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Review

Inclusive Pedagogical Models in STEM: The Importance of Emotional Intelligence, Resilience, and Motivation with a Gender Perspective

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Abstract: This study presents a systematic mapping of inclusive pedagogical models in STEM education, focusing on integrating emotional intelligence, resilience, and motivation from a gender perspective. The research aims to identify strategies that promote inclusive learning environments and reduce gender gaps in STEM disciplines. A total of 753 studies were initially identified, with 51 articles meeting the inclusion criteria and being analyzed in depth. The results reveal that active methodologies, emotional intelligence training, mentoring programs, and the presence of female role models are key strategies for fostering women's participation and retention in STEM fields. Additionally, the findings highlight the growing importance of integrating socio-emotional skills in STEM education to improve academic performance and strengthen resilience and motivation, particularly in under-represented groups. The study discusses challenges such as teacher resistance, lack of training, and contextual barriers that affect the implementation of inclusive models. It also reflects on the influence of cultural and linguistic factors, especially in Latin American contexts. This work expands the understanding of inclusive pedagogical practices in STEM and provides relevant recommendations for educators, curriculum designers, and policymakers aiming to foster equity and sustainability in education.

Keywords: STEM; higher education; inclusive; gender approach; gender perspective; women; learning strategie; teaching; pedagogical models; active methodology; challenges; initiatives; emotional intelligence; resilience; motivation; reduction; Sustainable Development Goals

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1. Introduction

In pursuing a sustainable educational process, inclusive pedagogical models in STEM (Science, Technology, Engineering, and Mathematics) play a transformative role by promoting essential competencies such as emotional intelligence, resilience, and motivation, particularly from a gender perspective. The urgent need for innovative teaching methods arises from contemporary society's complex and multidimensional challenges. In this regard, education serves both as a tool and an objective to foster sustainable development, along with fundamental values such as cooperation, equity, and inclusion [1].

The under-representation of women in STEM remains a global challenge. Despite efforts to promote gender equity in these fields, studies show that women continue to face high dropout rates and lower participation rates in STEM careers compared to their male

counterparts [2,3]. Factors such as gender stereotypes, a lack of female role models, and non-inclusive educational environments have been identified as key barriers influencing this issue [4,5].

Beyond these structural factors, recent research has highlighted that socio-emotional competencies, such as emotional intelligence and resilience, play a fundamental role in the retention and success of women in STEM [6–8]. Emotional intelligence—the ability to recognize, understand, and manage one's emotions and those of others—has been linked to improved academic performance and increased motivation among STEM students [9]. Similarly, resilience, understood as the capacity to face and overcome challenges, has been identified as a key factor of persistence in scientific and technological careers [10].

Historically, STEM education has been criticized for its overly technical and content-driven approach, overlooking crucial aspects such as socio-emotional learning and the development of soft skills [11,12]. The literature has documented structural interventions such as mentoring programs, female empowerment initiatives, and curriculum modifications. However, little attention has been given to how pedagogical models can integrate the development of socio-emotional competencies [10].

Recent studies underscore the necessity of acknowledging the unique qualities of each individual and incorporating internal dimensions—such as emotional well-being and personal motivation—into educational frameworks, areas traditionally overlooked in sustainability education [13]. Other studies have demonstrated that the use of active and inclusive methodologies, such as project-based learning, cooperative learning, and simulations, can foster the development of emotional intelligence and resilience, positively impacting the retention and performance of women in STEM [7,11]. However, a systematic framework analyzing the most effective pedagogical strategies for integrating these competencies into STEM education has yet to be established.

Despite the growing evidence on the importance of socio-emotional competencies in STEM education, there is a lack of systematic studies compiling the impact of inclusive pedagogical models on students' emotional intelligence, resilience, and motivation. Most previous research has focused on structural and sociocultural factors, without exploring how pedagogical design can transform the educational experience and reduce the gender gap in STEM.

To address this issue, this article presents a systematic mapping review based on the collection and analysis of recent studies on inclusive pedagogical models in STEM. Trends, methodological approaches, and key findings on the integration of emotional intelligence, resilience, and motivation in STEM education are identified by examining publications indexed in academic databases such as IEEE, Web of Science, and Scopus. This contribution integrates existing evidence and proposes a reference framework for advancing future research and inclusive educational practices. Instead of generating new empirical data, this work focuses on analyzing and systematizing previous knowledge to offer a comprehensive view of the current state of the literature in this field.

The research seeks to compile existing studies and address key questions such as the following:

- The influence of emotional intelligence, resilience, and motivation on the retention and success of women in STEM;
- The effectiveness of pedagogical models in fostering these competencies in STEM education environments;
- The relationship between these models and academic achievement, gender equity, and educational sustainability.

Based on the final analysis of 51 articles, selected from an initial pool of 753 studies, which propose various implementations of inclusive and active pedagogical practices,

the findings reveal a strong correlation between emotionally safe learning environments, resilience in facing academic challenges, and increased motivation among female students.

The main contributions of this literature review include the following:

- Impact of Emotional Intelligence and Active Learning: Previous research indicates that these factors enhance academic performance and promote students' holistic development. Inclusive pedagogical methods have been shown to equip students with essential skills, such as resilience, empathy, and self-regulation, preparing them to face academic and social challenges.
- Contribution to Educational Sustainability: By incorporating values such as equity, cooperation, and solidarity, the reviewed literature establishes connections between educational practices and the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 5 (Gender Equality).
- Reducing Female Dropout Rates in STEM: Various studies emphasize the critical role of motivational strategies and emotionally supportive learning environments in enhancing female persistence in STEM fields. The gathered evidence suggests that these pedagogical practices can help counteract structural and social barriers that have historically limited women's participation in these fields.
- Framework for Pedagogical Innovation: Building on the synthesis of existing literature, the proposed model offers guidance for the design of inclusive educational practices aligned with equity and diversity in STEM. This framework emphasizes the need for adaptive and personalized methods that respond to current educational demands for equity and sustainability.

This article critically synthesizes existing knowledge, identifying proposed pedagogical strategies that impact student retention, academic achievement, and socio-emotional development. This work seeks to enrich the academic debate and identify practical tools to improve educational systems in the context of sustainability and equity. This study aims to address key gaps in the literature regarding the integration of emotional intelligence and resilience as inclusive pedagogical strategies in STEM education, particularly from a gender-sensitive perspective. Previous reviews have either focused on psychological traits without a pedagogical lens or explored gender in STEM without explicitly connecting it to emotional competencies. Our contribution lies in proposing a conceptual synthesis that bridges these domains and highlights emotional intelligence not as a soft skill detached from scientific learning but as a transformative element for the building of inclusive, sustainable, and equitable STEM environments.

In this context, this study seeks to address several key questions that emerge from current challenges in STEM education and the need for more inclusive pedagogical models. Specifically, we consider the following:

- How can emotional intelligence, resilience, and motivation be integrated into teaching practices within STEM disciplines to foster more inclusive learning environments?
- What strategies and pedagogical models have proven effective in promoting gender equity and reducing the participation gap in STEM education?
- What are the main barriers and challenges that limit the implementation of inclusive pedagogical models in different educational and cultural contexts?

These questions guided the design and focus of this study, providing a framework for identifying, analyzing, and synthesizing educational practices aimed at building more equitable, diverse, and sustainable STEM learning environments.

The structure of this article is outlined as follows: Section 2 discusses related concepts and general research. Section 3 outlines the employed methodology, while Section 4

presents the results, addressing the research questions directly. Finally, Section 5, provides reflections, limitations, and conclusions.

2. Background

Inclusive pedagogical models in STEM education highlight fundamental concepts that contribute to effective, equitable, and empowering learning environments. Key psychological and social constructs—emotional intelligence, resilience, and motivation—are essential in shaping student engagement and achievement. Nurturing these attributes within STEM education fosters a holistic approach that addresses cognitive and socio-emotional needs, creating an environment where all students, regardless of gender, feel valued and motivated. Integrating a gender perspective is also crucial, as it draws attention to the unique challenges women and under-represented groups face in STEM, thereby promoting inclusivity. In the following subsections, related concepts are detailed to provide context for this article, followed by an overview of related studies that highlight their application and effectiveness.

2.1. Inclusive Pedagogical Models in STEM

Inclusive pedagogical models in STEM focus on addressing retention challenges and promoting diversity in higher education by creating supportive and flexible learning environments. These models prioritize adaptable teaching methods, inclusive classroom practices, and individualized learning plans to meet the diverse needs of under-represented minorities and students with disabilities [14]. Key strategies within this approach include group and personalized learning, peer coaching, and contextual learning, all designed to foster a sense of belonging and success among students [15].

2.2. Emotional Intelligence

Emotional intelligence (EI) is the capacity to perceive, understand, and manage emotions in oneself and others. This skill set, which includes emotional awareness and regulation and the ability to use emotions constructively, has garnered considerable attention for its impact on relationships and performance in various settings, including education [16]. The applicability of EI in STEM contexts is particularly valuable, as it has been shown to improve interpersonal dynamics and resilience among students. Although some researchers argue that EI can be developed over time, others suggest it may be an inherent trait [17,18].

