using Microsoft Excel to maintain the quality of the review (Khan and Qureshi, 2020). Furthermore, the abstracts and conclusions of the articles were thoroughly checked to ensure the quality and relevance of the academic documents included. At the later stage, all these papers were carefully evaluated in detail. The next was to consider the inclusion and exclusion criteria and all the studies were limited to English-written documents only focusing on women in engineering and the built environment. For the exclusion criteria, 36 documents were not of the topic interest and were those not focused on STEM fields or gender equality, as a result, they were excluded in this study. This process is also explained in detail with the PRISMA flowchart below.
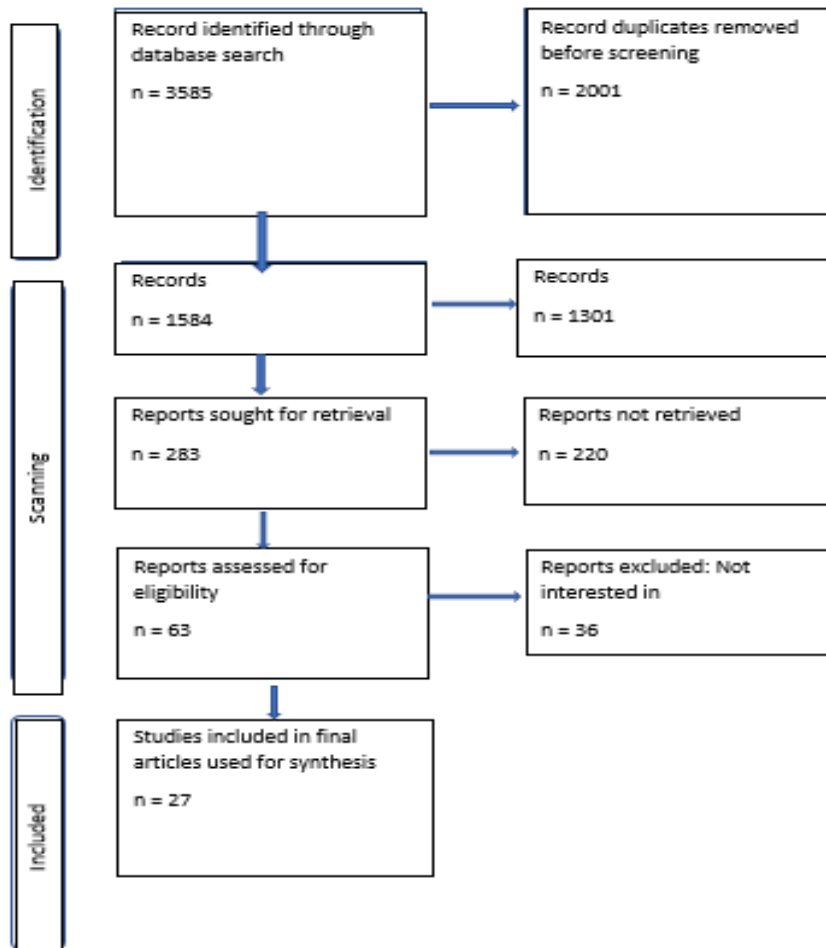

Figure 1: Studies selection flow chart

3.3 Studies Included in the Qualitative Synthesis

The final 27 documents were used after the assessment of each article based on the above-mentioned exclusion and inclusion criteria. These articles were used for the final process of writing up the paper. Thereafter, the content analysis was done from the classified literature where analysis of the variables was carried out and the reporting of the future possible directions on this topic.

4. FINDINGS AND DISCUSSION

4.1 Barriers to Women's Participation in STEM

Numerous studies have highlighted the challenges women face in STEM fields. According to Al-Haj Ali and Hijazi (2020), women encounter significant obstacles in the form of societal expectations and institutional biases and not much is changing in this regard. Similarly, the paper Smith discusses how early socialization and gender stereotypes dissuade women from pursuing engineering careers that are perceived to be spaces reserved for men (Smith, 2021).

Furthermore, the report by O'Donoghue-Lindy (2008) emphasizes that gender stereotyping, self-efficacy doubts, and the predominantly male science, engineering, and technology (SET) image and culture are significant barriers for women. Despite these barriers, several studies have identified effective strategies for overcoming them. For example, the use of female role models and mentors has been shown to positively influence young women's perceptions of engineering as a viable career option (Bilimoria & Liang, 2012).

Additionally, creating inclusive and supportive educational environments can help mitigate the negative impact of stereotypes and biases (Khasawneh & Hijazi, 2020). Addressing these issues at the institutional level is critical for fostering a culture that supports and values diversity (Bilimoria & Liang, 2012).

