Title: Artificial intelligence applications supporting women's career development: a scoping review

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Abstract

Background

Artificial intelligence (AI) technologies are increasingly employed in career development interventions. However, the extent to which these technologies support women's career advancement, mitigate structural barriers, and promote gender equity remains underexplored.

Objective

This scoping review systematically maps the empirical evidence on AI-driven interventions designed to support women's career development.

Methods

The review was conducted in accordance with PRISMA-ScR guidelines and pre-registered on the Open Science Framework (OSF). Twelve empirical studies published between 2018 and 2025 were identified through systematic searches across seven databases. Thematic analysis was employed to inductively synthesise the data, leading to the identification of three overarching domains: (1) bias mitigation and representation, (2) skills' development and empowerment, and (3) career pathways and retention.

Results

Findings suggest that AI interventions hold significant promise to reduce gender biases in career processes, enhancing women's professional skills and agency, and facilitating sustainable career trajectories. Nonetheless, the review reveals notable gaps, including limited longitudinal data, underrepresentation of diverse populations, insufficient theoretical integration, and ethical considerations inadequately addressed.

Conclusions

While AI-driven interventions align with conceptual propositions about their transformative potential, empirical evidence remains fragmented. Future research should prioritise longitudinal, intersectional, and theory-informed studies to ensure AI technologies effectively promote gender equity in career development.

Keywords:

Artificial Intelligence; Career Development; Gender Equity; Women in STEM; SDG-5; SDG-8; Bias Mitigation; Empowerment; Career Advancement.

Introduction

Women's participation and advancement in male-dominated industries, particularly in science, technology, engineering, and mathematics (STEM), continues to be hindered by systemic and intersectional barriers that are deeply embedded within organisational, cultural, and economic structures (Trauth, 2006; Bapna & Funk, 2021). Persistent challenges such as implicit bias, exclusionary work environments, unequal access to mentorship and professional development opportunities, and the absence of visible role models contribute to gendered disparities in career progression (Blickenstaff, 2005; Hewlett et al., 2008; Babalola et al. 2024). These impediments are not merely logistical or institutional. They shape women's sense of belonging, professional identity, career decisiveness and long-term engagement, particularly within highly competitive or male-dominated professional environments (Trauth, 2006; Khan et al., 2024).

The imperative to advance gender equity within career development has led to the proliferation of targeted interventions, most notably upskilling initiatives, networking opportunities, sponsorship schemes, and coaching and mentoring programmes (Ibarra, et al., 2010; Brown & Lent, 2020; Saffie-Robertson, 2020; Maree & Nortjé, 2023). While such approaches are foundational and often effective, their implementation is frequently limited by structural constraints, including resource scarcity, geographical disparities, and issues of scalability and sustainability (Baruch, 2004; Bapna & Funk, 2021; Terblanche et al., 2022).

In response, there is an increasing global attention to the potential of artificial intelligence (AI) technologies in overcoming such structural barriers and transforming the landscape of career support (Ding, 2024; Lent, 2025). AI systems, particularly those leveraging machine learning (ML), natural language processing (NLP), and generative models, are being integrated into a wide range of career development tools, from automated resume feedback and personalised job matching to intelligent mentoring systems and communication coaching applications (Bommasani *et al*., 2021; Mer, 2023). These technologies offer the promise of scalable, personalised, and data-informed support mechanisms that transcend the limitations of traditional human-led interventions.

The emergence of generative AI (GenAI) powered by large language models (LLMs) is of particular relevance, as it can simulate professional scenarios, generate tailored feedback, and provide context-sensitive career guidance (Ding, 2024). Such tools hold considerable potential for democratising access to career development

resources, particularly among women who face systemic exclusions from elite professional networks or high-stakes mentoring opportunities (Duan & Wu, 2024; Gedrimiene et al., 2024).

Despite these technological advancements, empirical investigations into the effectiveness, equity implications, and experiential outcomes of AI-driven career interventions remain nascent and uneven. Much of the current literature is conceptual or speculative, with relatively few studies empirically examining how AI applications affect women's career trajectories, professional agency, or identity formation (Pasha, 2021; Wang, et al. 2021; Tariq, 2025). Moreover, the theoretical underpinnings of many AI interventions are underdeveloped, with minimal engagement with established frameworks from vocational psychology, gender studies, or career development research - such as Career Construction Theory (Savickas, 2005), Social Cognitive Career Theory (Brown & Lent, 2023), the Life Design paradigm (Hartung, 2019) or the Systems Theory framework in career development (Patton & McMahon, 2006), among other well-established models.

This evidentiary gap is particularly problematic given the increasing enthusiasm with which educational institutions, employers, and governments are adopting AI tools for career guidance (Manganello *et al.*, 2025). Without a clear understanding of how such interventions function across diverse contexts, and whether they reinforce or mitigate existing inequities, there is a risk of technologically amplifying gendered disparities rather than resolving them (Dastin, 2022).

This scoping review seeks to address this critical gap by systematically mapping the emerging empirical literature on AI-driven interventions aimed at supporting women's career development. Anchored in the methodological guidance of the PRISMA-ScR framework (Tricco et al., 2018), this review synthesises findings from empirical studies published between 2018 and 2025. The objective is not only to catalogue the types of AI interventions employed, but also to analyse their supporting theoretical models (if any), the outcomes for women's career development that these interventions produce, and the ethical and practical challenges they raise.