2.3. Sustainable Learning

Sustainable Learning in Education (SLE) extends beyond simply teaching sustainability; it emphasizes the development of skills for continuous learning and adaptation in challenging situations [19]. SLE encompasses four key aspects: renewal and relearning, independent and collaborative learning, active engagement, and the transferability of skills. Incorporating instrumental and intrinsic educational approaches, SLE is vital in building resilient social-ecological systems and fostering lifelong learning skills essential for sustainable development [20].

2.4. Resilience in STEM

Resilience in STEM education refers to students' ability to recover from setbacks, stay focused, and adapt to academic challenges. Within the framework of ecological systems theory, resilience can be influenced by factors such as social support, behavioral planning, and practical goal setting [21]. STEM activities that promote resilience can enhance students' academic performance by improving social skills and fostering a supportive environment [22].

2.5. Active Teaching Methods

Active teaching methods engage students as active participants in the learning process, fostering critical thinking, motivation, and self-directed learning [23]. This learner-centered approach represents a shift from traditional, teacher-centered instruction, encouraging students to encounter and interact with information actively while teachers facilitate and guide activities [24]. Active methods are essential in modern education to enhance vocational skills and promote creativity among young learners.

2.6. Motivation in STEM

Motivation is a key factor in promoting students' active participation in STEM disciplines (science, technology, engineering, and mathematics). Studies indicate that motivation significantly influences students' choice of STEM-related careers and persistence in these fields. A systematic review conducted by Sechenov University identified that motivation is essential to foster interest and retention in STEM, highlighting that research in this area has increased considerably since 2008, particularly in the United States [25].

Intrinsic motivation, which refers to the inherent interest and enjoyment in performing an activity, has been associated with greater engagement and academic success in STEM. For example, extracurricular programs such as SeaPerch and Girls Who Code have demonstrated their ability to increase students' intrinsic motivation by providing practical and meaningful STEM learning experiences [26].

Additionally, students' perception of the relevance of STEM content to everyday life and future careers can improve their motivation. Research suggests that students' interest and engagement increase when they understand how STEM concepts apply to real-world contexts [27].

2.7. Feminist Perspectives and Gender Theories in STEM Education

While previous analyses have highlighted gender disparities in participation and retention in STEM, a feminist pedagogical lens enables a deeper understanding of the structural and epistemological factors underpinning these gaps. Feminist educational theory critiques the androcentric foundations of traditional STEM curricula and emphasizes the importance of relational, contextual, and identity-based learning processes [28,29].

This perspective argues that mere inclusion is insufficient if educational environments do not simultaneously challenge the gendered norms that shape who is perceived as competent, legitimate, or belonging in STEM fields [30]. For example, learning spaces often reinforce masculine-coded attributes such as competition, individualism, and objectivity while undervaluing collaborative, affective, and process-oriented approaches historically associated with femininity [31].

Furthermore, intersectional feminist approaches highlight that gender does not operate in isolation. The experiences of female students in STEM are mediated by class, race, ethnicity, and other identity categories that interact to produce differentiated outcomes and barriers [32,33]. Recognizing these layered oppressions is essential for the design of inclusive pedagogies that are responsive not only to gender but to the full diversity of student experiences.

Therefore, inclusive STEM pedagogies must move beyond quantitative measures of female participation. They should actively interrogate the sociocultural and epistemic assumptions embedded in disciplinary practices and reimagine learning environments where multiple ways of knowing and being are equally valued.

2.8. Related Works

Research in inclusive pedagogy for STEM education has explored various approaches to enhance gender equity. These works underscore the importance of integrating emotional

intelligence, resilience, and motivation into STEM teaching practices to foster sustainable, inclusive learning environments.

Denham et al. [34] examined programs aimed at developing emotional intelligence among students, finding that these initiatives enhance vital interpersonal skills such as communication, empathy, and self-regulation, which are critical in collaborative learning contexts. This emphasis on emotional development is particularly relevant in STEM education, where teamwork and problem-solving are integral. Their findings suggest that incorporating emotional skills training can create supportive, empathetic environments that empower students to engage more fully in STEM disciplines.

Further contributions to inclusive pedagogy come from the "Heroine's Learning Journey" (HLJ) model, designed to increase female enrollment and retention in STEM courses through student-centered narratives highlighting resilience and success. Cohen et al. [35] demonstrated that the HLJ model fosters a sense of belonging and self-efficacy among female students, particularly in online settings. By embedding emotional skills within the learning narrative, this model shows that targeted pedagogical interventions can mitigate the effects of gender stereotypes and support women in overcoming barriers in STEM fields.

The significance of emotionally safe learning environments is another recurring theme in the literature. Goleman [36] and others suggest that supportive environments, bolstered by mentors and empathetic educators, are crucial for building self-confidence and motivation, especially among women in STEM. This approach aligns with the objectives of creating inclusive STEM programs that focus on academic achievement and prioritize students' emotional and psychological well-being. Studies affirm that such environments help female students persist in disciplines where they have been historically under-represented, promoting resilience and reducing dropout rates.

Role models and mentoring have also been widely recognized as effective strategies for supporting women in STEM. Tinto [37] emphasized that mentorship programs contribute significantly to student resilience, aiding them in adapting to academic challenges and building the perseverance needed to succeed in STEM fields. Programs like the "Matilda Latin American Open Chair", for instance, provide structured mentorship and visible role models, which have positively impacted women's motivation and retention by offering real-world examples of success and persistence in STEM careers [38]. These initiatives reflect an approach that combines emotional intelligence and motivational support to enhance gender equity in STEM.

In addition to emotional intelligence and resilience, motivation is pivotal in women's academic and professional success in STEM. Avolio et al. [39] and Msambwa et al. [40] examined how intrinsic and extrinsic motivational factors influence women's career choices and persistence in STEM fields. These studies highlight the importance of creating supportive networks, promoting self-efficacy, and addressing gender-based challenges that affect women's motivation. Pedagogical interventions that focus on building confidence and offering female role models are essential in addressing these motivational challenges.

In this article, emotional intelligence is understood as the ability to recognize, manage, and express one's own emotions, as well as to understand and influence the emotions of others—a competency shown to enhance interpersonal dynamics, motivation, and learning in STEM contexts [36]. Similarly, we adopt a conceptualization of resilience not merely as individual endurance or grit, but as a socio-educational construct linked to support networks, equity conditions, and learners' sense of belonging [41].

Framed within inclusive pedagogy, both emotional intelligence and resilience are essential not only for equitable access and retention in STEM but also to build more sustainable educational models. These constructs enable educational systems to adapt to

diversity, reduce dropout rates, and promote long-term engagement, particularly among under-represented groups [42].

Finally, research has examined active, gender-inclusive teaching strategies to foster an equitable learning environment. Vázquez Valencia et al. [43] explored the integration of emotional intelligence training and gender awareness in teaching methods. They argued that project-based and cooperative learning approaches facilitate inclusive participation and actively counteract biases that affect female students in STEM. This approach advocates for continuous teacher training in gender-sensitive and emotional competencies to create more responsive learning environments that can support all students effectively.

The literature highlights diverse approaches to building inclusive, resilient STEM learning environments that prioritize emotional intelligence, motivation, and gender equity. From emotional intelligence programs that develop interpersonal skills to mentoring initiatives that provide female role models, these works collectively support a holistic approach to STEM education. This work builds on these findings by examining how inclusive pedagogical models that integrate emotional intelligence, resilience, and motivation contribute to sustainable educational practices that align with gender equity and student empowerment.

3. Methods and Materials

A systematic mapping study is a research method used mainly in areas such as informatics and medicine, aimed at reviewing and structuring the existing literature on a specific topic. Its main objective is to identify, classify, and provide an overview of the current knowledge in a given area of study [44].

This methodology consists of conducting a detailed search of relevant publications, followed by classification and analysis of the collected studies. Its objective is to identify trends, gaps in current research, and possible areas for future studies [44]. Unlike systematic reviews, which focus on answering specific research questions through in-depth analysis of a limited number of studies, systematic mapping seeks to provide a more general overview of the field of study. This technique highlights the amount and type of research conducted, as well as the employed methodologies and obtained the results.

Guided by Petersen's methodological proposal, the process implements the stages detailed in Figure 1. The activities that make up the systematic mapping process are detailed in the following sections.

3.1. Goal and Research Questions

Following the systematic mapping methodology, research questions were formulated at an early stage. These are essential to the mapping process, as they provide an overview of the specific area under study [44].

This systematic mapping offers a valuable contribution by demonstrating that teaching methods that emphasize emotional intelligence and active methodologies are fundamental not only for improving academic performance but also for the integral development of students as individuals committed to the values of sustainability. Table 1 outlines the research questions and their underlying rationale. These questions informed the selection and classification of the articles, as well as the organization of the gathered data.

