AG EDITOR

REVIEW

Gender Equality in Education: Mapping Challenges, Innovations, and Unexplored Dimensions

Igualdad de género en la educación: mapeo de desafíos, innovaciones y dimensiones inexploradas

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ABSTRACT

Introduction: gender equality in education was recognized as a critical pillar of social development, encompassing equal access, equitable learning outcomes, and expanded opportunities. Despite the global commitment through Sustainable Development Goals (SDGs) 4 and 5, systemic disparities persisted, particularly in low-income, rural, and conflict-affected regions. Cultural norms, curriculum biases, and structural inequalities continued to limit the participation of girls and underrepresented genders in education, especially in STEM fields. The COVID-19 pandemic further widened these gaps by intensifying barriers related to digital access, caregiving burdens, and school dropout.
Objective: this study aimed to map the challenges, innovations, and unexplored dimensions of gender equality in education by synthesizing peer-reviewed research published between 2020 and 2025. It sought to identify persistent barriers, examine effective interventions, and highlight emerging areas requiring further scholarly and policy attention.
Method: a systematic literature review (SLR) was conducted following the PRISMA framework. Articles published between 2020 and 2025 were retrieved from Scopus, Web of Science, ERIC, and ScienceDirect. Inclusion criteria focused on studies addressing gender equality in formal education. Thematic analysis was applied to synthesize findings, which were grouped into persistent challenges, innovations and interventions, and emerging research areas.
Results: the review identified three themes: (1) persistent barriers such as entrenched gender norms, economic constraints, and STEM underrepresentation; (2) interventions including gender-sensitive teacher training, curriculum reform, and early childhood equity initiatives; and (3) emerging areas such as digital inclusion, climate-related educational risks, and intersectional inequities.
Conclusions: achieving gender equality in education required sustained, intersectional, and context-responsive approaches. Bridging policy, pedagogy, and practice was essential for building inclusive and transformative education systems.

Keywords: Gender Equality; Inclusive Education; STEM; Intersectionality; Educational Policy.

RESUMEN

Introducción: la igualdad de género en la educación se reconoció como un pilar fundamental del desarrollo social, abarcando la igualdad de acceso, resultados de aprendizaje equitativos y la ampliación de oportunidades. A pesar del compromiso global a través de los Objetivos de Desarrollo Sostenible (ODS) 4 y 5, persistieron las disparidades sistémicas, especialmente en las regiones de bajos ingresos, rurales y afectadas por conflictos. Las normas culturales, los sesgos curriculares y las desigualdades estructurales continuaron limitando la participación de las niñas y los géneros subrepresentados en la educación, especialmente en las áreas STEM. La pandemia de COVID-19 amplió aún más estas brechas al intensificar las barreras relacionadas con el acceso digital, la carga de cuidado y el abandono escolar.

Objetivo: este estudio buscó mapear los desafíos, las innovaciones y las dimensiones inexploradas de la igualdad de género en la educación mediante la síntesis de investigaciones revisadas por pares publicadas entre 2020 y 2025. Buscó identificar las barreras persistentes, examinar las intervenciones efectivas y destacar las áreas emergentes que requieren mayor atención académica y política.

Método: se realizó una revisión sistemática de la literatura (SLR) siguiendo el marco PRISMA. Los artículos publicados entre 2020 y 2025 se recuperaron de Scopus, Web of Science, ERIC y ScienceDirect. Los criterios de inclusión se centraron en estudios que abordan la igualdad de género en la educación formal. Se aplicó un análisis temático para sintetizar los hallazgos, que se agruparon en desafíos persistentes, innovaciones e intervenciones, y áreas de investigación emergentes.

Resultados: la revisión identificó tres temas: (1) barreras persistentes como las normas de género arraigadas, las limitaciones económicas y la infrarrepresentación de las áreas STEM; (2) intervenciones que incluyen la formación docente con perspectiva de género, la reforma curricular y las iniciativas de equidad en la primera infancia; y (3) áreas emergentes como la inclusión digital, los riesgos educativos relacionados con el clima y las desigualdades interseccionales.

Conclusiones: lograr la igualdad de género en la educación requirió enfoques sostenidos, interseccionales y sensibles al contexto. Conectar políticas, pedagogía y prácticas fue esencial para construir sistemas educativos inclusivos y transformadores.

Palabras clave: Igualdad de **Género; Educación** Inclusiva; STEM; Interseccionalidad; Política Educativa.