This inquiry contributes to the international evidence base on AI and career development, with particular relevance to educational, counselling, and policy contexts where gender equity remains a critical concern. It aligns with the aims of the United Nations Sustainable Development Goals. Notably, SDG 5, which promotes gender equality and the empowerment of all women and girls, and SDG 8, which seeks to promote inclusive and sustainable economic growth, employment, and decent work for all (United Nations, 2015). By exploring how

AI technologies are currently being leveraged to support women's career trajectories, this review contributes to the evidence base informing educators, counsellors, policymakers, and technologists concerned with equitable career support. It also foregrounds critical questions regarding the intersection of digital innovation, gender justice, and vocational development. Questions that are essential for shaping the next generation of inclusive career guidance systems.

Objectives

This scoping review aims to systematically map and synthesise the existing empirical research on AI-driven interventions designed to support women's career development. The specific objectives are to:

- Identify the types of AI-based technologies and applications currently employed to facilitate women's career development;
- Examine the theoretical frameworks and conceptual models underpinning these interventions;
- Assess the career-related outcomes associated with AI-driven approaches;
- Analyse the ethical, practical, and technological challenges and risks linked to the deployment of AI in this context.

Through a systematic synthesis of peer-reviewed and grey literature, this review provides a comprehensive overview of how AI technologies are being leveraged to enhance women's career development. It also identifies critical gaps in the literature and proposes directions for future research and innovation.

Methods

Study design

This scoping review was conducted in accordance with the PRISMA-ScR (guidelines, which provide a structured framework for reviewing heterogeneous bodies of evidence, especially in emerging or interdisciplinary fields (Tricco et al., 2018). A scoping review design was selected as it allows for the systematic mapping of key concepts, types of evidence, and research gaps in areas where the evidence base is still evolving, such as the use of artificial intelligence (AI) in women's career development. To ensure methodological rigour and replicability, this review was conducted in accordance with a pre-registered protocol developed a priori. The

protocol established clear eligibility criteria, a systematic search strategy, rigorous screening procedures, and a transparent data synthesis plan. It is publicly accessible via the Open Science Framework (OSF): https://osf.io/a8qf7/?view_only=d39e5ea5225440db8e6df4e44a9b290a.

Eligibility criteria

Inclusion and exclusion criteria were defined to ensure the relevance, focus, and empirical grounding of the included literature. Eligible studies met the following criteria:

- Investigated interventions and/or technologies related to career development;
- Incorporated AI tools or techniques, including ML, GenAI, or NLP;
- Focused explicitly on women and girls, or examined gender-relevant challenges in career contexts;
- Employed empirical methods (qualitative, quantitative, or mixed);
- Were published in English.

Studies were excluded if they:

- Did not involve AI-based technologies (e.g., only discussed digital platforms without AI components);
- Focused on career guidance without a developmental or supportive intervention component;
- Were non-empirical (e.g., theoretical articles, opinion pieces, or editorials);
- Did not include a gender-specific analysis or focus on women.

Further detail on the empirical inclusion criteria and screening procedures is provided in the Appendix.

Information sources and search strategy

A systematic literature search was conducted between November 2024 and March 2025, across seven major databases, to ensure comprehensive coverage of interdisciplinary evidence: PubMed, Scopus, Web of Science, APA PsyInfo , APA PsycArticles, Psychology and Behavioral Sciences Collection and Google Scholar. The inclusion of both STEM-oriented and social science databases reflects the interdisciplinary nature of the research question, spanning educational technology, gender studies, psychology, and labour market policy.

Backward and forward snowballing techniques were applied to the reference lists of included studies to identify additional relevant publications. All sources, including those identified via snowballing, were assessed using the same screening protocol and eligibility criteria.

The search strategy was structured around three core concept clusters:

1. AI Technologies: "artificial intelligence", "machine learning", "natural language processing", "generative AI", "chatbots", "algorithmic tools".
2. Career Development: "career guidance", "career coaching", "professional mentoring", "career advancement", "skill development".
3. Gender Focus: "women's career development", "gender equity", "girls in STEM", "women in tech", "gender bias".

Boolean operators (AND/OR) and appropriate truncation symbols were applied. Searches were limited to the period 2010 to March 2025 to capture developments in AI technologies relevant to career development within a contemporary context.

Selection of sources of evidence

The screening process followed a two-step approach using Rayyan (rayyan.ai) to facilitate blinded, collaborative screening by two independent reviewers. First, duplicate records were removed (n = 131). Titles and abstracts of 702 unique records were then screened for initial relevance. Of these, 24 full-text articles were retrieved and assessed for eligibility based on the predefined criteria.

An additional twelve records were identified through snowballing techniques, of which five met the inclusion criteria. The final sample comprised 13 empirical studies. Discrepancies during screening were resolved through discussion, and a third reviewer was consulted where consensus could not be reached.

Data charting process

A structured data charting form was designed and piloted prior to full extraction to ensure consistency and completeness. For each included study, the following information was extracted:

- Author(s) and publication year;

- Country or region of study;
- Target population and sample characteristics;
- Study objectives and methodological approach;
- Type of AI technology or application deployed;
- Career-related outcomes assessed;
- Theoretical frameworks or conceptual models applied;
- Reported ethical, practical, or technological challenges.

Two reviewers independently charted the data, and 15% of entries were cross-checked by a third reviewer to ensure inter-rater reliability and internal validity.

Data analysis and synthesis

The extracted data were synthesised using an inductive thematic analysis approach, guided by the work of Saldaña (2021) and Braun and Clarke (2023). This method is well-suited for scoping reviews aiming to generate conceptual clarity across heterogeneous studies. The analytic process followed six iterative steps:

1. Familiarisation with included studies;
2. Initial inductive coding of relevant features and themes;
3. Generation of candidate thematic categories;
4. Review and refinement of themes;
5. Mapping of studies to thematic domains;
6. Final synthesis aligned with the review's research objectives.

