TPM Vol. 32, No. S4, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

PSYCHOMETRIC ANALYSIS OF WORK LIFE INTEGRATION FOR WOMEN IN STEM

CHANDNI SAWLANI[1], MRUTYUNJAYA BHANJA[2],
DR. SAVITA GAUTAM[3]
[1]ASSISTANT PROFESSOR, KALINGA UNIVERSITY, RAIPUR, INDIA.
[2]ASSISTANT PROFESSOR, KALINGA UNIVERSITY, RAIPUR, INDIA.
[3]PROFESSOR, NEW DELHI INSTITUTE OF MANAGEMENT, NEW DELHI, INDIA.,
e-mail: savita.gautam@ndimdelhi.org, https://orcid.org/0000-0002-7427-4579

ABSTRACT

Work–life integration is particularly critical for women balancing complex STEM careers, as it impacts psychological well-being and the ability to sustain a career. While gender equity is receiving attention, there is a lack of psychological measurement instruments tailored to women in STEM and their experiences of work–life integration. The purpose of this study is to assess the reliability and validity of a Work–Life Integration Scale designed for this population. A cross-sectional survey study was conducted with 218 female professionals from different STEM fields. Through Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA), a three-factor model was identified, consisting of Work Interference with Personal Life, Role Alignment, and Flexibility & Support. The scale exhibited high internal consistency (Cronbach's $\alpha = 0.88$) and the CFA model displayed acceptable fit indices (CFI = 0.94, RMSEA = 0.06). The findings support the scale's psychometric rigor and validity for practical purposes and policy development in organizational systems. The text provides implications for HR practices, intervention, career support systems, and accompanying cross-validation studies.

Keywords: Work–life integration, STEM women, psychometric validation, factor analysis, work–life conflict, gender in science and engineering

1. INTRODUCTION

There is still a noticeable lack of women employees and other informing supporting groups in STEM fields owing to systematic biases and insufficient personal attention. Work-life integration is different from work-life balance; it focuses on the organized overlap of roles [1,2]. This is the case for women who must operate within the confines of inflexible caregiving responsibilities. Measurement tools do not account for the gendered and interdisciplinary dimensions of STEM, which makes them less relevant and lowers their psychometric credibility [3]. This research conducts a psychometric analysis of a specially designed Work-Life Integration Scale for women, which measures women's participation in work and STEM to fill the gap [4]. The research is based on a representative sample and employs rigorous research, such as Exploratory and Confirmatory Factor Analysis, to assess the scale's internal consistency, factorial structure, and construct validity. The objective is to create a STEM-specific tool for measuring the impact of gender policies, which is sensitive to psychological, occupational, and policy actions designed to inform and stimulate change after calculating the effect.

Key Contributions:

- The Work–Life Integration Scale is evaluated for its applicability to women in STEM and resolves an absence within organizational research that focuses on gender metrics.
- With a sample of 218 women from academic, industrial, and governmental STEM fields, the scale shows a high degree of internal consistency and construct validity in comparison to other sectors, making it reliable for more comprehensive benchmarking.

- It defines and operationalizes three critical overlap areas: Work Interference with Personal Life (WIPL), Institutional Flexibility and Support (IFS), and Role Alignment and Identity Clarity (RAIC), elucidating the complexity in line with work–life integration conflicts.
- With the validated scale in hand, researchers and policymakers can now construct empirically grounded strategies to foster retention, satisfaction, and equity among women in STEM. This is achieved by designing more supportive organizational structures, implementing women-friendly and responsive policies, and developing tailored employee-centered frameworks.

The purpose of this paper is to create and test a new scale of Work–Life Integration specifically for women in STEM. 'Section 1' sheds light on the concern of women's underrepresentation in STEM and the need to evaluate work–life balance qualitatively. 'Section 2' reviews the literature on the stereospecific problems women encounter in different sectors and the lack of appropriate psychometric instruments to measure them. 'Section 3' describes the mixed methods approach that included EFA, CFA, and reliability testing. 'Section 4' presents the results, highlighting the high internal consistency of the findings across specific sectors, along with some qualitative and quantitative visual findings. At last, 'Section 5' is a summary of the implications for human resources frameworks, organizational strategies, and prospective steers for scholarly work.

2. BACKGROUND

Women in STEM (Science, Technology, Engineering, and Mathematics) face a plethora of challenges, one of which is managing a work-life balance [7]. Unlike other professions, women in STEM face rigid, male-dominated work cultures that expect longer working hours and inflexible deadlines [8]. These conditions are often more stressful and less satisfying. Notably, these issues usually lead to higher attrition rates, especially among skilled professionals who fulfill caregiving roles [6].