INTRODUCTION

Gender equality in education is not only a human right but also a prerequisite for sustainable social and economic development. Yet despite decades of advocacy and reform, the pursuit of equity in education remains incomplete. While access has expanded globally, inequities in learning outcomes, representation, and opportunities continue to persist.[1,2,3] These gaps reveal that gender equality in education cannot be reduced to enrollment statistics; it requires dismantling systemic barriers that reproduce disadvantage across generations. The critical challenge today lies in bridging the gap between global policy commitments and the lived realities of marginalized learners, particularly in low-resource and crisis-affected contexts.[4,5,6]

At the global level, the Sustainable Development Goals (SDGs) link education and gender equity through SDG 4 (quality education) and SDG 5 (gender equality). Together, they emphasize education as both a pathway to and a product of greater gender equity.[7,8] Evidence shows that when girls are educated, they are more likely to participate in decision-making, contribute to family well-being, and accelerate national development.[9,10] Yet this potential remains unevenly realized, highlighting a paradox: while education is celebrated as transformative, schools often reinforce stereotypes, curriculum biases, and inequitable structures.[11,12,13] This suggests that without transforming educational institutions and practices, the 2030 SDG targets may remain out of reach.[14,15,16]

The Philippine experience illustrates these tensions. Gains in enrollment rates have been reported, but disparities persist, especially in rural and economically disadvantaged areas.[17,18] Early marriage, poverty, and gender-insensitive resources continue to drive dropout rates among girls.[19,20] The COVID-19 pandemic further intensified these inequities, restricting digital access and increasing domestic responsibilities.[21] National policies aimed at closing the gap often remain misaligned with the specific needs of female learners, reflecting the limits of generic strategies.[22] This example demonstrates how global aspirations encounter local barriers, revealing the fragility of progress and the resilience of structural inequalities.

In response, global and local movements have advanced reforms such as inclusive curricula, gender-sensitive teacher training, and gender-equity frameworks.[23,24] Grassroots initiatives have mobilized communities to challenge discriminatory norms, while digital innovations have opened new pathways for girls to access education.[25,26] However, the literature documenting these efforts remains fragmented—focused mainly on

access and enrollment, concentrated in high-income contexts, and less attentive to systemic inequities, intersectionality, and emerging risks such as climate change.[27]

This review addresses these gaps. By synthesizing research published between 2020 and 2025, it moves beyond surface-level measures of access to map the multi-dimensional nature of gender equality in education. The objective of this review is to identify and characterize persistent barriers, innovative interventions, and underexplored dimensions—particularly digital inclusion, climate-related risks, and intersectional inequities—that shape progress toward gender equality in education. Through this synthesis, the review provides evidence-based insights to guide future research, policy, and practice toward more equitable and transformative education systems.

METHOD
Research Design
This study employed a systematic literature review (SLR) to synthesize scholarly work on gender equality in education published between January 2020 and May 2025. The timeframe was selected to capture evidence from the COVID-19 pandemic and its aftermath, a period that reshaped educational access, equity, and gender dynamics. Although 2025 was still in progress at the time of review, studies published up to May 15, 2025 were included to ensure the analysis reflected the most current developments.

Only English-language articles were considered, as English is the dominant medium of high-impact, peer-reviewed publications indexed in Scopus and Web of Science. Both empirical and theoretical studies were included: empirical work contributed data on access, outcomes, and interventions, while theoretical studies provided conceptual frameworks, policy critiques, and normative perspectives that enriched the thematic synthesis.

To ensure transparency, replicability, and methodological rigor, the review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework at all stages of the process.

Search Strategy
A comprehensive search was conducted across four major academic databases—Scopus, Web of Science, ERIC, and ScienceDirect—with the final search executed on May 15, 2025. Search strings were designed using Boolean operators, truncation, and controlled vocabulary where applicable, and were adapted to each database's indexing features.

- Scopus example: ("gender equal*" OR "gender equity") AND (education OR "educational policy" OR school*) AND (STEM OR science OR technology OR engineering OR math*) AND ("inclusive education" OR "digital inclusion" OR "climate change").
- ERIC example: (DE "Gender Equality" OR DE "Sex Fairness") AND (DE "Education" OR DE "Educational Policy") AND (STEM OR "Science Education" OR "Mathematics Education") AND ("equity" OR "inclusion" OR "digital divide").
- Web of Science example: TS=("gender equal*" OR "gender equity") AND TS=(education OR "educational policy") AND TS=(STEM OR science OR technology OR engineering OR math*) AND TS=("inclusive education" OR equity OR access OR outcomes).
- ScienceDirect example: ("gender equality" OR "gender equity") AND ("education" OR "educational policy") AND (STEM OR science OR mathematics) AND ("equity" OR "inclusion" OR "digital access").

Filters were consistently applied to restrict results to peer-reviewed journal articles, English language, and publication dates between January 2020 and May 2025.

To enhance comprehensiveness, backward reference tracking was performed on the bibliographies of included studies. Additionally, grey literature (e.g., UNESCO, UNGEI, and World Bank reports) was screened for contextual insights; however, only peer-reviewed journal articles were retained in the final synthesis.

Inclusion and Exclusion Criteria
Inclusion criteria:
- Focused on gender equality or equity in formal education (primary, secondary, or tertiary);
- Empirical or theoretical peer-reviewed journal articles;
- Published between January 2020 and May 2025;
- Written in English.