Educational interventions that target early childhood and adolescence are particularly important for shaping girls' attitudes toward STEM fields hence the need to go to schools and talk and mentor young girls into taking up STEM subjects in school. Research has shown that girls who are exposed to STEM activities and role models at a young age are more likely to pursue careers in these fields (Zayed et al., 2021). Schools and educational programs that actively promote gender equality and challenge traditional gender roles can play a significant role in encouraging more girls to consider engineering and other STEM careers (Khasawneh & Hijazi, 2020). In addition to educational interventions, workplace policies and practices also play a crucial role in supporting women in STEM.

Flexible working arrangements, parental leave policies, and initiatives to address unconscious bias are essential components of a supportive work environment (Challenges and Enablers of Women Advancement in Academia Careers at a Selected South African University, 2020). Companies that actively promote diversity and inclusion tend to have higher retention rates of female employees as the culture of the company is also an inclusive and safe space for women to thrive (Bilimoria & Liang, 2012).

Moreover, research has highlighted the importance of creating networks and communities for women in STEM can ensure retention as it caters to the fundamental need to belong. These networks provide opportunities for mentorship, professional development, and peer support, which are critical for career advancement and retention as well as the flourishment of women within the spaces (Khasawneh & Hijazi, 2020). Women's organizations and affinity groups within professional associations can also serve as valuable resources for women in engineering (Bilimoria & Liang, 2012). Another important aspect to consider is the role of government and policy in promoting gender equality in STEM.

National and regional policies that support gender diversity and inclusion can provide a framework for institutions and organizations to implement effective strategies (Bilimoria & Liang, 2012). For example, initiatives such as gender quotas, funding for women's STEM programs, and incentives for companies to adopt inclusive practices can drive significant progress toward gender equality in these fields (Zayed et al., 2021). In conclusion, addressing the barriers to women's participation in STEM requires a multifaceted approach that includes educational interventions, supportive workplace policies, and strong government and institutional support that is consistent and relentless and not just a tick-box exercise. By removing these barriers, we can create an environment that empowers and retains women in engineering and the built environment.

4.2 Mentorship and Support Programs

Mentorship has been identified as a crucial factor in supporting women's careers in STEM as it demonstrates the positive impact of peer mentoring on women's confidence and career progression and encourages retention within the sector (Khasawneh & Hijazi, 2020). Additionally, the paper by Zayed et al. (2021) emphasizes the importance of awareness programs in changing perceptions and encouraging young women to pursue STEM careers.

Comparative international experiences highlight the success of resource centers in consolidating various approaches to support women in SET fields (O'Donoghue-Lindy, 2008). Mentorship programs provide women with valuable guidance, support, and networking opportunities that are critical for career advancement (Bilimoria & Liang, 2012). These programs can take various forms, including one-on-one mentoring, peer mentoring, and group mentoring though one-on-one has proven to be most effective. Each type of mentorship offers unique benefits and can be tailored to meet the specific needs of women in different stages of their careers (Khasawneh & Hijazi, 2020).

One-on-one mentoring relationships, where an experienced professional provides guidance to a less experienced mentee, are particularly effective in helping women navigate the challenges of STEM careers. These relationships can offer personalized advice, professional development opportunities, and emotional support, which are essential for building confidence and resilience (Bilimoria & Liang, 2012). Peer mentoring, where women at similar career stages support each other, is another valuable approach. Peer mentoring can create a sense of community and shared experience, reducing feelings of isolation and providing mutual encouragement (Khasawneh & Hijazi, 2020).

This type of mentoring is especially beneficial in environments where women are underrepresented and may lack access to senior female mentors. Group mentoring, which involves multiple mentors and mentees, can provide a broader range of perspectives and expertise. This format can also facilitate networking and the exchange of ideas among participants, fostering a collaborative learning environment (Bilimoria & Liang, 2012).

Group mentoring programs can be particularly effective in academic settings, where they can complement formal education and training. In addition to formal mentoring programs, informal mentoring relationships can also play a significant role in supporting women's careers in STEM. These relationships often develop organically and can provide spontaneous and ongoing support (Bilimoria & Liang, 2012). Encouraging a culture of mentorship within organizations can help facilitate these informal connections and ensure that women have access to the support they need.