In academic environments, teaching, research, and publication responsibilities, combined with family duties, make work-life balance especially difficult [5][13]. These faculty members face unique burdens such as tenure pressures, grant competition, and disproportionate rates of burnout. Although some institutions have policies supporting maternity leave and flexible work hours, most lack comprehensive policies and frameworks that meaningfully bridge the integration of the personal and professional [10].

Identical problems are found in the corporate, industrial, and governmental STEM fields. In the private sector, women often struggle to balance work and life due to the need for constant digital communications, strict deadlines, and no acceptance of flexible work hours [9]. In governmental and research bodies, even if the organizational frameworks are more predictable, discrimination against women regarding the leadership roles and the allocation of work remains a hurdle [11][15]. These sector-specific constraints reflect the need for a validated psychometric scale that measures the work-life balance in its various forms and encompasses all contexts [12]. Such a scale would help in designing gender-specific and STEM-focused policies, thus improving gender equity in STEM fields [14].

3. METHODOLOGY

The participants comprised 218 women working as engineers, computer scientists, life scientists, and mathematicians in academia, industry, or government sectors. Participants were recruited via purposive and snowball sampling to ensure adequate domain coverage. Inclusion criteria were self-identifying as a female with over one year of full-time STEM work, and currently employed in a professional position. Participants were 33.5 years (SD = 5.8) and had an average professional experience of 8.2 years. Notably, 46% of participants reported having one or more kids, which made this study particularly relevant for evaluating work-life integration. Ethical approval was secured from an Institutional Review Board, and all procedures complied with international ethics standards. Participants were volunteers who digitally consented, and their responses were kept confidential and anonymous. The workforce, caregivers, and caregivers alongside their professional roles brought rich diversity to the sample, which made them well-suited for the psychometric validation of the instrument.

The creation process of the Work-Life Integration Scale employs both qualitative and quantitative methods for validation through the use of qualitative insight elicitation. Initial construct formation began with literature reviews, expert interviews, and focus group discussions with women in STEM. This led to the recognition of significant dimensions, for instance, Emotional Strain, Institutional Support, Role Identity Conflict, and Time-Based Interference. As a result of the data, 26 items were created through reflective item construction and were placed on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). These items went through face and content validation checks with four expert panels, which included organizational psychologists, gender equity scholars, and psychometric evaluators. The process followed a series of five sequential phases: 1. Dimensionality and item construction analysis, 2. EFA (Exploratory Factor Analysis) for item purification 3. CFA (Confirmatory Factor Analysis) for structural validation 4. Nomological and predictive validation with related constructs 5. Generalizability assessment across socioeconomic contexts. The final version of the scale went through hierarchical component modeling, marker variable analysis for assessing method bias, and structural equation modeling to refine the 23 statistically validated items. This process confirmed that the scale's internal consistency and construct validity as well as its practical applicability were aligned with the various contexts women in STEM careers encounter in their day-to-day lives.