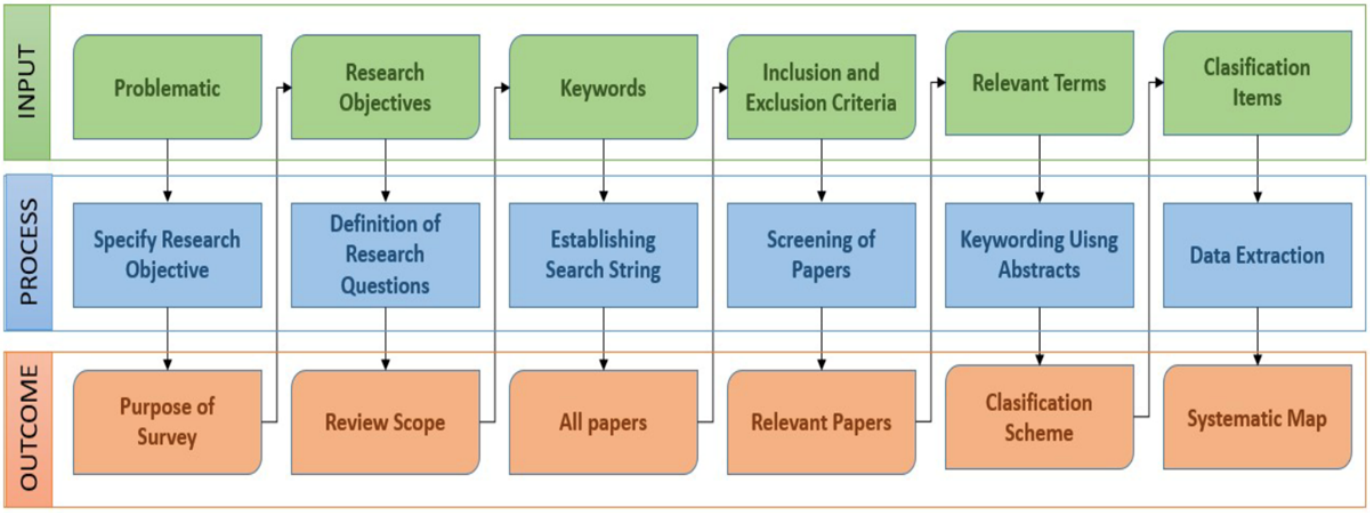


Figure 1. Stages of the systematic mapping process (adapted with permission from [45]).

Table 1. Research questions.

Question	Objective
RQ1: How do pedagogical models and teaching methods influence the development of students' emotional intelligence in STEM areas?	It is possible to identify how pedagogical models and teaching methods influence the development of emotional intelligence of students in STEM areas.
RQ2: What are the benefits, difficulties, and challenges of implementing active methodologies in STEM education?	It is possible to observe the benefits, difficulties, and challenges of implementing active methodologies in STEM education.
RQ3: What educational initiatives and experiences have been most successful in implementing active methodologies in STEM with a gender perspective?	It is possible to characterize initiatives and educational experiences that have been successful in the application of active methodologies in STEM with a gender perspective.
RQ4: What motivational strategies and active methodologies contribute to reductions in the dropout of women in STEM areas?	It is possible to recognize motivational strategies and active methodologies that contribute to reductions in the dropout of women in STEM areas.

3.2. Data Sources and Keywords

The literature search on the research topic was conducted systematically in the following databases: IEEE, WOS, ACM, and Scopus. The review included published studies with no lower time limit, mainly covering the period from 2018 to 2024. We used a combination of keywords related to STEM: higher education, inclusive, gender approach, gender perspective, women in STEM, learning strategies, teaching, pedagogical models, active methodology, challenges, initiatives, emotional intelligence, resilience, motivation, reduction, and Sustainable Development Goals (and some synonyms).

Given the interdisciplinary nature of this study—located at the intersection of STEM education, inclusive pedagogical practices, and socio-emotional competencies—a wide range of keywords was required to ensure adequate coverage of the topic. The selected terms were grouped into four thematic dimensions (STEM, pedagogy, emotional skills, and gender inclusion), allowing us to capture diverse expressions and terminologies used across different disciplinary fields. This breadth was necessary to avoid excluding relevant studies due to conceptual or disciplinary language variations.

3.3. Search String

To construct a search string, keywords were identified from the research questions and objectives and connected using logical operators. This string was used in various search engines and reviewed by the researchers. The following final string was obtained:

((STEM OR "Engineering" OR "Technology" OR "Science" OR "Mathematics" OR "Higher Education" OR Universit* OR Inclusive) AND ("Gender Approach" OR "Gender Perspective" OR "Women in STEM" OR "Gender Gap" OR Equity OR Women) AND (Learning OR Strategies OR Teaching OR Methods OR Pedagogical OR Models OR Active OR Methodology OR Benefits OR Difficulties OR Challenges OR Initiatives OR Experiences) AND ("Emotional Intelligence" OR Resilience OR Motivation OR Attrition OR Dropout or Reduction) AND ("SDGs" OR "Sustainable Development Goals"))

3.4. Data Extraction

The search and data extraction were performed using several databases and websites that allow access to digital libraries. These platforms were selected for their ability to search with customized search strings, which facilitates the retrieval of a large number of relevant documents. The data chosen sources included WOS, Scopus, IEEE Xplore, and ACM Digital Library, all recognized for their extensive collection of scholarly publications and research relevance. In addition, the quality and timeliness of the retrieved documents were checked to ensure that the collected information was relevant and reliable.

3.5. Inclusion and Exclusion Criteria

The inclusion and exclusion criteria ensured the relevance, consistency, and quality of the studies selected for this systematic mapping. These criteria align with the study's primary objective: to identify pedagogical models in STEM that integrate emotional intelligence, resilience, and motivation, focusing on gender inclusion in higher education.

Inclusion criteria:

- Papers in English;
- Journals and conferences;
- Full papers.

Exclusion criteria:

- Technical reports, abstracts, editorial opinions, and state-of-the-art reviews;
- Studies published up to and including 2024, with a focus on the period from 2018 onward;
- Papers not related to higher education contexts.

We included only peer-reviewed journal and conference papers written in English, as these tend to provide more rigorous and widely accessible scientific contributions. Restricting the search to full papers enabled us to conduct a deeper analysis of the methodology, results, and discussion of each paper, which is essential to identify how socio-emotional dimensions are operationalized in pedagogical strategies.

The time frame (2018–2024) was selected to capture recent developments in inclusive pedagogies, particularly following the global emphasis on the Sustainable Development Goals (SDGs), which began to influence educational policy and research agendas after 2015. Focusing on this period allows us to observe how gender-sensitive and emotionally responsive teaching models have evolved in recent years, especially after the impact of the COVID-19 pandemic on educational practices.

Studies unrelated to higher education were excluded because STEM education's social and cognitive demands in university contexts differ substantially from those in primary or secondary education. This scope limitation allows for a more precise understanding of

the challenges and innovations relevant to adult learners, career preparation, and equity policies at the tertiary level.

Excluding technical reports, editorials, and non-peer-reviewed literature ensured the synthesis was grounded in validated, replicable, and methodologically sound research. These decisions collectively contributed to the construction of a reliable evidence base from which pedagogical trends and research gaps could be meaningfully analyzed.

3.6. Search Execution

The selected sources applied the search string, yielding an initial collection of 753 papers (see Table 2). The data were collected using the export options available in each digital library. After performing a search to eliminate duplicate indexed documents, we were able to reduce the initial number due to duplication, leaving a total of 702 documents. After applying filters 1 and 2, 271 articles were selected for the final analysis, of which 51 studies were selected in the third review.

Table 2. Considered electronic data sources.

Electronic Data Source	URL	Resources
Web of Sciences	https://www.webofknowledge.com accessed on 10 December 2024	260
SCOPUS	https://www.scopus.com accessed on 10 December 2024	116
IEEE	https://ieeexplore.ieee.org accessed on 10 December 2024	9
ACM	https://www.acm.org accessed on 10 December 2024	368

To ensure the transparency and reliability of the selection process, several procedures were implemented to minimize both duplication and selection bias throughout the systematic mapping.

The initial set of articles was extracted from four major academic databases (Scopus, Web of Science, IEEE Xplore, and ACM Digital Library) using a standardized search string. The search results were exported in compatible formats (BibTeX, RIS, or CSV) to facilitate their integration into a common dataset for analysis.

The first filtering step involved automatically detecting duplicate records based on unique identifiers such as their DOI (Digital Object Identifier), title, and authorship. This process was conducted using reference management tools (Mendeley and Zotero), followed by manual validation to confirm the removal of residual duplicates that could result from slight variations in metadata across databases.

Regarding bias reduction, the selection process was structured into multiple levels of review to enhance the objectivity and consistency of the study selection. Specifically, the following steps were performed:

- Title screening: Articles whose titles clearly did not align with the mapping's objectives (e.g., unrelated to education, STEM, or higher education) were excluded.
- Abstract screening: The remaining articles were analyzed based on their abstracts to confirm the presence of key elements: inclusive pedagogical models, a STEM context, and relevance to higher education. This step ensured the consistency of the thematic scope.
- Full-text screening: The final set of articles underwent a detailed reading of the full text to assess their methodological contribution and alignment with this review's focus.