Exclusion criteria:
- Studies focused solely on workplace or vocational training;
- Literature on informal education or adult literacy programs;
- Non-peer-reviewed sources (e.g., editorials, book chapters, conference abstracts).

Screening and Selection Process

All identified records were exported to Zotero, where duplicates were systematically removed. Screening followed two phases:

- Title and abstract screening to exclude irrelevant studies;
- Full-text screening to verify compliance with inclusion criteria.

To strengthen rigor and minimize selection bias, two independent reviewers conducted screening at both stages. Discrepancies were resolved through discussion, and a third reviewer was consulted when consensus could not be reached.

Data Extraction and Synthesis

A structured data extraction sheet was developed to capture key information from each included study, including author(s), year of publication, country or region, educational level, research objectives, methodology, main findings, and identified gaps. To analyze the extracted data, we employed thematic analysis following Braun and Clarke's six-step approach. First, all included articles were read in full to achieve familiarity with their content. Second, initial codes were generated inductively to capture relevant concepts related to gender equality in education, such as "access barriers," "curriculum bias," "digital inclusion," and "policy implementation." Third, codes were systematically collated and compared across studies to identify similarities, differences, and contradictions. Fourth, the codes were grouped into broader categories, from which preliminary themes were derived. Fifth, these themes were refined and reviewed against the data to ensure internal coherence and external distinctiveness. Finally, the themes were defined and named, and supporting evidence was synthesized into the results section.

Through this iterative process, three major themes were identified: (1) persistent challenges to gender equality in education, including socio-economic and cultural barriers; (2) innovative and effective interventions, such as gender-sensitive pedagogies, teacher training, and early childhood equity programs; and (3) emerging or underexplored areas, including digital inclusion, climate-related educational risks, and intersectional inequities. This approach ensured that both empirical evidence and conceptual insights were systematically integrated to capture the complexity of gender equality in education.

Quality Appraisal

To ensure the credibility and reliability of the synthesized findings, all included studies underwent a structured quality appraisal using established tools. The Critical Appraisal Skills Programme (CASP) checklist was applied to qualitative studies, while the Joanna Briggs Institute (JBI) critical appraisal tools were used for quantitative and mixed-methods research. Each study was assessed for clarity of aims, appropriateness of methodology, rigor in data collection and analysis, transparency of findings, and attention to ethical considerations. Studies that demonstrated methodological weaknesses were not automatically excluded; instead, their inclusion was carefully considered if they offered substantive thematic insights, such as novel perspectives on digital inclusion, climate-related risks, or the intersection of gender with disability, ethnicity, or rural marginalization. To mitigate potential bias arising from the integration of weaker studies, their findings were triangulated with higher-quality evidence and used primarily to highlight emerging or complementary issues rather than to substantiate core claims. This strategy ensured a balance between methodological rigor and comprehensiveness, enabling the review to remain inclusive of underexplored yet significant themes while maintaining a cautious and critical stance in interpreting their contributions.

RESULTS

Table 1 served as the analytical backbone of this systematic literature review, synthesizing 24 peer-reviewed articles into three overarching themes: (1) Persistent Challenges, (2) Innovations and Effective Interventions, and (3) Emerging or Underexplored Areas. Its structure provided a panoramic yet nuanced understanding of global scholarly efforts on gender equality in education from 2020 to 2025, reflecting both empirical findings and conceptual reflections across diverse educational settings and sociocultural contexts.

The first section of the table, "Persistent Challenges to Gender Equality in Education," compiled studies that critically examined entrenched obstacles to educational equity. These included deeply rooted patriarchal norms, curriculum and institutional biases, socio-economic constraints, and the underrepresentation of girls and marginalized genders in science, technology, engineering, and mathematics (STEM). For instance, Song[1] and Pan et al.[11] analyzed how Chinese school curricula and textbook content subtly reinforced gender roles, while Qaisrani et al. investigated how structural inequities in Pakistan's education system inhibited female participation.[5]

Table 1. Summary of Reviewed Studies Categorized by Thematic Focus on Gender Equality in Education (2020-2025)