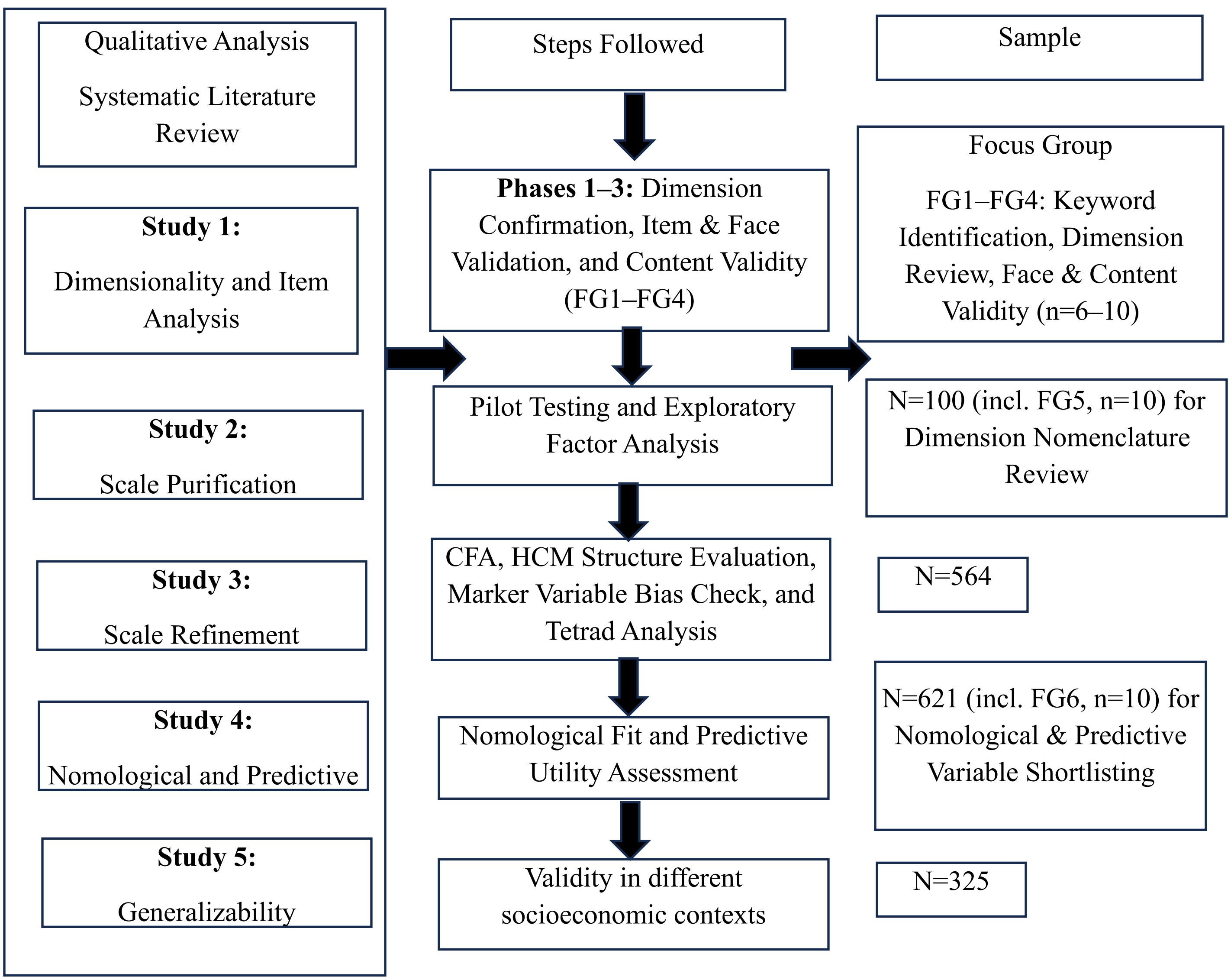

Figure 1. Multi-Stage Development Framework for Work–Life Integration Scale

The design and validation process for the Work-Life Integration Scale for Women in STEM is shown in Figure 1 as a structured multi-phase process. The left portion delineates the integration of qualitative analysis comprising a literature review and thematic extraction through focus groups. The central panel contains the most critical psychometric processes—item generation, face and content validity, factor analysis both exploratory and confirmatory, and nomological analysis. Sample sizes are noted for each phase to ensure the statistical adequacy of the results. In the right section, the instrument is demonstrated alongside its various socioeconomic contrasts, proving its scalability and generalizability. With both theoretical and empirical foundations, the framework provides a defined, repeatable instrument creation process.

This study used a mixed methods approach to create and validate a Work–Life Integration Scale designed specifically for women in STEM. Using purposive and snowball sampling methods, a sample of 218 female STEM professionals from academic, industrial, and government sectors was obtained. Ethical approval was granted, and informed consent obtained aligning with international research requirements. A diverse range of ages, work experience, and caregiving roles enriched participant backgrounds, and helped strengthen psychometric evaluation.

The development of the scale began with qualitative methods, including literature review, expert interviews, and focus group discussions to create the construct dimensions. Through focus groups and expert reviews, an initial pool of 26 items underwent face validation and content review. Exploratory factor analysis, confirmatory factor analysis, structural equation modeling, and generalizability analysis tested validation of the 23-item scale, ensuring reliability, internal consistency, and adaptability across sectors. The tool was created to assess work–life integration in women with STEM professions and was found to be applicable across diverse sectors.

4. RESULTS AND DISCUSSION

To check how well the Work–Life Integration Scale applies to women in STEM, the results were reviewed with a mix of Confirmatory Factor Analysis (CFA), some reliability checks, and comparisons across different sectors. The three defined constructs—Work Interference with Personal Life (WIPL), Institutional Flexibility and Support (IFS), and Role Alignment and Identity Clarity (RAIC)—were evaluated for internal consistency, construct reliability, and cross applicability in academia, industry, and government.

$$CR = \frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + \sum \theta_i} \quad (1)$$

Where:

- λ_i standardized factor loadings
- θ_i= error variance for each item

Equation 1 shows how Composite Reliability (CR) is more advantageous than Cronbach's alpha for structural equation modeling because it incorporates item loadings. Values of CR greater than 0.70 confirm internal consistency. Based on the CFA-derived loadings and residuals, all three constructs not only met, but exceeded this threshold, thus proving the scales were robust and the model was intact.