Mentorship programs that include training for mentors are also essential. Effective mentors need to be equipped with the skills and knowledge to provide meaningful support and guidance (Khasawneh & Hijazi, 2020). Training can help mentors understand the unique challenges faced by women in STEM and develop strategies to address these challenges. Furthermore, mentorship programs should be integrated into broader organizational and institutional strategies for gender equity. This integration ensures that mentorship efforts are aligned with other initiatives and can have a more significant impact (Bilimoria & Liang, 2012). For example, mentorship programs can be linked to recruitment, retention, and promotion strategies to create a comprehensive support system for women in STEM. It is also important to evaluate the effectiveness of mentorship programs regularly.

Continuous assessment can help identify areas for improvement and ensure that the programs are meeting the needs of participants (Bilimoria & Liang, 2012). Surveys, interviews, and focus groups can provide valuable feedback from mentees and mentors, informing the ongoing development of the programs. In summary, mentorship and support programs are vital for empowering women in STEM. By providing guidance, support, and networking opportunities, these programs help women overcome barriers, build confidence, and advance in their careers. Implementing effective mentorship programs requires a commitment to training, integration with broader strategies, and regular evaluation.

4.3 Institutional and Policy Interventions

 Institutional policies play a significant role in promoting gender equity. The study "Challenges to and Enablers of Women's Advancement in Academic Careers at a Selected South African University" highlights the importance of supportive institutional policies and the need for a transparent recruitment process to enhance women's representation in academia (Mbukanma & Strydom, 2022).

Moreover, "Attitudes of Academicians towards Gender Equality at Institutions of Higher Learning in South Africa" discusses how the masculine-oriented environment in higher education institutions creates barriers for women (Maqubela et al., 2019).

Institutional policies that promote gender equity include those that address recruitment, retention, and advancement of women in STEM fields. Recruitment policies should focus on attracting a diverse pool of candidates by using inclusive language in job postings and actively seeking out qualified women applicants (Bilimoria & Liang, 2012). Retention policies should address the challenges that women face in the workplace, such as work-life balance, by offering flexible working arrangements and parental leave (Mbukanma & Strydom, 2022). In addition, policies that support women's career advancement are crucial. These can include programs for professional development, leadership training, and opportunities for networking and collaboration (Bilimoria & Liang, 2012). Institutions should also implement policies to address unconscious bias in performance evaluations and promotions, ensuring that women have equal opportunities for advancement (Maqubela et al., 2019).

Institutional support for gender equity initiatives can take various forms, such as the establishment of gender equity offices or committees, funding for gender-focused research, and the creation of awards and recognition programs for gender equity efforts (Bilimoria & Liang, 2012). These initiatives signal an institution's commitment to gender equity and provide resources and support for implementing effective strategies. Moreover, institutions can benefit from conducting regular assessments of their gender equity policies and practices. These assessments can help identify areas for improvement and track progress over time (Bilimoria & Liang, 2012). Surveys, focus groups, and data analysis can provide valuable insights into the experiences of women in STEM and inform the development of targeted interventions.

Collaborations and partnerships with external organizations and networks can also enhance institutional efforts to promote gender equity. Engaging with professional associations, advocacy groups, and other institutions can provide access to best practices, resources, and support (Bilimoria & Liang, 2012). These partnerships can also help institutions leverage broader initiatives and policies aimed at promoting gender equity in STEM fields. Policy interventions at the national and regional levels are equally important.

Government policies that mandate gender diversity in STEM fields, provide funding for women's programs, and incentivize organizations to adopt inclusive practices can drive significant progress (Bilimoria & Liang, 2012). For example, initiatives such as gender quotas for research funding and leadership positions can ensure that women have equal opportunities to contribute to and benefit from STEM fields (Zayed et al., 2021). In conclusion, institutional and policy interventions are critical for promoting gender equity in STEM. By implementing inclusive recruitment, retention, and advancement policies, supporting gender equity initiatives, conducting regular assessments, and engaging in collaborations and partnerships, institutions can create a more inclusive and supportive environment for women in engineering and the built environment.

4.4 Effective Mentorship and Support Programs

The review found that mentorship programs significantly impact women's retention and success in STEM fields. Peer mentoring, as discussed by Khasawneh and Hijazi (2020), helps build confidence and career progression among women in STEM.

Mentorship programs provide women with valuable guidance, support, and networking opportunities that are critical for career advancement (Bilimoria & Liang, 2012). These programs can take various forms, including one-on-one mentoring, peer mentoring, and group mentoring. Each type of mentorship offers unique benefits and can be tailored to meet the specific needs of women in different stages of their careers (Khasawneh & Hijazi, 2020). One-on-one mentoring relationships, where an experienced professional provides guidance to a less experienced mentee, are particularly effective in helping women navigate the challenges of STEM careers. These relationships can offer personalized advice, professional development opportunities, and emotional support, which are essential for building confidence and resilience (Bilimoria & Liang, 2012).