Theme	Title	Authors	Journal	Year
Persistent Challenges to Gender Equality in Education	Gender equality education in China: inadequacy and outlook	Song J.	Journal of Education, Humanities and Social Science	2023
	The role of education in promoting gender equality in modern society	Karim D, Pattiruhu C, Chin J.	Modern Scientific Journal	2024
	Gender equality in educational institutions	Godara A.	International Journal of Scientific Research Archive	2024
	Gender equality and education â€" a conceptual study	Barathnivash V.	n/a	2024
	Exploring new pathways to gender equality in education: does information and communication technology matter?	Qaisrani A, Ahmed A.	Nust Journal of Social Sciences and Humanities	2021
	The positive effect of promoting gender equality in education on economic growth: from the perspective of gender dividend	Zeng Y.	n/a	2023
	On gender equality in junior high school English textbooks: a case study of the Chinese PEP eighth-grade textbooks	Pan Q, Zhong J.	International Journal of Social Science and Human Research	2024
	Gender equality. Conditions for ensuring gender equality in education	Cojocaru È˜, Bunea O, Cojocaru D, Neculau C, Patrascu A.	Quality in Education	2023
	Gender equality in education: a challenge for policy makers	Esteves M.	People International Journal of Social Sciences	2020
	Gender equality education in childcare: an analysis from an Islamic perspective	Aini K.	Ummul Qura Journal InstitutPesantren Sunan Drajat (Insud) Lamongan	2024
Innovations and Effective Intervention	Gender inequalities in university teaching practice: an innovative project at the University of the Basque Country	Vã©lez M, RenterÃa A, GastÃ³n A, Gurrutxaga I.	Journal of Higher Education Theory and Practice	2022
	Educating prospective teachers for a sustainable gender equality practice: survey design and validation of a self-efficacy scale	Miralles-Cardona C, Chiner E, MoltÃ³ M.	International Journal of Sustainability in Higher Education	2021
	Advancing gender equality in schools through inclusive physical education and teaching training: a systematic review	Guerrero M, Puerta L.	Societies	2023
	Promoting gender equality in early childhood education: lessons from the Nordic countries	Zeng X.	World Journal of Educational Research	2023
	Education and gender equality: pathways to the realization of women´s rights	Wu Y.	Communications in Humanities Research	2024
	Capabilities-based gender equality analysis of educational policy-making and reform in Turkey	Cin F, Karlda-Dennis E, Temiz Z.	Gender and Education	2018
	The right to education for ethnic minority women and girls in Vietnam	Yen N, Hoang D.	Journal of Southeast Asian Human Rights	2022

Emerging or Underexplored Areas Requiring Further Research	Contextualizing gender issues and inclusive education: an analysis of the perceptions of primary education teachers	Cosculluela C, Toledo S, Orós M, Ramón-Palomar J.	Teacher Development	2022
	The flow of gender equality education practices in China and the media bias in the new era: from the perspective of sociology of knowledge	Huang T, Liu X.	Advances in Social Science, Education and Humanities Research	2021
	Analysis of the educational environment in kindergartens for gender equality and preschoolers' gender-role development	Li J, Yang M.	Creative Education	2022
	New concept and new practice of gender equality education at the background of digital society	Wang W.	SHS Web of Conferences	2022
	Executive summary: education, girls' education and climate change	Sims K.	K4D Helpdesk Report	2021
	Promoting gender equality and structural change in academia through gender equality plans: harmonising EU and national initiatives	Bencivenga R, Drew E.	Gender – Zeitschrift Für Geschlecht Kultur Und Gesellschaft	2021

The second section, "Innovations and Effective Interventions," featured a smaller yet significant set of studies that highlighted proactive measures to address gender inequality. These included teacher training for gender sensitivity,[28] inclusive curriculum design,[29] and policy frameworks such as Gender Equality Plans. [30,31] The interventions were localized yet multidimensional, ranging from pedagogical shifts to institutional reforms. What made this section particularly valuable was its documentation of scalable practices rooted in specific contexts—such as early childhood equity initiatives in the Nordic countries[32]—that served as models for cross-cultural adaptation.

The third thematic grouping, "Emerging or Underexplored Areas Requiring Further Research," pointed to the need to expand the research frontier beyond traditional metrics such as access and enrollment. These studies drew attention to novel intersections—such as digital transformation, climate vulnerability, media bias, and early childhood socialization—and how these shaped gender equality. For example, Wang examined how digital societies reshaped or reproduced gender inequalities,[26] while Sims analyzed how climate change exacerbated educational vulnerabilities for girls.[22] Other studies, such as Li et al., explored the gender role development of preschoolers, suggesting that early interventions were critical for dismantling gender stereotypes at their source.[34]
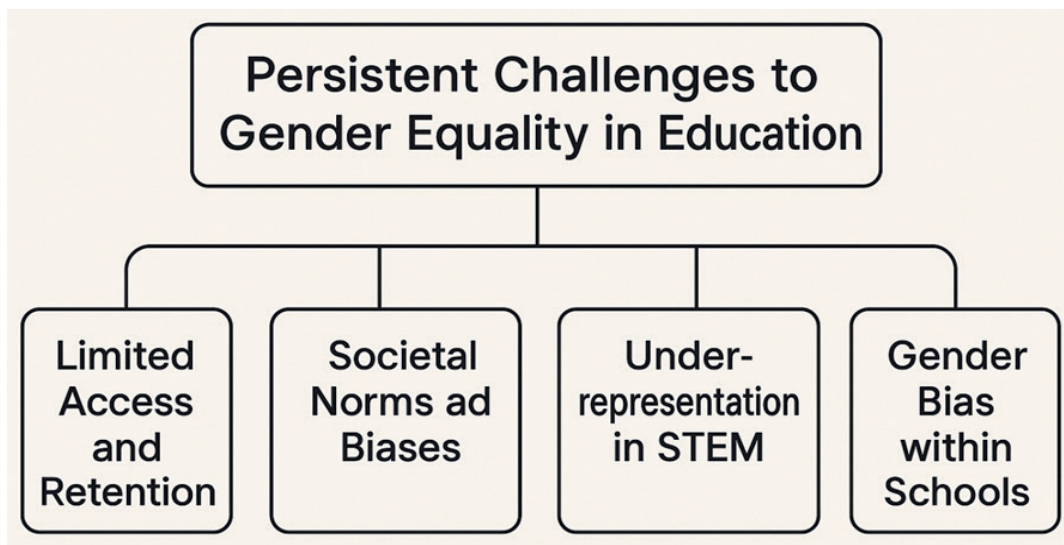