To mitigate selection bias, the entire selection and filtering process was independently conducted by three researchers. Any discrepancies or doubts regarding a study's inclusion or exclusion were discussed in collaborative sessions until a consensus was reached.

This multi-step, collaborative, and transparent process strengthened the internal validity of the systematic mapping and enhanced the robustness of the evidence base derived from the literature review.

Applying the above process, duplicates were eliminated from the initial set of 753 articles, reducing the number to 702. Subsequently, a review of the titles according to the inclusion/exclusion criteria reduced the number to 325 articles. Next, reviewing the abstracts against these criteria reduced the total to 271 papers. Finally, the full articles were reviewed, confirming the selection of 51 papers and, thus, completing the process (see summary in Figure 2).

The complete list of selected articles is available in Appendix A, Table A1.

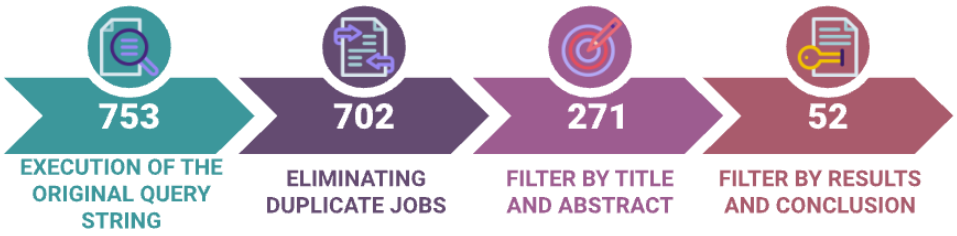


Figure 2. Consolidation of selected publications.

3.7. Classification Scheme

The publications were classified in three dimensions: temporal, database type, and content dimensions (based on keywords). In the temporal dimension, articles were organized by year of publication, prioritizing publications from the last seven years (2018 to 2024), with the majority concentrated after 2020. The database type dimension refers to the source or origin from which the publication is obtained—in this case, the WOS, Scopus, IEEE Xplore, and ACM Digital Library databases. The content dimension focuses on categorizing topics relevant to the objective of the review, including the topics linked to each keyword, which are presented in the results according to each research question. Finally, a classification associated with the nature of the articles was also determined: theoretical, practical, or mixed.

3.8. Map Development

The result of the systematic mapping phase was the creation of a map that facilitates both the visualization and analysis of the collected data. This map serves as a key tool for understanding the structure and trends of the study area. In the following sections, each of the graphs generated in this research is presented and analyzed in detail, providing a deeper understanding of the findings and their relevance in the current context.

4. Results

This section is organized with subheadings for clarity, providing a concise and accurate representation of the results, along with their interpretation. In addition, conclusions derived from the findings of the analyses are presented.

Figure 3 shows the classification of articles according to keywords or relevant elements. On the right side of the image, the distribution of publications by year intervals is presented. It is important to note that some articles may address several topics represented in the graph, causing them to be counted in more than one category (some increase considerably). On the left side of the image, the documents are classified according to their practical,

theoretical, or combined nature. The central axis concentrates the keywords or relevant elements derived from the search string.

The elements of the central axis of the graph correspond to thematic groupings made from the keywords. The details of these groupings are outlined as follows:

- STEM: STEM, engineering, technology, science, and mathematics.
- Equity: inclusive, gender approach, gender perspective, women in stem, gender gap, equity, and women.
- Learning: learning, strategies, teaching, methods, pedagogical, models, active, and methodology.
- Retention: motivation, attrition, dropout, and reduction.
- SDGs: SDGs and Sustainable Development Goals.

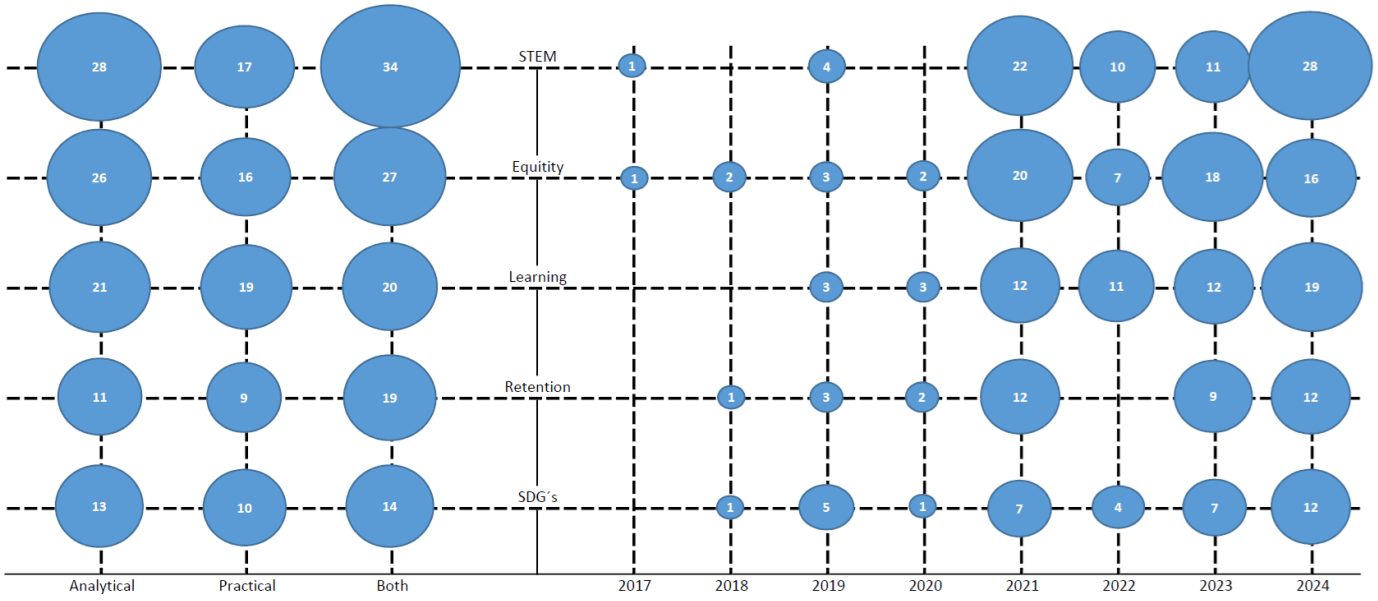


Figure 3. Bubble map.

From the analysis of the presented map, the following conclusions can be deduced:

- The left representation of the bubble chart shows a relatively even number of articles among the three categories. However, the category of studies combining analytical and practical approaches (Both) has a slightly higher overall representation than the analytical and practical-only categories. This suggests that there is an interest in integrative approaches that address both theoretical analysis and practical implementation.
- In the right-hand section of the graph, we see an increase in publications in almost all categories in recent years. This could reflect a recent and growing interest in these topics, possibly driven by increased global awareness of gender equity, sustainability, and the need for inclusive learning environments.
- There is a slight predominance of papers in STEM and equity, suggesting that these topics have received significant attention over the years. This could be related to their importance in promoting educational innovation and reducing gaps, especially in disciplines historically dominated by one gender. It also reflects these issues' growing relevance globally in recent years.
- There is evidence of fewer articles focused on retention and the Sustainable Development Goals (SDGs) than on STEM and equity. This fact suggests the need to delve deeper into how student retention and the SDGs can be more effectively integrated into research and educational practice, especially in the context of STEM disciplines.

The bubble map analysis provides several relevant insights regarding research trends and gaps in inclusive pedagogical models within STEM education. First, the apparent predominance of studies categorized under the "implementation" maturity level indicates that much of the current research is focused on designing and proposing new pedagogical models rather than on their practical application or empirical analysis. Additionally, many studies fall under the "use" category, reflecting growing efforts to test and evaluate these models in real educational settings. Regarding thematic areas, the "competency assessment" and "learning outcomes" categories concentrate on the most publications, demonstrating a strong interest in assessing and validating teaching and learning strategies. In contrast, thematic areas such as "resilience" and "socio-emotional skills" present fewer studies, suggesting emerging fields requiring further exploration and development. Overall, this visualization helps to identify both consolidated research areas and emerging gaps, highlighting the need to advance towards a more balanced distribution of research efforts, especially in addressing the practical challenges of implementing inclusive pedagogical models that incorporate emotional and resilience-based dimensions in STEM education.