Ethical considerations

This study did not involve primary data collection and only analysed publicly available material. As such, it did not require ethical approval. Nonetheless, ethical reflexivity was maintained throughout the process, particularly in relation to how AI technologies may reproduce or challenge gendered power structures in professional contexts.

PRISMA Flow diagram

The study selection process is illustrated in Figure 1 (PRISMA Flow Diagram). A total of 833 records were initially identified via databases and registers, with an additional 12 studies identified through snowballing. Following deduplication and screening, 13 studies were included in the final synthesis. Reasons for exclusion at each stage are clearly documented, ensuring transparency in the evidence selection pathway.

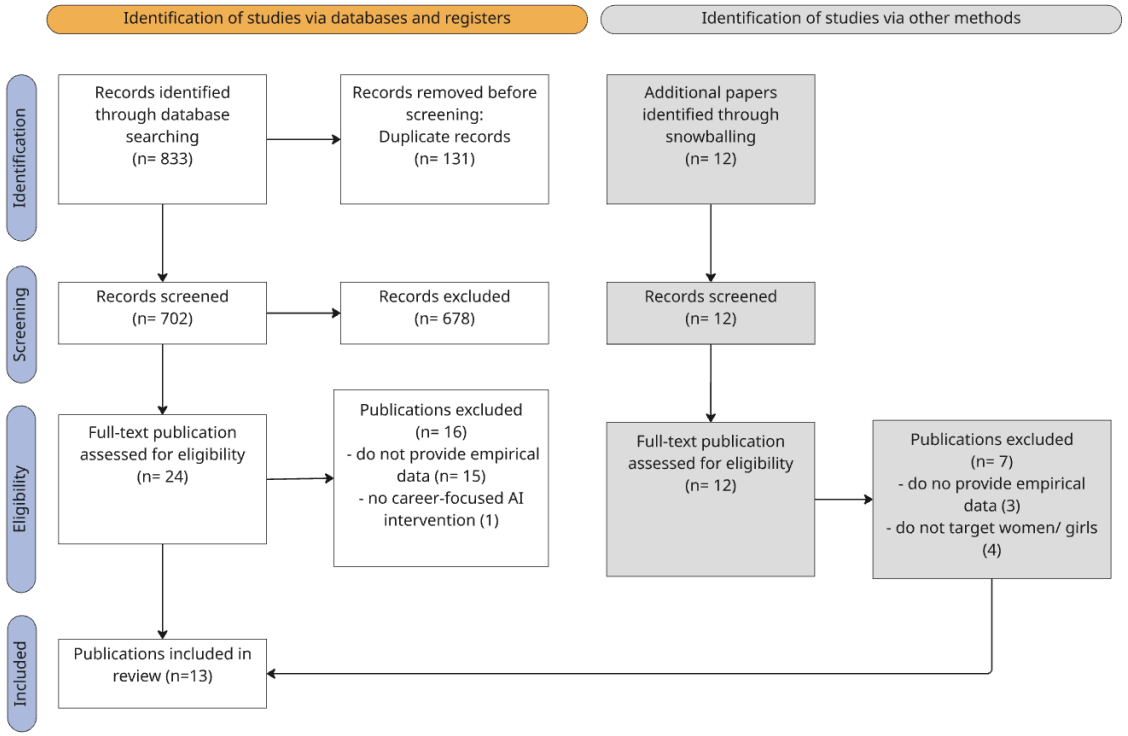

Figure 1: PRISMA flow diagram

Results

Overview of included studies

The included studies reflect a diverse range of geographical and institutional contexts, although the distribution reveals notable regional imbalance. The majority were conducted in the United States (n = 6), followed by the Middle East (n = 5), India (n = 1) and Germany (n = 1). Significantly, while Europe has been active in both gender policy and AI regulation, it was substantially underrepresented in the empirical evidence. Only one study originated from a European country (Germany), and no studies were identified from the UK, Scandinavian

countries, Eastern, or Southern Europe. This deficit suggests either a delay in empirical uptake of AI tools within vocational contexts, or limitations in the publication, dissemination, or indexing of such research.

Most of the included studies were published between 2021 and 2025, indicating the recent emergence and acceleration of research on AI interventions in women's career development. This time-frame aligns with the broader proliferation of generative AI and machine learning technologies, which have increasingly been applied to education, employment, and social inclusion domains.

Methodological characteristics

The studies employed a variety of methodological approaches, though the majority were quantitative (n = 9). These included predictive modelling, structural equation modelling, and survey-based analyses. The sample also included one qualitative narrative inquiry, one mixed-methods design, one quasi-experimental intervention study, and one design validation study. This distribution highlights a clear emphasis on data-driven and evaluative methodologies, though it also reveals a gap in longitudinal or participatory methods capable of capturing deeper experiential dimensions of women's engagement with AI tools.

Types of AI technologies employed

A broad range of AI technologies was represented across the included studies. These were predominantly:

- NLP tools, used to detect gendered language, perform sentiment analysis, or evaluate text-based artefacts such as recommendation letters and resumes;
- ML algorithms, used for forecasting attrition, recommending job matches and career paths, or evaluating hiring outcomes;
- GenAI applications, including language model-based tools for writing assistance and simulation-based coaching;

NLP and ML were the most frequently deployed technologies (n = 8), often used in tandem with large datasets from academic, HR, or platform-based sources. The use of GenAI tools - particularly for career simulations and feedback - has grown rapidly since 2023, reflecting the wider deployment of large language models in educational settings.

Target populations and career development outcomes

All included studies focused on women or girls, either exclusively or through subgroup analysis. Target populations varied in terms of career stage and social context:

- High school and university students, including girls from underrepresented ethnic or socio-economic backgrounds;
- Female educators and academic professionals;
- Early-career women in male-dominated professions, such as engineering or medicine;
- Job applicants and workforce re-entrants, often navigating career transitions after maternity leave or prolonged absence.
- General users interacting with a simulated career recommender system.