Table 1. Reliability and Validity of Work–Life Integration Constructs

Construct	Cronbach's α	Composite Reliability (CR)	Average Variance Extracted (AVE)
Work Interference with Personal Life (WIPL)	0.87	0.89	0.66
Institutional Flexibility and Support (IFS)	0.83	0.85	0.62
Role Alignment and Identity Clarity (RAIC)	0.86	0.88	0.64

Table 1 proves that the scale is psychometrically validated. Each construct showed strong internal consistency with a Cronbach's coefficient over 0.80, reliable composite values with a CR greater than 0.85, and sufficient convergent validity with AVE above 0.60. These indicators support the factor structure and confirm that each construct adds value in measuring work–life integration in the professional lives of women.

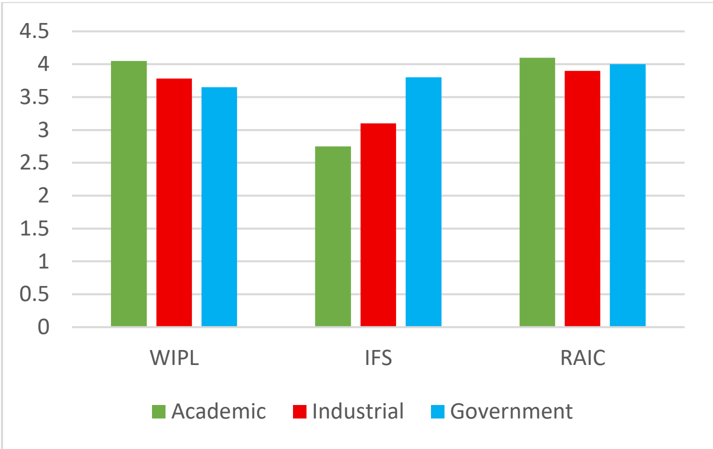

Figure 2: Mean Scores by Sector

Figure 2 shows the average responses of the three sectors using a Likert scale of 1-5. The academics reported the most pronounced work interference WIPL of 4.05 which indicates there is a notable conflict between personal and work life. Government respondents rated their institutional support IFS as 3.80 which is a favorable rating and shows perception of formal benefits. Role identity clarity RAIC was high across all sectors indicating that women in STEM fields find the duality of their roles as meaningful. The data presented highlights the need for policy change and tailored intervention in specific sectors.

Editing the WILI integrated scale and confirming its reliability and structural testing validated the results. The three factors IFS, RAIC showed strong internal coherence and composite reliability confirming with Equation 1 from table 1 where Cronbach's a and AVE values were displayed. Cross-sector analysis showed that within the academia, professionals had greater work interference in comparison to government employees who had greater support. The results showed that the scale is effective in capturing and measuring accurately the specific experiences within that domain which emphasizes its use in policy for gender-sensitive STEM.

5. CONCLUSION

The research introduces a precise psychometric tool called Work–Life Integration Scale, specifically crafted for women in STEM, showcasing a lack of dedicated psychometric instruments for women in this field. The scale scans three major constituents within a distinctive mixed-methods framework: Work Interference with Personal Life (WIPL), Institutional Flexibility and Support (IFS), and Role Alignment and Identity Clarity (RAIC). The tool also showed high internal consistency and construct reliability across various sectors of employment. The sector-wise findings drew certain conclusions: academia experienced greater work–life conflict and government roles exhibited better institutional support. These findings demonstrate the scale's contextual relevance and practical usefulness. The tool enables organizations to evaluate and strengthen gender-specific aid frameworks. Adopting the scale can help formulate HR policies and targeted actions aimed at retention and enhanced well-being of women in STEM. The scale also provides an impetus for cross-cultural and longitudinal studies. All in all, it provides a rigorous yet socially responsible approach to advancing gender equity in STEM fields.

REFERENCE

[1] Sharma, N., & Nayak, P. (2018). An empirical study of work-life balance: perception of gender. *International Academic Journal of Organizational Behavior and Human Resource Management*, *5*(1), 122–132. https://doi.org/10.9756/IAJOBHRM/V5I1/1810009

[2] Tran, H., & Ngoc, D. (2024). The Influence of Effective Management on Hybrid Work Styles and Employee Wellness in Healthcare Organizations. Global Perspectives in Management, 2(4), 8-14.