On the other hand, in Table 3, a specific analysis is presented regarding the number of articles that consider elements associated with student retention (retention parameters), such as emotional intelligence, resilience, motivation, attrition, dropout, and reduction. This table shows that out of the total set of articles (51), 71% (37 papers) include these types of elements in their analyses or proposals. This high percentage highlights how important the community considers these parameters to be in conducting such analyses. Additionally, the table emphasizes a prioritization of parameters like "motivation" and "reduction", with 13 studies each, reflecting their relevance in inclusive pedagogical models for STEM aligned with the goals of educational sustainability. However, the imbalance in the representation of parameters such as "emotional intelligence" and "attrition", both of which are crucial for the development of socio-emotional skills and student retention, suggests areas for improvement. This is particularly significant from a gender perspective, as skills like resilience and emotional intelligence have been identified as crucial factors in reducing dropout rates among women in STEM.

Table 3. Papers encompassing multiple categories.

Cases	(1)	(2)	(3)	(4)	(5)	(6)	Total
One retention parameter	✓	-	-	-	-	-	1
	-	✓	-	-	-	-	8
	-	-	✓	-	-	-	11
	-	-	-	✓	-	-	1
	-	-	-	-	✓	-	2
	-	-	-	-	-	✓	12
Two retention parameters	-	✓	✓	-	-	-	1
	-	-	✓	-	-	✓	1
Total	1	9	13	1	2	13	

Retention parameters: (1) emotional intelligence; (2) resilience; (3) motivation; (4) attrition; (5) dropout; (6) reduction. "✓": There are articles in the category. "-": There are no articles in the category.

On the other hand, 35 articles consider only one retention parameter, while 2 articles consider two parameters. From this, it can be inferred that multidimensional studies combining two parameters are scarce, limited to two specific combinations: "resilience" with "motivation" and "motivation" with "reduction". This scarcity of studies combining multiple parameters highlights the need for an integrative approach that considers the complex interactions between emotional and structural factors.

The analysis of the selected studies reveals that most inclusive pedagogical models in STEM education tend to address student retention factors in a fragmented manner. Although motivation, emotional development, and dropout prevention are frequently mentioned, they are often treated as isolated components rather than interconnected dimensions. This suggests a limited understanding of the complexity of the retention problem, particularly in the context of inclusive and gender-sensitive education.

The predominance of motivation and dropout reduction as the most recurrent parameters reflects a growing interest in sustaining student engagement and persistence in STEM programs. However, other equally relevant factors—such as emotional intelligence or resilience—are still underexplored, despite their recognized influence on students' academic and personal development. This gap points to the need for more comprehensive pedagogical approaches that integrate cognitive, emotional, and motivational dimensions coherently.

In light of these findings, it is recommended that future research and instructional design efforts adopt integrated perspectives that simultaneously consider multiple retention-related factors. Inclusive pedagogical models should be designed to recognize the interdependence between students' emotional needs, their learning processes, and the institutional structures that support their educational journey. Furthermore, the development of evaluation instruments and interventions should incorporate academic outcomes and indicators of socio-emotional growth and resilience, as these are fundamental for promoting equity and sustainability in STEM education.

4.1. Summary and Main Observations on Selected Articles

Studies show that active methodologies such as project-based learning and service learning have had a positive impact on STEM education. These methodologies have been most effective when integrated with inclusive perspectives that consider gender equality [46]. Articles from universities in Mexico and Argentina highlight that these approaches increase the active participation of women in STEM, contributing to SDG 5. However, some articles also identify significant challenges, such as the lack of teacher training to implement these methodologies in an inclusive manner. In terms of participation numbers and trends, a study conducted at a private university in Mexico shows that only 17% of students in STEM programs are women, which is evidence of a large gender gap [46].

The research also reveals that factors such as teacher support, personal motivation, and classroom competence are key determinants of the retention of women in STEM.

However, with respect to methodological criticism, it can be noted that despite progress, there are still significant challenges related to the resistance of teachers to adopt more inclusive teaching approaches. In some studies, the lack of training in emotional intelligence for teachers has been noted as an obstacle to the full integration of inclusive and active methodologies. The gender perspective is often seen as a marginal issue rather than a central issue in STEM teaching [47].

4.2. Overall Results

Regarding the categorization of the 51 publications, Figure 4 shows the number of publications selected for systematic mapping, distributed by year. The graph reveals the evolution of research output and its inclusion in this work during period of 2017–2024, highlighting key trends and potential influencing factors.

During the initial years (2017–2019), the number of selected publications was notably low, reflecting limited interest or availability of research focused on integrating emotional intelligence, active learning strategies, and gender equity in STEM education. A slight increase was observed in 2019, possibly signaling a growing recognition of the need for inclusive pedagogical models. This increase suggests major attention on the topic, probably

influenced by international initiatives such as the United Nations' Sustainable Development Goals (SDGs), especially SDG 4 (Quality Education) and SDG 5 (Gender Equality). These initiatives began to impact research project funding and the orientation of educational policies, promoting studies on gender equity in STEM disciplines.

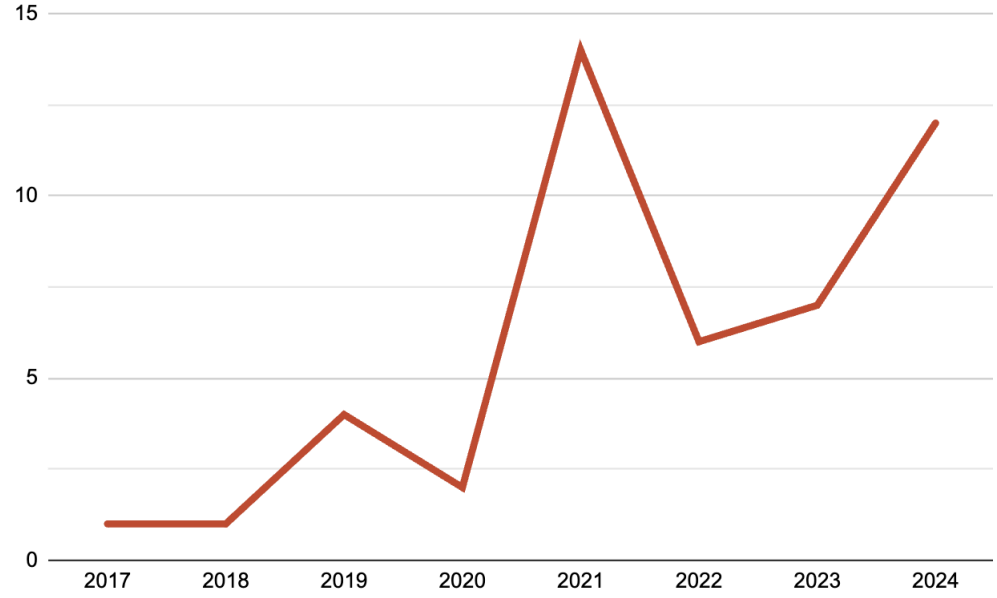


Figure 4. Number of articles per year of publication. Own elaboration.

The decline in 2020 could be related to the crisis caused by the COVID-19 pandemic, which significantly altered the landscape of education and academic research. The reallocation of resources toward health-related studies, the disruption of in-person activities at universities, and the general uncertainty about the impact of online learning have slowed the production of research on inclusive pedagogy in STEM.

However, the data show a significant peak in 2021, marking the year with the most selected publications in the analyzed period.

This increase can be attributed to two main factors: (1) an accelerated interest in addressing equity in STEM education as a response to global social movements and educational reforms prioritizing inclusion and (2) a broader focus on students' socio-emotional well-being, which gained relevance during the COVID-19 pandemic.

The increased scientific production in STEM education can be attributed to a growing interest in equity and inclusion in these disciplines, driven by social movements and educational reforms. Initiatives such as MeTooSTEM [48] have highlighted the barriers women face in academia, promoting policies against discrimination and harassment in scientific and technological environments.

Similarly, organizations like Girls Who Code [49] and the UN Women's HeForShe Initiative [50] have promoted strategies to reduce the gender gap and encourage women's participation in STEM. These initiatives have fostered the development of research analyzing more inclusive educational methodologies, mentoring programs for under-represented groups, and curriculum designs that reflect students' cultural and social diversity. In response, global initiatives have emerged to promote policies and strategies aimed at reducing gender disparities, improving the representation of minorities in STEM, and ensuring equitable learning conditions. This trend has increased research on inclusive pedagogical practices and the implementation of educational models that promote diversity and equity in scientific and technological disciplines.

On the other hand, the pandemic also accelerated the development and evaluation of new pedagogical methodologies adapted to remote and hybrid teaching [51]. Traditionally based on hands-on experiences and laboratory work, STEM education had to transform to ensure the continuity of learning in virtual environments. This shift accelerated the adoption of educational technologies, online project-based learning, and virtual simulations, which could explain the increased research production on the effectiveness of these strategies in scientific and technological training.

With its profound impact on educational systems, this global event likely drove an increase in research investigating new methodologies and pedagogical strategies adapted to remote or hybrid learning environments. Of the 14 articles analyzed for the year 2021, 6 explicitly reference the pandemic and its impact on education, representing 43% of the total publications for that year. This figure highlights how the pandemic became a central research topic in 2021, significantly influencing academic output in areas such as education, equity, and sustainability.