The career development outcomes assessed were diverse, but broadly fell into the following categories:

- Skill development and confidence building, including improvements in writing fluency, interview readiness, and technical literacy;
- Professional identity formation, especially in fields where women are underrepresented;
- Career paths, including returnship after prolonged absences;
- Recruitment and hiring outcomes, including application completion, perceived fairness, and algorithmic transparency;
- Work-life balance and retention, particularly through AI-enabled managerial systems and predictive analytics;
- Bias detection and representational equity, using AI tools to evaluate and challenge gendered language, visual representation, and algorithmic discrimination.

Theoretical and ethical dimensions

Despite the range of outcomes assessed, only two studies engaged fully with formal theoretical frameworks, specifically Empowerment Theory, and the Workforce Sustainability Model. Several others drew on applied conceptual orientations, such as behavioural economics or bias frameworks, but did not develop or test structured models. This lack of theoretical depth was noted across most studies, highlighting a missed opportunity to align empirical interventions with vocational psychology or gender theory.

Ethical dimensions were discussed in several studies, particularly those involving hiring algorithms or sentiment analysis. Key concerns included:

- Algorithmic bias and unintended discrimination;
- Opacity and lack of user control over AI-generated outputs;
- Cultural limitations of training data used in generative models;
- Limited stakeholder engagement, especially among women from marginalised groups.

Summary table

A comprehensive summary of the study characteristics, including year, location, AI type, population, methodology, theoretical framework, outcomes, and key findings, is provided in Table 1. This table offers a foundation for the thematic synthesis that follows, wherein studies are grouped according to the primary function of AI in supporting women's career development.

Table 1. Summary of included studies

Author(s)	Year	Country	Study type	Population	AI type	Theoretical framework	Career outcome(s)	Key findings
Alnuaimi & Tabbara	2023	UAE	Quantitative, predictive modelling	Employment data (36,897 instances)	Supervised ML (Decision Trees)	None reported	Career sustainability, attrition risk	Forecasted sustainable career paths; informed gender equity policy.
Alvarez et al.	2022	USA	Mixed methods	24 high school students (10 female, 14 male)	AI/ML curriculum with NLP APIs	Conceptual orientation (empirical inclusion studies)	AI literacy, computing career interest	Increased engagement and confidence in computing among participants.
Avery et al.	2024	USA	Field experiment	1,295 applicants; 187 hiring evaluators	AI screening automation	Conceptual orientation (behavioural economics)	Recruitment equity, application completion	AI transparency improved application rates and reduced bias.
Elmorsy et al.	2024	Saudi Arabia	Quasi-experimental (pre-post)	45 female teachers	ChatGPT-based writing intervention	Conceptual orientation (GenAI in education)	Writing fluency, confidence	Improved writing skills and confidence via ChatGPT training.
Göritz et al.	2022	Germany	Pilot evaluation	Text evaluators	NLP for gender bias detection	Conceptual orientation (gender bias in education)	Bias detection in texts	AI matched human judgement in detecting gender bias.
Heath et al.	2019	USA	Quantitative, retrospective cohort	7,326 evaluations for 521 faculty	NLP, text mining	Conceptual orientation (gendered language analysis)	Gender bias in evaluations	AI revealed persistent gendered descriptors in academic evaluations.
Lambrecht & Tucker	2018	Global	Field experiment	Digital ad platform users	ML-based ad delivery algorithm	Conceptual orientation (economic/legal theories)	Exposure to STEM careers	Algorithm prioritised men due to cost optimisation.
Meharunisa et al.	2024	Saudi Arabia	Quantitative (SEM)	180 faculty women	AI managerial systems	Empowerment Theory; Work-life	Empowerment, work-life balance	AI infrastructure linked to better empowerment outcomes.

					(ML/NLP)	Balance Theory		
Vij et al.	2023	India	Quantitative, predictive modelling	HR data from women faculty	ML (Logistic Regression, Decision Trees)	Conceptual orientation (HR analytics, attrition)	Retention predictors	Work-life balance and advancement linked to attrition.
Ramadan et al.	2024	Middle East	Quantitative, model development	962 women's resumes	NLP & ML; KNN classifier	Conceptual orientation (policy & inclusion reports)	Returnship alignment	Model aligned resumes to returnship jobs with 96.89% accuracy.
Sarraf et al.	2021	USA	Quantitative, retrospective	171 residency applicants	NLP and sentiment/emotion analysis	Conceptual orientation (bias frameworks)	Equity in medical education	LoRs showed gender bias; AI revealed emotional disparities.
Volpe & Simmons	2024	USA	Qualitative, narrative inquiry	7 early-career women engineers	Generative AI (image-based)	Workforce Sustainability Model (Gambatese et al., 2019)	Representation, identity in engineering	AI visuals reinforced male-dominated imagery; alternatives were more inclusive.
Wang et al.	2021	USA	Field experiment	308 general users (study 1) 296 general users (study 2)	Simulated AI career recommender (biased vs. debiased algorithms)	Conceptual orientation (HCI and fairness research)	Recommendation acceptance, perceived fit, trust	Users preferred gender-stereotypical recommendations, even when less accurate; human bias undermined algorithmic fairness.