Figure 1. Persistent Challenges to Achieving Gender Equality in Education

Figure 1 illustrated the persistent challenges to achieving gender equality in education, as identified across the reviewed literature. These challenges were deeply rooted in intersecting socio-cultural, economic, and institutional structures that systematically disadvantaged girls and underrepresented genders. A major barrier highlighted was the prevalence of traditional gender norms and stereotypes, which influenced family expectations, educational policies, and classroom practices. Studies from China revealed how educational content, such as textbooks and teaching materials, continued to reinforce gender biases,[1,11] while research in Pakistan showed that gender norms in many societies still prioritized boys' education.[5] Economic constraints also remained a significant issue, particularly in low-income and rural settings, where girls were more likely to drop out due to financial pressures, early marriage, or domestic responsibilities, as noted in studies from India, Indonesia, and the Philippines.[35,36,37] Another persistent challenge was the underrepresentation of girls in STEM fields, driven by both structural limitations and cultural expectations that dissuaded girls from pursuing science and technology-related careers.[38]
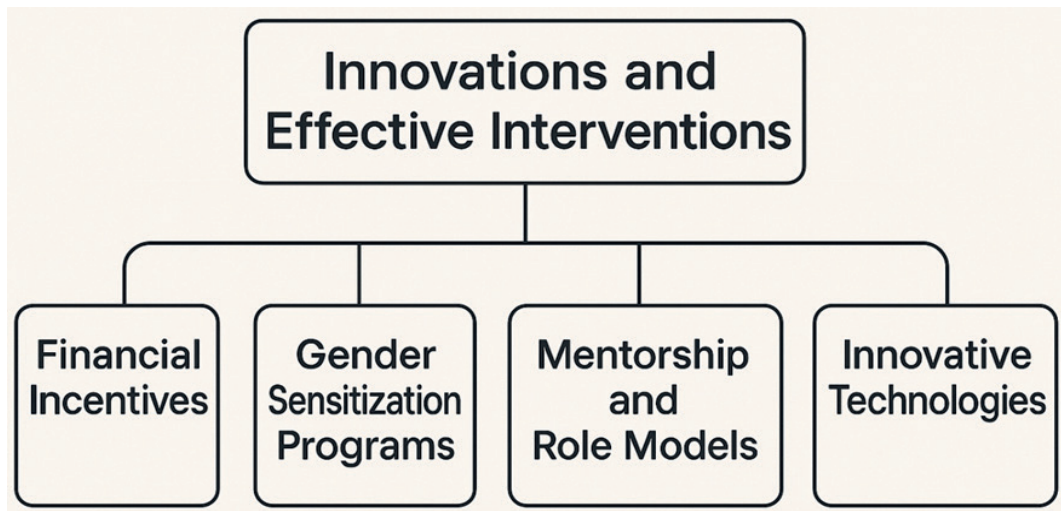

Figure 2. Innovations and Effective Interventions for Promoting Gender Equality in Education