In this context, the abrupt transition to remote learning and the suspension of in-person interactions may have exposed pre-existing emotional issues among students. For many of them, social interaction is a vital component of academic development—through teamwork, group discussions, and collaborative activities—and a key source of emotional support. Without these dynamics, feelings of isolation, anxiety, and stress intensified, directly affecting motivation and academic performance.

This situation spurred renewed interest in researching and developing pedagogical strategies integrating socio-emotional dimensions, such as emotional intelligence and resilience, into educational models. This shift in focus responds to the urgent need to address the consequences of social isolation, especially for students who, in many cases, lacked the technological, familial, or institutional support necessary to adapt to new learning modalities. Consequently, research emerged analyzing how teaching methods could mitigate these challenges, promoting more inclusive and sustainable learning environments. In this context, the increase in publications reflects a collective effort to understand and respond to these dynamics, offering practical solutions for an education system profoundly transformed by the pandemic.

On the other hand, a sharp decline is observed in 2022, which may reflect a post-pandemic transitional phase in which institutions and researchers adapted to new educational norms. This decline could also be related to a temporary reduction in research output due to resource reallocation or difficulties conducting studies during the immediate aftermath of the pandemic. However, the rebound observed in 2024 suggests that interest in these topics has not only persisted but regained momentum, likely driven by the recognition of persistent gender equity gaps and the need for inclusive and sustainable educational practices in STEM.

The trends highlighted in Figure 4, underscore the dynamic nature of research in STEM education, particularly in the context of inclusive pedagogical models. The observed variability aligns with external factors such as global events and educational changes influencing research priorities. The sustained relevance of these topics in 2024 also suggests that innovative approaches, informed by lessons learned in recent years, are being developed to address persistent challenges in STEM education, emphasizing gender equity and socio-emotional learning.

Regarding the rankings of the 51 publications, the distribution by publication category, expressed in percentages, is shown in Figure 5. The pie chart shows the distribution of key topics in an educational or research context, where five main areas stand out. “Teaching strategies” represents the highest percentage, with 22.7%, indicating a strong focus on the application of educational methodologies. This is followed by “STEM and education” with 22.2%, suggesting the relevance of science, technology, engineering, and mathematics

(STEM)-related topics in the analysis. "Gender in STEM" occupies 21.2%, underlining the importance of gender equity in these disciplines. "Emotional", with 18.7%, reflects the interest in the impact of emotional factors on learning. Finally, "sustainable", with 15.2%, highlights the consideration of sustainable practices in the study environment. This breakdown suggests a comprehensive perspective, combining teaching strategies, gender inclusion, sustainability, and the role of emotions in learning, all crucial elements for a more inclusive and effective education.

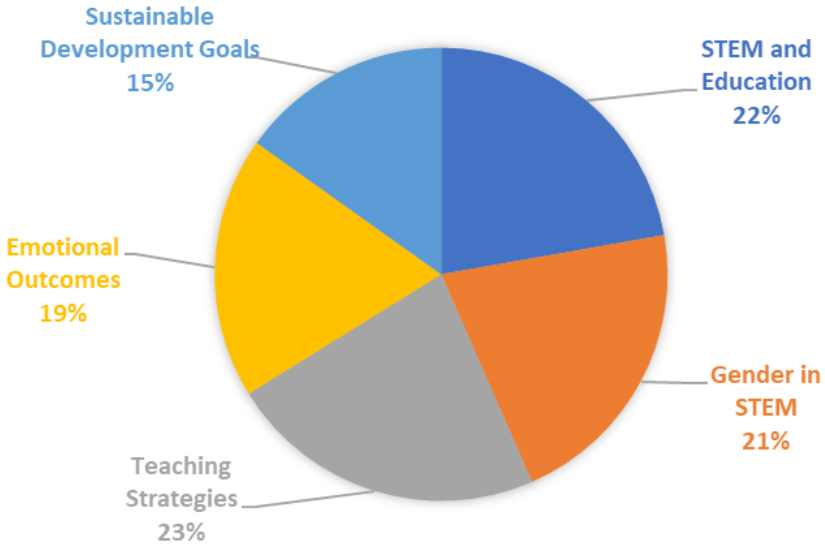


Figure 5. Percentage of publications by category. Own elaboration.

The graphs indicate that the subject of this work has become increasingly relevant and has gained momentum since 2020, maintaining an upward trend, despite a dip followed by a rebound.

Figure 6 shows a heat map of the presence of keywords in the STEM and education dataset for this analysis. This map reflects the convergence of key concepts related to innovative educational strategies, gender-differentiated learning, and inclusive technologies. It highlights the relevance of self-regulated learning, motivation, and the integration of tools such as the active inverted classroom and educational games to address gender gaps in STEM disciplines. The prominence of terms such as "collaboration", "advanced technology", and "gender equity" underscores a focus on participatory and equitable methodologies, emphasizing the need for personalized pedagogical strategies that foster both inclusion and academic performance, especially in technological and autonomous learning contexts.

As a quantitative and analytical complement, it is possible to indicate that emotional intelligence (EI) development programs can improve academic performance and reduce anxiety, especially in STEM disciplines. According to the report, 78% of students who participated in an EI program reported an improvement in their emotional management skills [52]. Yale University found that integrating EI strategies into STEM curricula significantly improved student retention, especially in cognitively demanding areas such as engineering and biology. In a study conducted by Cornell University in 2021, it was shown that STEM students with EI training achieved a 12% increase in academic performance over those without specific training in this area. According to a study by Freeman [53], active methodologies, such as problem-based learning (PBL) and cooperative learning, have been shown to increase students' academic performance by 6% compared to traditional methods. In particular, in STEM, students who participated in active learning showed a 34% lower dropout rate. According to Maisano et al. [54], teachers reported that a lack of adequate

technological resources is a significant challenge in implementing active methodologies in STEM. On the other hand, active methodologies require a significant change in pedagogical training, which represents a major barrier [55].

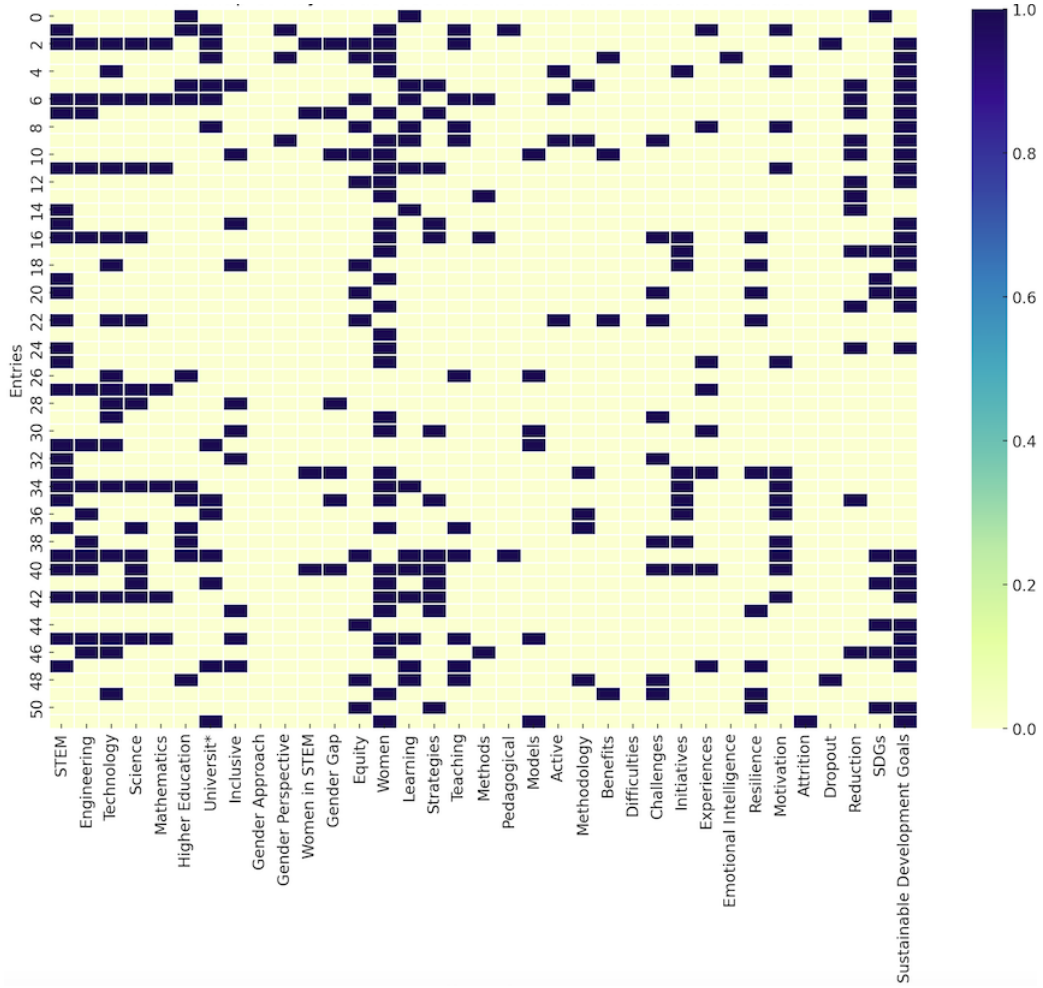


Figure 6. Heat map of keyword presence. Own elaboration.