Thematic content analysis

The synthesis of the 13 included studies revealed three overarching themes that capture the distinct yet interrelated ways in which artificial intelligence (AI) technologies are being utilised to support women's career development. These themes emerged through an inductive thematic analysis process and represent both the technical functions of AI tools and the developmental, experiential, and institutional outcomes they are designed to influence. The three themes identified are:

1. AI for Bias Mitigation and Representation: AI technologies deployed to identify, reduce, or counteract gender biases in recruitment, evaluation, and representation systems.
2. AI for Skills Development and Empowerment: AI-enabled interventions that facilitate skill acquisition, confidence building, and professional agency for women across diverse career stages.
3. AI for Career Pathways and Retention: Predictive and assistive AI tools used to support career progression, re-entry, and long-term retention in the workforce.

These themes reflect the diverse mechanisms through which AI facilitates women's career inclusion and advancement, from addressing structural inequities to enabling individual empowerment and organisational reform. While some studies mapped neatly onto a single thematic domain, several contributed to more than one, highlighting the interconnected nature of AI applications in this context.

To provide a structured overview of the evidence base, Table 2 presents a thematic mapping of the included studies, indicating their primary and secondary contributions to the three thematic areas. This categorisation serves as a foundation for the detailed narrative synthesis that follows, which explores how each theme manifests across different AI applications, professional contexts, and career development outcomes for women.

Table 2. Thematic categorisation

Study	Thematic focus
Avery et al. (2024)	AI for bias mitigation and representation; AI for career pathways and retention
Göritz et al. (2022)	AI for bias mitigation and representation
Heath et al. (2019)	AI for bias mitigation and representation
Lambrecht & Tucker (2018)	AI for bias mitigation and representation
Sarraf et al. (2021)	AI for bias mitigation and representation
Volpe & Simmons (2024)	AI for bias mitigation and representation
Wang et al (2021)	AI for bias mitigation and representation
Alvarez et al. (2022)	AI for skills development and empowerment
Elmorsy et al. (2024)	AI for skills development and empowerment
Meharunisa et al. (2024)	AI for skills development and empowerment; AI for career pathways and retention
Alnuaimi & Tabbara (2023)	AI for career pathways and retention
Ramadan et al. (2024)	AI for career pathways and retention
Vij et al. (2023)	AI for career pathways and retention

The following subsections provide a detailed synthesis of each thematic category, illustrating the specific roles AI played in shaping women's professional experiences and outcomes.

Theme 1: AI for bias mitigation and representation (n=7)

AI technologies are increasingly being harnessed to detect and address entrenched gender biases across evaluative, representational, and recruitment contexts. This theme synthesises evidence from five studies that illuminate how AI tools, particularly natural language processing (NLP), machine learning (ML), and generative AI, are employed to identify and either perpetuate or mitigate gendered disparities in professional settings.

Textual bias detection in evaluative materials

Sarraf et al. (2021) conducted a retrospective analysis of over 600 letters of recommendation (LoRs) for surgical residency candidates using IBM Watson NLP tools and sentiment analysis. Their findings revealed systematic gendered language, with LoRs for female applicants showing more gendered wording and less positive sentiment compared to those for male counterparts, even after adjusting for academic metrics. Notably, the AI system detected greater emotional language in LoRs for women, with "joy" increasing over time yet remaining

lower than for male applicants. The study demonstrated that AI could robustly detect implicit biases in linguistic tone and content, suggesting its utility for institutional audit and reform in academic evaluations.

Similarly, Göritz et al. (2022) developed an automated gender bias detection system using an AI-enhanced classifier aligned with human judgement to identify biased phrases in educational texts. Their work confirmed that AI systems could reliably replicate human sensitivity to bias while providing scalable solutions for institutional settings, reinforcing AI's potential for real-time monitoring of gender representation across curricula and training materials.

Bias in recruitment and advertising

In the recruitment context, Avery et al. (2024) conducted two field experiments involving AI-based candidate assessment tools. Their results indicated that the transparent and regulated use of AI tools mitigated gender disparities in application and hiring rates in tech industries, particularly by reducing ambiguity and enhancing perceived fairness in evaluations.

Conversely, Lambrecht and Tucker (2018) highlighted how ML algorithms, optimised for cost-efficiency in digital advertising, inadvertently amplified gender disparities. Their study showed that men were disproportionately targeted for STEM job ads, not due to discriminatory intent, but because ML systems selected demographics most likely to click, reflecting existing social biases. This underscores how AI, when left unchecked, can reproduce structural inequalities even in ostensibly neutral systems.

Bias in visual representation and occupational stereotyping

Volpe and Simmons (2024) examined AI-generated imagery of engineering workplaces and found a profound gender gap: among 100 images, not a single engineer depicted was a woman. The study then utilised AI to generate images inspired by early-career women engineers' narratives, revealing a stark contrast in visual themes, moving from sterile, male-centric depictions to inclusive, vibrant, and collaborative spaces. These findings suggest that generative AI tools, unless deliberately guided, are prone to reflect dominant occupational stereotypes, but can also be harnessed to amplify marginalised perspectives when prompted ethically and inclusively.

Bias in user interaction with AI career tools

Wang et al. (2021) conducted two experimental studies examining user responses to gender-stereotypical versus fairness-aware AI-generated career recommendations. Despite the availability of debiased suggestions generated through counterfactual fairness techniques, participants overwhelmingly favoured stereotype-congruent options. These findings underscore a critical tension between algorithmic fairness and human bias: even when AI systems are designed to promote equity, user preferences may reproduce entrenched gender norms. This study reveals that technical solutions alone are insufficient and must be paired with strategies that address user attitudes and behavioural reinforcement of stereotypes.

Synthesis and implications

Collectively, these studies reveal AI's dual potential: while it offers sophisticated tools to identify and expose biases, its deployment must be critically monitored to avoid reinforcing existing inequities. Importantly, the evidence points to the need for ethical design, diverse training data, and critical human oversight in all AI applications intended to support equity in career development - while also attending to the social dimensions, particularly how end-users engage with and interpret AI-generated outputs.