Figure 2 illustrated the innovations and effective interventions that were implemented to promote gender equality in education, based on the synthesis of selected studies. These interventions represented proactive, context-responsive strategies aimed at addressing systemic inequities within formal educational systems. A central innovation was the integration of gender-sensitive teacher training, which equipped educators with the knowledge and skills to foster inclusive learning environments. For instance, studies emphasized the importance of preparing teachers to recognize and challenge gender biases in their pedagogy.[28,29] Curriculum reforms also emerged as a key intervention, particularly in early childhood and secondary education, where inclusive and representative content reshaped learners' perceptions of gender roles. In Nordic and East Asian contexts, early childhood programs and human rights-based approaches to education demonstrated success in promoting gender equity from the foundational years.[32,39] Another notable intervention involved institutional policy reform, including the implementation of Gender Equality Plans (GEPs) and capabilities-based policy evaluations, as evidenced in studies from Turkey and Spain.[30,31]
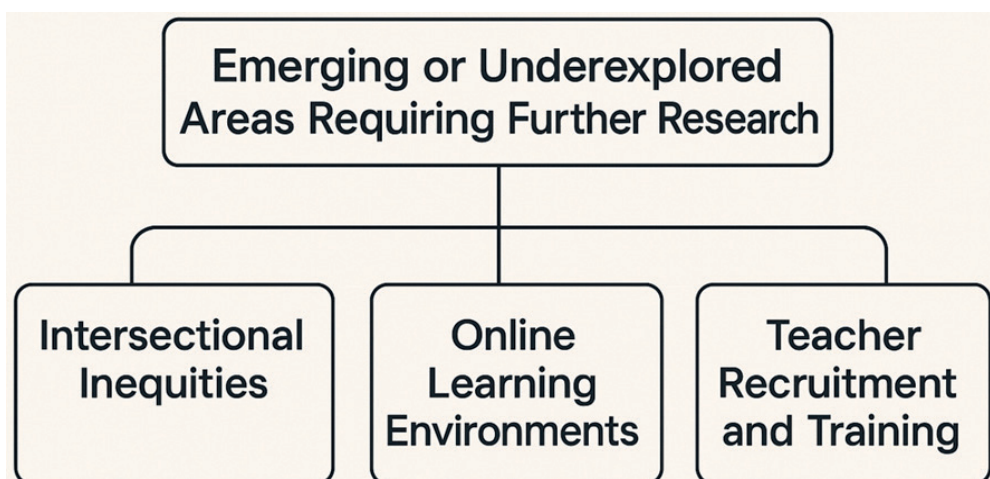

Figure 3. Emerging and Underexplored Areas Requiring Further Research on Gender Equality in Education

Figure 3 presented the emerging and underexplored areas that required further research in the pursuit of gender equality in education. These areas reflected evolving challenges and knowledge gaps that extended beyond traditional concerns of access and enrollment, signaling a need for more nuanced and forward-looking inquiry. One critical domain was the intersection of gender with inclusive education, particularly in how primary teachers perceived and applied gender-sensitive strategies in diverse classroom settings.[40] Another promising area was the impact of digital transformation on gender equality in education; research advocated rethinking gender instruction in the context of digital societies, examining how technology could both reinforce and dismantle gender barriers.[26] Similarly, early childhood education emerged as a vital stage where gender roles were first internalized; studies emphasized the role of preschool environments in shaping gender perceptions and called for more targeted pedagogical interventions at this level.[34] Additionally, climate-related risks and educational access gained attention, particularly for girls in vulnerable regions. Evidence showed that climate change disrupted girls' schooling, suggesting a new frontier for research at the intersection of environmental and gender justice.[33] Finally, policy-level studies pointed to the need for rigorous evaluations of Gender Equality Plans (GEPs) in academia, focusing on their adaptability and effectiveness across cultural contexts.[41]

DISCUSSION
Persistent Challenges to Gender Equality in Education
The persistent challenges to gender equality in education cannot be understood as isolated issues but rather as interwoven layers of a systemic problem shaped by cultural norms, structural inequities, global crises, and technological divides. These barriers operated simultaneously and reinforced one another, creating complex obstacles that continued to disadvantage girls and underrepresented genders despite significant global progress toward inclusive education.

Cultural and institutional practices that upheld traditional gender roles remained a foundational challenge. Senior leadership in educational institutions often attributed inequities to cultural factors rather than recognizing their systemic and structural nature.[42] This perspective allowed deeply ingrained biases in curricula, teaching practices, and resource allocation to persist, often subtly reinforcing stereotypes and limiting girls' educational aspirations.[43] Such cultural constraints established the conditions under which other inequities were magnified.

The COVID-19 pandemic intensified these pre-existing challenges by both exposing and deepening structural vulnerabilities. During school closures, girls in many societies bore disproportionate domestic and caregiving responsibilities, while mothers—especially those with lower levels of education—faced higher rates of job loss.[44,45] This regression in gender equity not only disrupted educational attainment but also curtailed long-term professional opportunities for women, raising concerns about intergenerational impacts.[46,47] Importantly, the pandemic intersected with cultural norms that already prioritized boys' education, making girls' dropout rates higher in many regions.

One critical dimension that emerged in the aftermath of the pandemic was the gender digital divide, which exacerbated existing inequalities in access to education. As schools transitioned to online and technology-mediated learning, girls—particularly in low-income and rural contexts—were less likely to have access to devices, stable internet, or digital literacy opportunities compared to boys.[48,49] This technological disparity limited their ability to keep pace with peers, reinforcing both cultural and economic barriers to equality in education.