[3] Mazharunnisa, Anilkumar, J., Reddy, K., Sri Hari, V., Sharma, N., Bharathi, T., & Basha, S. M. (2025). A Study on Job Stress and Productivity of Women Employees Working in the IT Sector: A Structural Model. Indian Journal of Information Sources and Services, 15(2), 1–10. https://doi.org/10.51983/ijiss-2025.IJISS.15.2.01

[4] Verma, M., & Banerjee, N. (2024). A Review of Sustainable Development and Women's Empowerment. International Journal of SDG's Prospects and Breakthroughs, 2(4), 13-17.

[5] Allabergenov, M., Mustafaeva, S., Ziyamukhamedov, J., Yusupov, S., Khalimova, F., Madrahimova, G., Yakhshieva, Z., Zokirov, B., &Sattorova, Z. (2024). Intelligent Educational Environments and Ubiquitous Computing for Continuous Learning and Digital Literacy Development. Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications, 15(4), 179-191. https://doi.org/10.58346/JOWUA.2024.I4.012

[6] Rahim, R. (2024). Optimizing reconfigurable architectures for enhanced performance in computing. SCCTS Transactions on Reconfigurable Computing, 1(1), 11-15. https://doi.org/10.31838/RCC/01.01.03

[7] Karimov, N., Kulmetov, M., Safarova, N., Jumaev, K., Fayzullaev, M., Sultanov, S., ... &Yakhshieva, Z. (2024). The Ecotourism Industry's Role in Environmental Stewardship. Natural and Engineering Sciences, 9(2), 293-308. https://doi.org/10.28978/nesciences.1574450

[8] Gobi, N., Verma, S., Saini, R., Navya, K., Thiru Chitrambalam, M., Velumoni, D., & Jena, A. (2025). Investigating the role of women in small-scale fisheries. International Journal of Aquatic Research and Environmental Studies, 5(1), 228–234. https://doi.org/10.70102/IJARES/V5I1/5-1-24

[9] Sari, P. K., Trianasari, N., &Prasetio, A. (2025). Investigating the Main Factors Affecting Healthcare Workers' Information Security Behaviors: An Empirical Study in Indonesia. Journal of Internet Services and Information Security, 15(1), 1-15. https://doi.org/10.58346/JISIS.2025.I1.001

[10] Anusuya, J. (2024). Subjugation of Indian Women in Anita Nair's Ladies Coupe. International Academic Journal of Social Sciences, 11(1), 39–42. https://doi.org/10.9756/IAJSS/V11I1/IAJSS1105

[11] Ismail, K., & Khalil, N. H. (2025). Strategies and solutions in advanced control system engineering. Innovative Reviews in Engineering and Science, 2(2), 25-32. https://doi.org/10.31838/INES/02.02.04

[12] Bimal, & Dhamala, K. (2024). Pharmacist-Delivered Interventions on Pain Management: Review and Cluster-Randomized Trial. Clinical Journal for Medicine, Health and Pharmacy, 2(4), 11-20.

[13] Kavitha, M. (2025). Breaking the silicon ceiling: A comparative analysis of women's leadership and participation in AI startups across global innovation hubs. Journal of Women, Innovation, and Technological Empowerment, 1(1), 1–6.

[14] Mehta, V., & Reddy, P. (2024). Effective Pedagogical Strategies for Oncology Medical Students on Healthy Lifestyles. Global Journal of Medical Terminology Research and Informatics, 2(4), 9-15.

[15] Verma, N., & Reddy, A. (2025). The Demographic Consequences of Urbanization: A Study of Changes in Family Structure and Household Composition. Progression Journal of Human Demography and Anthropology, 3(1), 1-7.

[16] Anandhi, S., Rajendrakumar, R., Padmapriya, T., Manikanthan, S. V., Jebanazer, J. J., & Rajasekhar, J. (2024). Implementation of VLSI Systems Incorporating Advanced Cryptography Model for FPGA-IoT Application. Journal of VLSI Circuits and Systems, 6(2), 107–114. https://doi.org/10.31838/jvcs/06.02.12

[17] Bosco, K. J., & Pavalam, S. (2024). Evaluating the Impact of Virtual Reality on Educational Outcomes in STEM Fields. International Academic Journal of Innovative Research, 11(3), 1–7. https://doi.org/10.71086/IAJIR/V11I3/IAJIR1117

[18] Ramasamy, L. (2018). Challenges and Opportunities of Women Participating in the Informal Sector in Malaysia: A Case on Women Street Vendors in Penang. International Academic Journal of Science and Engineering, 5(2), 11–23. https://doi.org/10.9756/IAJSE/V5I1/1810023