This theme establishes that AI, when responsibly applied, can serve as both diagnostic and transformative, making the invisible visible, and enabling targeted interventions to foster more inclusive professional and educational environments for women.

Theme 2: AI for skill development and empowerment (n=3)

Beyond mitigating bias, AI technologies are being actively integrated into educational and professional development programmes to cultivate women’s skills, confidence, and career readiness. This theme captures how AI applications are purposefully designed to enhance technical competence, foster self-expression, and strengthen professional identity, particularly among women in early career stages or underrepresented domains. The evidence reveals that AI can function not only as an instructional tool but also as a catalyst for empowerment, supporting women’s active participation and leadership in evolving work environments.

Generative AI for writing and self-authorship

Elmorsy et al. (2024) examined the integration of ChatGPT into a professional development programme for female kindergarten teachers in Saudi Arabia. Using a quasi-experimental design with pre- and post-tests, the study revealed statistically significant improvements in participants' planning, writing production, and revision skills following AI-enhanced training sessions. ChatGPT was instrumental in fostering self-authorship - defined as the ability to articulate personal values and professional perspectives through writing. The structured sessions facilitated the development of original educational materials, thereby empowering educators to exercise creative and intellectual autonomy in their pedagogical practice.

Confidence building through curricular interventions

In a high school context, Alvarez and collaborators (2022) implemented an AI-integrated summer curriculum designed to introduce machine learning and programming to female students. The curriculum strategically employed socially relevant applications, such as AI in environmental justice and criminal law, to align with interests commonly expressed by young women. Survey data showed significant gains in confidence and perceived knowledge of computer science roles and responsibilities. These findings suggest that contextualising AI education within socially impactful domains can meaningfully enhance both skill acquisition and identification with computing careers.

Institutional empowerment through AI-informed management

At the organisational level, Meharunisa and collaborators (2024) evaluated the impact of AI-driven managerial infrastructure on women's empowerment and work-life balance in Saudi academic institutions. The study identified a positive correlation between AI-enhanced institutional agility and the empowerment of female staff, mediated by improved access to flexible systems, supportive policies, and real-time feedback mechanisms. Notably, the deployment of AI systems facilitated the redistribution of managerial oversight and administrative load, contributing to an environment more conducive to women's sustained professional engagement.

Synthesis and implications

AI can serve as a multifaceted enabler of women's professional growth, especially when integrated into supportive learning environments and institutional frameworks. Whether used to develop writing fluency and self-authorship, increase confidence in technical domains, or restructure managerial systems to better

accommodate work-life balance, AI interventions show promise in fostering sustained engagement, professional agency, and skill acquisition. However, their success depends heavily on intentional design, contextual sensitivity, and alignment with learners' values and aspirations. Embedding AI tools within pedagogically grounded, equity-informed programmes is therefore essential to fulfilling their empowering potential.

Theme 3: AI for career pathways and retention (n=5)

Ensuring women's sustained engagement in the workforce demands equitable access and development opportunities, but more importantly, it requires systems that support long-term retention and career progression. Recent studies reveal how artificial intelligence is being integrated into both organisational infrastructure and predictive modelling frameworks to anticipate attrition risks, align opportunities with women lived realities, and strengthen institutional responsiveness. This theme synthesises evidence on how AI contributes to the creation of more sustainable, inclusive career trajectories for women.

Predictive modelling for career sustainability

Alnuaimi and Tabbara (2023) employed machine learning algorithms to analyse demographic and employment data, producing predictive models for career continuity among women in the UAE's private sector. Their findings identified key variables - such as educational attainment, marital status, and organisational setting - that influenced long-term retention. By forecasting the likelihood of sustainable employment, the model offered actionable insights for organisational planning and policy design aimed at reducing female workforce attrition.

Vij et al. (2023) developed an Arabic NLP-powered resume parsing system designed to match women jobseekers with suitable career opportunities. The AI model accounted for regionally specific cultural needs, such as accommodating flexible work arrangements during Ramadan, which enhanced job fit and retention potential. Their study emphasises how culturally adaptive AI can act as a bridge between institutional needs and women's socio-religious responsibilities, improving inclusivity and long-term engagement.

AI in organisational management and work-life balance

In the academic sector, Meharunisa and collaborators (2024) investigated the impact of AI-enabled institutional agility on women's empowerment and retention. The findings demonstrated that AI-informed managerial systems, such as automated workflows and responsive feedback mechanisms, reduced bureaucratic burden and

improved work-life integration. These factors significantly influenced retention, particularly among women balancing caregiving responsibilities and academic careers, confirming that AI can play a pivotal role in organisational reform when aligned with gender-sensitive practices.

Synthesis and implications

Together, these studies show that AI has a critical role to play in designing and sustaining inclusive career ecosystems for women. Predictive analytics offer institutions powerful tools to identify and mitigate attrition risks, while intelligent systems at the organisational level can help reshape work environments to retain diverse talent. Notably, models that are culturally attuned, such as those that respect religious observances or familial structures, demonstrate the importance of contextual sensitivity in AI design. As such, the long-term success of AI in supporting women's career retention depends not only on its technical accuracy, but on its ethical adaptability and contextual knowledge.

Discussion

This scoping review reveals the emerging empirical landscape of artificial intelligence (AI) interventions aimed at supporting women's career development. Drawing on 13 studies published between 2018 and 2025, the review encompassed a broad range of AI technologies, including natural language processing (NLP), machine learning (ML), and generative AI, applied across varied professional, educational, and organisational contexts. The thematic analysis revealed three primary domains of intervention: (1) addressing bias and enhancing representation, (2) fostering skills and empowerment, and (3) enabling personalised career pathways and long-term retention.