Contextual barriers, particularly in regions such as Pakistan, further demonstrated how socio-economic constraints and entrenched gender norms converged to restrict girls' access to education.[35] Structural inequities in STEM education reflected a similar pattern, where cultural expectations discouraged girls from pursuing careers in science and technology, even in cases where institutional access had improved. Such challenges highlighted the need for localized, context-sensitive interventions, including financial support, mentorship, and systemic advocacy to dismantle both cultural and structural barriers.[36]

Taken together, these challenges illustrated how cultural norms, economic constraints, the pandemic, and the digital divide collectively formed a layered system of disadvantage rather than discrete obstacles. Addressing them required intersectional approaches that simultaneously targeted cultural change, equitable access to technology, gender-responsive pedagogy, and systemic policy reforms. Without such integrated strategies, persistent inequities would continue to undermine progress toward true gender equality in education.

Innovations and Effective Interventions
Innovations and effective interventions for promoting gender equality in education have gained significant momentum in recent years, reflecting the urgent need to redress persistent inequities within evolving educational landscapes. These strategies have shown varying degrees of effectiveness, with evidence pointing to both their successes and limitations.

One widely implemented innovation has been the integration of a gender perspective into university teaching practices. For example, the University of the Basque Country piloted a project that systematically examined

gender biases in knowledge production and transmission within academia.[31] Evidence from this initiative suggested that faculty became more aware of how entrenched male-dominated organizational cultures shaped their teaching. However, its effectiveness was tempered by resistance from some educators who perceived such reforms as disruptive to established norms, highlighting that awareness-building alone was insufficient without institutional commitment and incentives for change.

Professional development and teacher training have emerged as another critical intervention. Programs that embed gender awareness into teacher preparation have been shown to significantly improve educators' capacity to foster inclusive learning environments.[28] Systematic reviews of gender-sensitive training in subjects such as physical education revealed measurable gains in teachers' confidence and willingness to challenge stereotypes in classrooms.[29] While these outcomes demonstrated clear effectiveness, the long-term sustainability of such programs remained limited in contexts where training was short-term, optional, or inadequately supported by school leadership.

In early childhood education, innovative strategies in Nordic countries, such as teacher training paired with the implementation of gender equality plans, proved effective in reshaping how preschool teachers approached gender roles.[32] Evaluations showed that children in these programs developed more flexible understandings of gender, suggesting success in preventing the early reinforcement of stereotypes. Nonetheless, these interventions faced limitations in scalability, as similar strategies adapted to non-Nordic contexts did not always achieve comparable outcomes due to cultural resistance or resource constraints.

Policy-level interventions have also been central. Research on Gender Equality Plans (GEPs) and institutional frameworks, such as those developed in Turkey and Spain, demonstrated that such policies could establish formal commitments to gender mainstreaming.[30,31] These plans were effective in prompting organizations to audit gender disparities and adopt corrective measures. However, studies noted that implementation often stalled at the symbolic level, with structural inequities persisting when monitoring and enforcement mechanisms were weak.

Beyond institutional policies, curriculum reforms represented another promising intervention. Evidence from programs in East Asia and Europe showed that inclusive curriculum design contributed to more equitable classroom participation and improved perceptions of gender equality among students.[39,50] Yet, these reforms were often dependent on broader cultural acceptance. In societies where rigid gender norms prevailed, curricular changes encountered pushback from parents, communities, and even educators themselves, limiting their transformative potential.

Taken together, the evidence suggested that innovations such as gender-sensitive teacher training, early childhood interventions, curriculum reforms, and institutional policies had achieved meaningful, context-specific successes in promoting equity. However, their effectiveness was consistently constrained by systemic barriers—such as cultural resistance, insufficient resources, weak institutional support, and lack of long-term monitoring. Thus, while these interventions represented important progress, their true potential lay in being part of a sustained, multi-level strategy that simultaneously targeted pedagogy, policy, institutional culture, and societal norms.

Emerging or Underexplored Areas Requiring Further Research

Emerging and underexplored areas in gender equality in education reflected not only new directions of inquiry but also critical gaps left unresolved by the challenges and interventions identified in earlier sections. These areas underscored the need to move beyond documenting barriers or piloting interventions toward evaluating impact, ensuring sustainability, and addressing systemic inequities exacerbated by global and technological shifts.

A foremost area requiring urgent research was the gender digital divide, which became particularly visible during and after the COVID-19 pandemic. While digital learning technologies were rapidly adopted to sustain education, evidence suggested that girls, especially in low-income and rural contexts, had less access to digital devices, internet connectivity, and opportunities for developing digital literacy.[26] This disparity not only limited participation in online education but also deepened pre-existing socio-cultural inequities. Despite its centrality to contemporary education, empirical studies directly examining how the digital divide perpetuated gender inequities remained scarce, making this a critical frontier for future inquiry.