4.3. Results Aligned with the Research Questions

Results for RQ1: How do pedagogical models and teaching methods influence the development of students' emotional intelligence in STEM areas?

To answer this research question, ten key words from articles on the topic were analyzed (engineering, technology, science, mathematics, higher education, universit*, learning, strategies, teaching, methods, pedagogical, models, active, methodology, emotional intelligence, and resilience). A total of 173 results were obtained for them. Table 4 shows the articles dealing with the topics analyzed in this research question.

Pedagogical models and teaching methods play a critical role in the development of students' emotional intelligence in STEM fields. An approach that integrates social-emotional skills within academic programs, especially in settings such as STEM, can enhance empathy, self-regulation, and team collaboration, which are essential skills in these fields. The work of Sanabrias et al. [56], which addresses emotional intelligence and quality of life in future teachers, highlights how awareness of gender issues, combined with the development of emotional competencies, improves students' perception of life and academic performance. The research highlights that women and men may develop emotional skills differently, but both experiences contribute to effective learning in STEM.

Table 4. Articles by topic for RQ1.

Topic	References
Engineering	[40,46,47,57–67]
Technology	[40,57–61,64,66–73]
Science	[40,46,57–59,61,64–66,71,73–75]
Mathematics	[40,46,57,59,61,66]
Higer Education	[57,61,63,64,72,74,76–80]
Universit	[46,56,57,60,62,64,75,77–79,81–83]
Learning	[40,57,61,64–66,76,78,80–82,84,85]
Strategy	[40,47,58,64,65,75,78,79,86–89]
Teaching	[46,57,64,66,72,74,77,80–82,84]
Methods	[57,58,67,90]
Pedagogical	[64,77]
Models	[60,66,72,83,87,91]
Active	[57,71,84,92]
Methodology	[62,74,78,80,84,93]
Emotional Intelligence	[56]
Resilience	[58,69–71,82,88,89,93,94]

These analyses illustrate how inclusive pedagogical models and teaching methods, based on role modeling and fostering equitable environments, can develop emotional intelligence in students, motivating and equipping them to meet challenges in STEM. The following is a list of the most prominent cases, along with descriptions of the publications, identifying how models and teaching methods influence the development of students' emotional intelligence in STEM areas, which contributes to this research:

1. This study shows how gender equity serves as a pedagogical model for developing empathy and social justice. A study on the coffee supply chain in Tanzania shows that teaching models focused on gender equity can inspire students in STEM to adopt a more inclusive and empathetic view of resource allocation. This type of pedagogical approach promotes the development of emotional intelligence by sensitizing students to the importance of equity and inclusion in their future professional environments [91]
2. This analysis considers role modeling and emotional expression in computer education, showing that educators who integrate caring and emotions into their teaching in STEM serve as effective role models, teaching students to value competencies such as empathy, responsibility, and self-awareness. Pedagogical methods that allow educators to express emotions and caring promote the development of emotional intelligence in students, helping them manage their own emotions and connect with learning more holistically [72]
3. This study shows how inclusive hackathon environments strengthen self-confidence and reduce impostor syndrome. Inclusion in hackathons encourages balanced participation, improving the self-confidence of women and other under-represented groups. Pedagogical methods that implement inclusive measures, such as supporting gender diversity, teach students to value themselves and trust their abilities, promoting emotional intelligence by helping them overcome insecurities and improving their self-esteem [87]

4. Studies have demonstrated the use of self-awareness tools in STEM for the development of self-perception and empathy. The ANNA tool allows students to relate their personality to profiles of engineering professionals, promoting self-knowledge and empathy. This type of pedagogical model reinforces emotional intelligence by helping students understand and accept their own strengths and limitations while exposing them to diversity and different paths in STEM [60]
5. This article reports a case of inquiry-based learning and female role models in early STEM education. In a space science program for young students, the use of inquiry-based learning and female role models fosters the development of emotional skills and motivation in STEM. These methods teach students to collaborate, develop confidence, and overcome emotional barriers, strengthening their emotional intelligence in the process [66]
6. This study looks at the visibility of female role models in architecture to foster resilience and how the lack of female role models in architecture in Nigeria reveals how the visibility of successful professionals can influence students' emotional intelligence, fostering resilience and self-confidence. Pedagogical methods that highlight female achievements in STEM enable students to develop a positive self-image, resilience, and emotional skills needed to persevere in their studies and careers [83]

In Figure 7, a word cloud is shown for research question 1, providing a visual representation of the results related to this question. The form is randomized and is intended only to show a consolidated concept that emerged from the analysis of the associated research question.



Figure 7. Word cloud linked to the outcomes related to RQ1.

Figure 7 offers insight into the dominant discursive themes in the reviewed literature. The prominence of terms such as challenges, gap, and higher education reflects a growing academic concern with structural and contextual barriers that hinder the implementation of inclusive pedagogical models in STEM. These terms suggest that the literature not only acknowledges the existence of inequities but is actively engaged in identifying critical obstacles and unresolved tensions—particularly within higher education contexts. The presence of terms like human and development goals further indicates an alignment with

broader global agendas, such as the Sustainable Development Goals (SDGs), emphasizing education as a key driver of human development and social justice. However, the relatively generic use of the term education, without the accompanying visibility of constructs such as inclusion, gender, or emotional skills, may point to a lack of specificity in how inclusive or equity-driven frameworks are being conceptualized in the field.

This visualization underscores the importance of deepening the focus on inclusive and socio-emotional dimensions in STEM education research and highlights the opportunity to shift from identifying "gaps" and "challenges" toward proposing integrated, action-oriented solutions.

Results for RQ2: What are the benefits, difficulties and challenges of implementing active methodologies in STEM education?

To answer this research question, eleven key words from articles on the subject were analyzed (engineering, technology, science, mathematics, higher education, universit*, learning, strategies, teaching, methods, pedagogical, models, active, methodology, benefits, difficulties, and challenges). A total of 177 results were obtained for them. Table 5 shows the articles dealing with the topics analyzed in this research question.

Active methodologies, such as problem-based learning, collaborative learning, and experiential learning, offer several benefits in STEM education, such as increased student engagement, the development of practical skills, and the fostering of creativity and critical thinking. However, they also present significant challenges. Davey [57], discussed how active methodologies improve accessibility and equity in STEM education but also identified barriers such as a lack of teacher preparation, resistance to pedagogical changes, and limited technological resources. Moreover, in conflict contexts, such as the case of conflict-affected areas in northern India, additional difficulties in implementing these methodologies have been identified due to the lack of adequate infrastructure.

Table 5. Articles by topic for RQ2.

Topic	References
Engineering	[40,46,47,57–67]
Technology	[40,57–61,64,66–73]
Science	[40,46,57–59,61,64–66,71,73–75]
Mathematics	[40,46,57,59,61,66]
Higer Education	[57,61,63,64,72,74,76–80]
Universit	[46,56,57,60,62,64,75,77–79,81–83]
Learning	[40,57,61,64–66,76,78,80–82,84,85]
Strategy	[40,47,58,64,65,75,78,79,86–89]
Teaching	[46,57,64,66,72,74,77,80–82,84]
Methods	[57,58,67,90]
Pedagogical	[64,77]
Models	[60,66,72,83,87,91]
Active	[57,71,84,92]
Methodology	[62,74,78,80,84,93]
Benefits	[56,69,71,91]
Difficulties	
Challenges	[58,63,65,68,69,71,80,84,94,95]

According to these results, active methodologies in STEM not only improve academic performance but also foster critical skills and creativity. Below, we offer a list of the most notable cases:

1. Among the benefits attributed to the implementation of active methodologies in STEM education, it has been shown that academic performance is significantly improved as a result of them. Skills such as critical thinking, creativity, and problem solving are encouraged. The author's proposal consists of promoting service learning experiences (SAP), which link educational objectives with volunteer activities that can satisfy community needs. In this way, the student understands the subject in the technical sense, in addition to developing social responsibility [76].
2. Another reflection is the one that refers to the fact that learning based on research and the inclusion of role models are elements that allow for the improvement of participation of girls in spatial projects. This involves bringing to class female figures who have who have ascended in STEM fields [66].
3. Given the phenomenon of gender gaps and the low motivation of women to choose STEM careers, the heroine's learning journey model is presented, which consists of proposing heroic narratives in the educational field. In this way, it seeks to improve the participation of women. This narrative fosters motivation and perseverance. Great benefits could be obtained by applying this model [61].
4. A challenge when implementing active methodologies involves ensuring equity in terms of access to STEM education. To do so, it is necessary that pedagogical approaches focus on specific sociocultural needs for each student tp resolve this challenge and adapt teaching methods. This can generate the benefit of improving educational performance and, on the other hand, motivate students' confidence [57].
5. The implementation of active methodologies entails increasing the participation of women in STEM areas but also offering a guidance program during the academic process, guaranteeing safe and stimulating environments. This is a major challenge in ensuring retention and developing effective strategies to ensure women's academic success [47].
6. In the field of difficulties, when implementing active methodologies in STEM education, the phenomenon of resistance to change on the part of academic staff arises, since, on the one hand, a gender perspective must be integrated into plans and, on the other hand, teachers need to be trained along the same lines, which can be done through workshops and courses.