The findings suggest that while empirical work in this area is still nascent and geographically uneven, AI offers tangible opportunities to address longstanding structural barriers to women's career advancement. These include implicit evaluative bias, underrepresentation in technical sectors, and systemic retention challenges. Importantly, several studies demonstrated AI's capacity to empower women through personalised learning, inclusive recruitment, and context-aware organisational systems. However, realising these benefits depends on the ethical design, inclusive implementation, and context-sensitive evaluation of AI technologies, especially in settings where gender norms, institutional cultures, and technological infrastructures vary considerably (Buchanan, 2025).

Prior conceptual literature has widely theorised AI's transformative potential for gender equity in vocational and educational guidance. Scholars have argued that AI can mitigate bias in hiring and selection processes (Syeda, 2023; Upadhyay & Khandelwal, 2018), promote leadership diversity (Abuwatfa *et al*., 2021; Domrös-Zoungrana *et al*., 2024), and support skill development through digital coaching and personalised learning environments (Mer, 2023; Pasha, 2021). Leung and collaborators (2023) further proposed that AI-powered text analysis could illuminate subtle linguistic biases in recommendation letters and faculty evaluations.

Yet, much of this literature remains theoretical or programmatic, with limited empirical substantiation. This evidence-based review brings to light that while real-world applications are indeed emerging, they are fragmented in scope and typically confined to pilot or experimental contexts. For instance, although several studies supported the use of NLP and ML tools to identify and reduce bias, others highlighted the risk of algorithmic reinforcement of inequities, especially when models are trained on unrepresentative data or optimised for efficiency over fairness (Lambrecht & Tucker, 2018).

Regarding empowerment and development of skills, AI tools such as ChatGPT were shown to enhance writing fluency, confidence, and self-authorship, particularly among early-career women and educators (Elmorsy *et al.,* 2024). Nevertheless, the absence of longitudinal or comparative designs limits our ability to assess the sustainability and generalisability of these outcomes. Theoretical claims about AI's role in supporting work-life balance (Abuwatfa *et al*., 2021) were echoed in studies demonstrating that AI-enabled institutional agility contributed to greater satisfaction and reduced burnout among women faculty (Meharunisa *et al*., 2024). However, these findings remain contingent on organisational will and infrastructural readiness and often do not engage with deeper structural or intersectional barriers.

In sum, while AI presents significant potential as a catalyst for women's career advancement, this promise is not self-fulfilling. Realising it requires deliberate, interdisciplinary, and ethically attuned approaches that address the unequal power structures shaping who designs, controls, and benefits from AI systems. These approaches must also account for data governance and the broader social contexts in which technologies are embedded. The findings of this review highlight the need to move beyond speculative discourse towards empirically grounded and critically reflective research agendas.

Implications for practice and policy

The findings of this review underscore the imperative for both technology developers and institutional stakeholders to integrate gender-sensitive design and governance principles into the development and deployment of AI interventions aimed at enhancing women's career development.

For technology developers and implementers

For technology developers and implementers, advancing gender equity in career development through AI requires a commitment to inclusive, ethical, and context-sensitive design. This includes curating diverse datasets that reflect the realities of women across racial, socio-economic, and life-stage differences. It also involves embedding bias auditing, system explainability and transparency, and user-centred feedback mechanisms. Finally, developers must ensure that systems are scalable without sacrificing personalisation or cultural relevance. These design imperatives are critical to ensuring that AI serves as a tool for equity rather than a vector for exclusion.

For policymakers and educational leaders

Policymakers and educational leaders play a critical role in ensuring that AI is implemented responsibly and ethically in career development. This includes incentivising and regulating interventions that address gender disparities in employment, leadership, and education; directing funding towards the co-design of AI systems with women's organisations and marginalised communities; and advancing digital literacy initiatives for women and girls, particularly in contexts where access to emerging technologies remains unequal. Such measures are essential to embedding gender equity within the broader governance of AI.

These interventions should align with international Sustainable Development Goals, including the SDG 5 and SDG 8 (United Nations, 2015), and be informed by critical insights from digital inclusion and feminist technology studies (Toupin, 2023; Pasha, 2024).

Future research directions

To advance knowledge and address the critical gaps identified across empirical and conceptual literatures, future research must adopt more rigorous, inclusive, and theoretically informed approaches. Key priorities include

assessing long-term impacts, applying intersectional perspectives, engaging users in participatory design, and grounding studies in robust theoretical frameworks.

Longitudinal and mixed-method studies are particularly needed to assess the sustained impact of AI interventions on women's career trajectories, professional identity, self-efficacy, and well-being. Moving beyond short-term evaluations will enable researchers to capture the developmental and systemic effects of AI over time, offering a more comprehensive understanding of its role in shaping professional futures.

Applying intersectional frameworks is also essential to examine how AI affects women from diverse and marginalised backgrounds. Research must consider compounded forms of disadvantage related to ethnicity, disability, migration, socio-economic status, and geographical location, thereby ensuring that interventions are equitable and contextually responsive.

Participatory design methodologies offer another critical avenue for future research. Aligning AI interventions with the lived experiences, preferences, and cultural contexts of women users enhances not only relevance and effectiveness, but also user trust and agency. These elements are essential for the ethical and sustainable deployment of AI technologies.