Closely connected to this gap was the limited evidence on the effectiveness of gender equality interventions. While promising innovations such as gender-sensitive teacher training, curriculum reforms, and Gender Equality Plans had been piloted, few studies systematically evaluated their long-term impact, scalability, or contextual adaptability. For example, GEPs in Europe demonstrated some success in shifting institutional priorities, yet evaluations often stalled at the symbolic level, with structural inequities persisting.[41] More rigorous, comparative research is needed to identify not only what interventions worked but also under what conditions they achieved lasting change.

Another underexplored area concerned the intersection of gender equality and inclusive education. While

inclusive practices were frequently promoted as equity-enhancing, little was known about how primary teachers perceived and enacted gender-sensitive strategies in diverse classrooms.[40] Research in this area could provide valuable insights for designing practical, context-sensitive pedagogical models.

Equally critical was the role of early childhood education in shaping gender norms. Studies emphasized that preschool environments strongly influenced how children internalized gender roles.[34] Yet, systematic research into effective pedagogical approaches for fostering gender equity at this stage remained limited. Given that early childhood is a formative period, further investigation could inform interventions that prevent the reinforcement of stereotypes before they become deeply entrenched.

Emerging research also pointed to macro-level structural challenges that intersected with gender. Regional disparities in educational resources, as noted in China, showed how geographic inequities compounded gender barriers, underscoring the need for place-based interventions.[51] Similarly, the intersection of climate change and gender equity represented a growing but underdeveloped research area. Evidence demonstrated that climate-related risks disproportionately disrupted girls' education in vulnerable communities, suggesting that future studies should integrate gender perspectives into environmental and climate adaptation policies.[33]

Taken together, these gaps highlighted two urgent priorities for future research: addressing the gender digital divide as a systemic barrier and conducting rigorous evaluations of intervention efficacy. At the same time, expanding inquiry into inclusive education, early childhood pedagogy, regional disparities, and climate-related vulnerabilities will be essential to building a comprehensive understanding of the evolving dynamics of gender equality in education. These underexplored areas, if investigated systematically, could bridge the disconnect between policy ambitions, educational practices, and lived realities.

The synthesis of challenges, innovations, and emerging areas points to several priorities for strengthening gender equality in education. First, building gender-responsive teacher training remains essential, with pre-service and in-service programs embedding gender sensitivity into pedagogy to ensure that inclusive practices are sustained in classrooms. Equally important is the mainstreaming of gender in curriculum design, where textbooks and instructional materials must be critically revised to eliminate stereotypes and provide balanced representations across disciplines, particularly in STEM and leadership contexts.

At the community level, localized and context-sensitive interventions should address socio-cultural barriers such as early marriage and discriminatory norms, especially in rural and conflict-affected areas. Parallel to this is the urgent need to expand access to digital education for girls, narrowing the gender digital divide by improving infrastructure, connectivity, and digital literacy opportunities. Long-term equity also depends on early childhood programs, which must challenge gender stereotypes through targeted teacher training and curriculum reforms at the preschool level.

Institutional frameworks require reinforcement through robust monitoring and accountability mechanisms to assess the implementation and impact of gender equality policies. Additionally, there is a clear need to prioritize research on underexplored themes, particularly the intersections of gender with digital transformation, climate change, and inclusive education. Finally, sustainable progress will depend on multi-stakeholder collaboration, engaging governments, schools, communities, and civil society in co-creating scalable and culturally responsive interventions.

This review also carries certain limitations, most notably the restriction to English-language, peer-reviewed articles indexed in major databases. While this ensured methodological rigor, it may have excluded relevant perspectives from local or non-English scholarship. Furthermore, the uneven distribution of studies across regions and levels of education indicates a publication bias toward high-income contexts. Future research should therefore expand coverage to underrepresented regions and adopt mixed methods to evaluate both the effectiveness and sustainability of interventions.

Looking forward, future projections highlight that advancing gender equality in education will require an intersectional and adaptive approach. This means aligning policies with local sociocultural realities while anticipating global shifts such as digitalization and climate change. By integrating evidence-based strategies with inclusive governance and participatory practices, education systems can move closer to achieving equitable, transformative outcomes for all learners.

CONCLUSION

This review mapped the landscape of gender equality in education by synthesizing recent scholarship on persistent barriers, innovative responses, and emerging research frontiers. The findings converged on the understanding that gender equality in education is not a linear goal of access expansion but a multidimensional challenge shaped by cultural norms, institutional practices, global crises, and technological divides. Addressing this complexity requires more than isolated interventions; it demands systemic and intersectional approaches that connect pedagogy, policy, and practice. The review underscores the need for critical engagement with digital inclusion, sustained evaluation of intervention efficacy, and deeper inquiry into underexplored domains such as early childhood and climate vulnerability. Advancing gender equality in education therefore calls for

transformative strategies that operate across levels of education and society, ensuring that reforms are both context-sensitive and globally responsive

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CONFLICT OF INTEREST

The authors declare no conflict of interest related to this study.

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