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In addition to formal mentoring programs, informal mentoring relationships can also play a significant role in supporting women's careers in STEM. These relationships often develop organically and can provide spontaneous and ongoing support (Bilimoria & Liang, 2012). Encouraging a culture of mentorship within organizations can help facilitate these informal connections and ensure that women have access to the support they need. Mentorship programs that include training for mentors are also essential. Effective mentors need to be equipped with the skills and knowledge to provide meaningful support and guidance (Khasawneh & Hijazi, 2020). Training can help mentors understand the unique challenges faced by women in STEM and develop strategies to address these challenges.

Furthermore, mentorship programs should be integrated into broader organizational and institutional strategies for gender equity. This integration ensures that mentorship efforts are aligned with other initiatives and can have a more significant impact (Bilimoria & Liang, 2012). For example, mentorship programs can be linked to recruitment, retention, and promotion strategies to create a comprehensive support system for women in STEM. It is also important to evaluate the effectiveness of mentorship programs regularly. Continuous assessment can help identify areas for improvement and ensure that the programs are meeting the needs of participants (Bilimoria & Liang, 2012).

Surveys, interviews, and focus groups can provide valuable feedback from mentees and mentors, informing the ongoing development of the programs. In summary, mentorship and support programs are vital for empowering women in STEM and this support needs to also be provided by leadership in key positions to ensure sustainability which means that even men

need to get on board to support empowerment initiatives for them to succeed. By providing guidance, support, and networking opportunities, these programs help women overcome barriers, build confidence, and advance in their careers. Implementing effective mentorship programs requires a commitment to training, integration with broader strategies, and regular evaluation.

5. CONCLUSION

Empowering and retaining women in engineering and the built environment requires a multifaceted approach that addresses cultural, educational, and workplace barriers. Mentorship programs, educational interventions, supportive workplace policies, and systemic changes are all crucial components of this effort. By implementing these strategies, institutions and policymakers can make significant strides toward achieving gender diversity in engineering and the built environment.

There is a gap in further research that explores the impact that the agenda of Equality can have when spearheaded by men in key positions to ensure sustainability and actualization of equality within our lifetime. Moreover, other research should explore whether equality initiatives gain broader acceptance and greater traction when men, particularly in traditionally male-dominated fields, take an active role in spearheading them. By addressing these gaps, future studies can contribute to shaping a more equitable and inclusive engineering and built environment sector, ensuring that gender diversity is achieved within our lifetime.

References

1) Alshdiefat, A.A.S., Sharif, A.A., Abu Ghunmi, N.A.M., Lee, A. and Rana, M.Q., 2024. Factors Impacting Women Gaining Leadership Roles in the Jordanian Construction Sector: Architects and Civil Engineers. *Buildings*, *14*(4), pp.944.

2) Aliyu, M.B., 2017. Efficiency of Boolean search strings for Information retrieval. American Journal of Engineering Research, 6(11), pp.216-222.

3) Amon, M.J., 2017. Looking through the glass ceiling: A qualitative study of STEM women's career narratives. *Frontiers in Psychology*, 8, pp.236.

4) Bataineh, O., Qablan, A., Belbase, S., Takriti, R., and Tairab, H. (2022). Gender Disparity in Science, Technology, Engineering and Mathematics (STEM) Programs at Jordanian Universities. Journal of Sustainability. 14, 14069, pp1-22

5) Bilimoria, D., & Liang, X. (2012). Gender Equity in Science and Engineering: Advancing Change in Higher Education. Taylor and Francis.

6) Borrego, M., Foster, M. J., & Froyd, J. E. (2014). Systematic Literature Reviews in Engineering Education and Other Developing Interdisciplinary Fields. Journal of Engineering Education, 103(1), pp. 45-76.

7) Blosser, E. An examination of Black women's experiences in undergraduate engineering on a primarily white campus: Considering institutional strategies for change. Journal of Engineering Education. September 2019, pp. 58-71.

8) Chesler, N.C. & Chesler, M.A., 2002. Gender-informed mentoring strategies for women engineering scholars: On establishing a caring community. Journal of engineering education, 91(1), pp.49-55.

9) Haupt, T. and Fester, F., 2012. Women-owned construction enterprises: A South African assessment. *Journal of engineering, design, and technology*, 10(1), pp. 52-71.