A persistent gap across the reviewed literature was the limited use of structured conceptual or theoretical frameworks to inform the design, interpretation, or evaluation of AI interventions. Only two studies - Meharunisa et al. (2024) and Volpe and Simmons (2024) - explicitly employed formal theoretical models. Meharunisa and collaborators (2024) grounded their organisational analysis in Empowerment Theory (Zimmerman, 2000), using it to examine how AI-enabled managerial systems influence women's work-life balance by enhancing professional autonomy, decision-making capacity, and overall wellbeing. Volpe and Simmons (2024), in turn, applied the Workforce Sustainability Model (Gambatese et al., 2019) to examine how AI-generated visual representations shape early-career women's perceptions of engineering workspaces, offering a theoretical lens on professional identity formation and spatial representation. There is therefore a pressing need for future research that not only expands the geographical and institutional scope of AI applications, but also deepens their integration with gender theory, vocational psychology, and socio-technical systems thinking. While several studies were informed by conceptual orientations or disciplinary methods, for example, Avery et al. (2024) drew on behavioural economics and diversity in hiring research; Heath et al. (2019) and Sarraf et al. (2021) utilised computational linguistics and algorithmic bias detection frameworks; and

Ramadan et al. (2024) engaged with socio-technical policy analysis and digital gender equity discourses, these conceptual anchors were not developed into cohesive theoretical frameworks that guided inquiry across research design, data interpretation, and implications. The absence of robust theoretical integration limits the interpretive depth, cumulative insight, and policy relevance of emerging empirical work.

As the use of GenAI expands in career development contexts, including mentoring, decision-making, and identity articulation, there is a pressing need to explore its influence on women's professional agency and autonomy. Despite rapid technological innovation, this area remains underdeveloped and requires urgent empirical and conceptual attention. Research should investigate how GenAI shapes women's perceptions of self, work, and future pathways, and whether it constrains or enhances their capacity to make meaningful, self-directed career choices. Particular attention should be paid to the risk that GenAI may reinforce existing gender biases, especially when its outputs are accepted uncritically, without adequate scrutiny or contextual interpretation.

Although bias mitigation was a recurring theme across the literature, most studies failed to engage substantively with broader ethical concerns such as algorithmic transparency, data governance, user agency, or unintended harms. Given the growing conceptual discourse advocating for robust ethical safeguards in AI deployment (e.g., Syeda, 2023), this lack of empirical scrutiny represents a concerning gap. Future research should contribute to the development of comprehensive, context-sensitive ethical evaluation frameworks for AI applications in vocational and educational contexts. These frameworks should encompass transparency, accountability, privacy, and inclusivity, and be grounded in interdisciplinary perspectives that reflect the complex realities of users' lives.

Addressing these limitations through methodologically rigorous, ethically attuned, and theoretically grounded research is essential for developing AI interventions that meaningfully promote gender equity in career development. Such research must move beyond descriptive accounts toward integrative, participatory, and longitudinal designs that are sensitive to the lived realities of diverse women. Only then can AI fulfil its potential as a tool for empowerment rather than exclusion in the future of work.

Conclusion

This scoping review offers the first empirical synthesis of how AI technologies are being applied to support women's career development across diverse global contexts. Through the analysis of twelve empirical studies published between 2018 and 2025, the review identified three primary thematic domains in which AI interventions operate: bias mitigation and representation, skill development and empowerment, and career pathways and retention.

The evidence affirms that while the application of AI in this field remains emergent and fragmented, it holds substantial promise for addressing structural inequities, fostering individual agency, and promoting more inclusive and sustainable career systems for women. At the same time, the findings expose critical gaps, particularly in longitudinal evaluation, intersectional design, ethical governance, and theoretical integration, that limit the scalability and generalisability of current interventions.

By bridging conceptual propositions with empirical analysis, this review contributes to a more grounded understanding of AI's role in advancing gender equity in vocational and educational guidance. It highlights the urgent need for multi-level, interdisciplinary, and ethically attuned approaches to AI development and deployment.

Future progress in this domain will depend on the capacity of researchers, practitioners, and policymakers to embed equity, accountability, and user agency at the core of the data sources used and applied by AI systems. As AI continues to reshape the landscape of career development, this review underscores the necessity of ensuring that these transformations serve to empower and sustain women's professional futures. The more capable these systems become, the more imperative it is to apply to them the evaluative frameworks and assessment models traditionally reserved for human judgement - such as those used in hiring decisions - to ensure fairness, contextual sensitivity, and responsibility in outcomes.

Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Appendix: Screening criteria and review procedures

Screening procedure

A two-stage screening process was conducted using Rayyan (rayyan.ai) to ensure rigour and reviewer independence:

- Stage 1 – Title and abstract screening: Two independent reviewers assessed 702 deduplicated records for initial relevance based on predefined inclusion criteria.
- Stage 2 – Full-text screening: 24 full-text articles were evaluated in detail. Discrepancies at either stage were resolved through discussion; a third reviewer was involved where necessary.

Inclusion criteria

To qualify for inclusion, studies had to present original data collection and analysis. Eligible methodologies included qualitative (e.g., interviews, case studies), quantitative (e.g., surveys, experiments), and mixed methods. Excluded were theoretical or conceptual papers, editorials, and literature reviews without original data.

Snowballing and additional sources

Backward and forward snowballing techniques were applied to the reference lists and citation networks of included studies. Additional sources retrieved from broad-based databases such as Google Scholar occasionally included non-traditional formats (e.g., conference papers); all were assessed using the same screening protocol and eligibility criteria as peer-reviewed articles.

Exclusion criteria

Studies were excluded if they were theoretical or conceptual papers, editorials, or literature reviews without original data. Full-text articles were excluded if they did not report original empirical data, did not involve AI-based technologies, lacked a gender-specific focus, or did not include a developmental or supportive component related to career guidance. These reasons applied equally to sources identified via database searches and snowballing. All exclusion decisions were guided by the predefined eligibility criteria and are summarised in the PRISMA flow diagram (Figure 1).