10) Hunt, J., 2016. Why do women leave science and engineering? ILR Review, 69(1), pp.199-226.

11) Ijagbemi, C.O., Kanakana, M.G. & Campbell, H.M., 2017. Interventions and pathways for South African women in engineering and the built environment professions. *African Journal of Science, Technology, Innovation and Development*, 9(6), pp.669-678.

12) Jesson, J., Lacey, F.M. & Matheson, L., 2011. Doing your literature review: Traditional and systematic techniques.

13) Khasawneh, R., & Hijazi, R. (2021). Peer Mentoring Women in STEM: An Explanatory Case Study on Reflections from a Program in Jordan. Journal of STEM. Mentoring & Tutoring: Partnership in Learning, 29(3), pp284-304.

14) Kwak, N., & Ramirez, F. O. (2019). Is Engineering Harder to Crack than Science? A Cross-National Analysis of Women's Participation in Male-dominated Fields of Study in Higher Education. Annual Review of Comparative and International Education, 37, pp. 159-183.

15) Khan N & Qureshi M 2020. A systematic literature review on online medical services in Malaysia.

16) Lourens, A., 2014. The development of co-curricular interventions to strengthen female engineering students' sense of self-efficacy and to improve the retention of women in traditionally male-dominated disciplines and careers. *South African Journal of Industrial Engineering*, *25*(3), pp.112-125.

17) Mahabeer, P., Nzimande, N., & Shoba, M. (2018). Academics of Colour: Experiences of Emerging Black Women Academics in Curriculum Studies at a University in South Africa. Agenda, 32(2), pp. 28-42. DOI: 0.1080/10130950.2018.1460139.

18) Maqubela, N.L., Mulaudzi, T.P., Muleya, A., & Raselekoane, N.R. (2019). Attitudes of Academicians towards Gender Equality at Institutions of Higher Learning in South Africa. AFFRIKA: *Journal of Politics, Economics and Society,*9(1) pp. 27-53.

19) Mbukanma, T., & Strydom, F. (2022). Challenges to and Enablers of Women's Advancement in Academic Careers at a Selected South African University. Journal of Higher Education Research.

20) Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P., Stewart, L.A. & Prisma-P Group, 2015. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic reviews*, 4, pp.1-9.

21) Maurer, J.A., Choi, D. & Hur, H., 2021. Building a diverse engineering and construction industry: Public and private sector retention of women in the civil engineering workforce. *Journal of Management in Engineering*, *37*(4), article number .04021028.

22) Nena, T.D., Musonda, I. & Okoro, C.S., 2022. A Systematic Review of the Benefits of Automation Inspection Tools for Quality Housing Delivery. In *IOP Conference Series: Materials Science and Engineering*, Vol. 1218, No. 1, pp. 1-9.

23) O'Donoghue-Lindy, L. (2008). Comparative International Experiences in Promoting Women's Participation and Position in the STEM. Master's Thesis, University of Pretoria https://search.proquest.com/openview/22f0df0104c858e724662d0edf8ad379/1?pq-origsite=gscholar&cbl=2026366&diss=y

24) O'Connell, C. & McKinnon, M., 2021. Perceptions of barriers to career progression for academic women in STEM. *Societies*, *11*(2), pp. 27.

25) Okoli, C., 2015. A guide to conducting a standalone systematic literature review. *Communications of the Association for Information Systems,* 37.

26) Ramabodu, M. & Nena, T.D., 2024. Unpacking Demographics-Based Impediments to Professionalization in the South African Built Environment. MDPI: *Buildings*, *14*(2), pp.501.

27) Smith, J. (2021). I Still Wanna Be an Engineer: Women, Education, and the Engineering Profession. Engineering Education Review.

28) Snyder, H., 2019. Literature review as a research methodology: An overview and guidelines. Journal of Business Research, 104, pp. 333-339.

29) Swafford, M. & Anderson, R. Addressing the Gender Gap: Women's perceived barriers to pursuing STEM careers. Journal of Research in Technical Careers Vol. 4, May 2020, pp. 61-74

30) Toolo, L. L. (2018). An awareness programme to improve participation of young women in the science, technology, engineering, and mathematics (STEM) fields in South African universities (Doctoral dissertation, University of South Africa). Retrieved from https://core.ac.uk/download/pdf/231922996.pdf

31) Watt, S., 2010. Facilitating the Advancement of the Next Generation of Women Faculty: Female Graduate Students and Postdoctoral Associates. In *Mentoring Strategies to Facilitate the Advancement of Women Faculty*, pp. 11-25. American Chemical Society.