Figure 8, presents a word cloud for research question 2, providing a visual representation of the results of the research question. The shape is random and only seeks to show a consolidated concept that resulted from the analysis of the associated research question.

Results for RQ3: What educational initiatives and experiences have been most successful in implementing active methodologies in STEM with a gender perspective?

Eight keywords from papers on the topic were analyzed to answer this research question (engineering, technology, science, mathematics, higher education, universit*, learning, strategies, teaching, methods, pedagogical, models, active, methodology, benefits, challenges, initiatives, experiences, SDGs, and Sustainable Development Goals). A total of 301 results were obtained for them. Table 6 shows the articles dealing with the topics analyzed in this research question.

Some of the most successful initiatives in the application of active methodologies in STEM with a gender perspective include mentoring projects and educational programs focused on the inclusion of women in STEM. Ortiz [46] highlighted how the use of mentoring and the implementation of specific workshops for women in STEM in Mexico, together with the support of digital technologies and learning platforms, has been crucial in improving

the participation and permanence of women in these areas. These experiences not only foster gender equity but also develop essential practical and academic skills in students.



Figure 8. Word cloud linked to the outcomes related to RQ2.

Table 6. Articles by topic for RQ3.

Topic	References
Engineering	[40,46,47,57–67]
Technology	[40,57–61,64,66–73]
Science	[40,46,57–59,61,64–66,71,73–75]
Mathematics	[40,46,57,59,61,66]
Higer Education	[57,61,63,64,72,74,76–80]
Universit	[46,56,57,60,62,64,75,77–79,81–83]
Learning	[40,57,61,64–66,76,78,80–82,84,85]
Strategy	[40,47,58,64,65,75,78,79,86–89]
Teaching	[46,57,64,66,72,74,77,80–82,84]
Methods	[57,58,67,90]
Pedagogical	[64,77]
Models	[60,66,72,83,87,91]
Active	[57,71,84,92]
Methodology	[62,74,78,80,84,93]
Benefits	[56,69,71,91]
Difficulties	- - -
Challenges	[58,63,65,68,69,71,80,84,94,95]
Initiatives	[58,61–63,65,70,79,92,93,96]
Experiences	[59,65,77,81,82,87,93,97]
SDGs	[64,67,75,76,89,94,96,98,99]
Sustainable Development Goals	[40,46,47,56–58,64–67,70,75,78,81–84,86,89,91,92,94,96,99–102]

According to these results, this research question highlights the impact of mentoring, inspirational faculty, and female role models in improving female participation and retention in STEM. Below, we offer a list of the most notable cases:

1. This study in a private university in Mexico highlights that women and men prefer inspiring faculties who motivate them to continue their careers. The lack of such

encouragement is the main reason for the dropout rate of women in STEM fields. This study proposed different initiatives, such as mentoring, monitoring of already enrolled female students, digital platforms, awareness workshops, and talks with successful women in STEM areas, to inspire female students to continue their careers [68].

2. At the Universidad Tecnológica de Bolívar, the engineering faculty presents gender gaps in most of its programs. The way in which this work is approached is by analyzing five factors to guide and support women in engineering: academic success, protection of women, scholarships and financial aid, international mobility, and leadership. With these factors, the university has developed several strategies and activities to reduce the gender gap, reduce dropout rates, and help female students succeed in their careers [47].
3. A systematic review examined the factors affecting girls' participation in STEM subjects. These factors were categorized as personal, environmental, and behavioral. The review indicates that 17 studies attributed girls' low participation to personal factors, 100 studies to environmental factors, and 48 studies to behavioral factors. Recommendations include valuable insights on creating an enabling a STEM learning environment that supports female students and further research on how education systems can create supportive STEM learning environments using feminist perspectives [40].
4. Female refugees encounter unique challenges, especially in accessing the job market. This study evaluates the effectiveness of a transdisciplinary educational intervention to help female refugees integrate into host societies, demonstrating the role of gender-focused STEM education in promoting female refugees' integration into host societies and enhancing their overall well-being [58].
5. In Latin America, there are different initiatives to achieve gender equality and empower women and girls following the Sustainable Development Goals (SDG) defined by the United Nations. Among these initiatives is the Matilda Latin America Open Chair, a collaboration of people and institutions. This work analyzes the fourth book of this initiative to understand the importance of visible female role models to inspire women in STEM and highlights challenges in STEM fields as a woman [65].
6. At Cornish College, an integrated unit of work for students in grade 5 focused on space science has been developed. Through collaborative learning and the introduction of older female role models, students were encouraged to learn about space science. At the end of the unit, there was a significant improvement in their enjoyment and learning of STEM, with a strong connection between 5th-grade students and their older role models. This reinforces the importance of visible female role models in STEM fields [66].

Figure 9 presents a word cloud for research question 3, providing a visual representation of the results of the research question. The shape is random and only seeks to show a consolidated concept that resulted from the analysis of the associated research question.

Results for RQ4: What educational initiatives and experiences have been most successful in implementing active methodologies in STEM with a gender perspective?

Eight keywords from papers on the topic were analyzed to answer this research question (Engineering, technology, science, mathematics, higher education, universit*, inclusive, gender approach, gender perspective, women in STEM, gender gap, equity, women, learning, strategies, teaching, methods, pedagogical, models, active, methodology, initiatives, experiences, motivation, attrition, dropout, reduction, SDGs, and Sustainable Development Goals). A total of 316 results were obtained for them. Table 7 shows the articles dealing with the topics analyzed in this research question.



Figure 9. Word cloud linked to the outcomes related to RQ3.

Motivational strategies and active methodologies, such as those based on project-based learning and challenge-based learning, are key to reducing female attrition in STEM areas. Costa et al. [61] presented a heroic narrative model (Heroine's Learning Journey), which uses the narrative model to increase women's motivation in STEM. This approach shows how to engage women in a narrative that highlights their achievements and challenges, making them feel part of a community that supports their success, which contributes to reduced attrition and improved performance.

Table 7. Articles by topic for RQ4.

Topic	References
Engineering	[40,46,47,57–67]
Technology	[40,57–61,64,66–73]
Science	[40,46,57–59,61,64–66,71,73–75]
Mathematics	[40,46,57,59,61,66]
Higer Education	[57,61,63,64,72,74,76–80]
Universit	[46,56,57,60,62,64,75,77–79,81–83]
Learning	[40,57,61,64–66,76,78,80–82,84,85]
Strategy	[40,47,58,64,65,75,78,79,86–89]
Teaching	[46,57,64,66,72,74,77,80–82,84]
Methods	[57,58,67,90]
Pedagogical	[64,77]
Models	[60,66,72,83,87,91]
Active	[57,71,84,92]
Methodology	[62,74,78,80,84,93]
Motivation	[40,61–65,77,79,81,81,93,97]
Attrition	[83]
Dropout	[46,80]
Reduction	[47,57,67,78,79,84,85,90,91,96,100–102]
Initiatives	[58,61–63,65,70,79,92,93,96]
Experiences	[59,65,77,81,82,87,93,97]
SDGs	[64,67,75,76,89,94,96,98,99]
Sustainable Development Goals	[40,46,47,56–58,64–67,70,75,78,81–84,86,89,91,92,94,96,99–102]
Inclusive	[66,70,73,78,82,86–88,91,95]

Table 7. *Cont.*

Topic	References
Gender Approach	—
Gender Perspective	[56,77,84]
Women in STEM	[46,47,65,93]
Gender Gap	[46,47,65,73,79,91,93]
Equity	[46,56,57,64,70,71,80,81,89,91,94,99,100]
Women	[40,46,47,56,58,61,65–69,74,75,77,79,83,84,86–88,90–93,96–98,100–103]

These analyses highlight how the combination of inclusive environments, motivational narratives, structural support, and mentoring can improve the retention of women in STEM by addressing specific barriers they face in these disciplines. Below, we offer a list of the most notable cases:

1. It is interesting to note the integration of the gender perspective in pedagogical practices. A study in Argentina on Sustainable Development Goal 5 (SDG 5) highlights the importance of integrating a gender perspective into pedagogical practices to facilitate women's access and success in STEM. Feminist knowledge-based courses and workshops can inspire and motivate women by providing an inclusive and reflective space for their roles and expectations in STEM [68].
2. This article highlights the importance of mentoring and the role of female role models. The presence of female mentors and role models in STEM academia contributes significantly in terms of motivating and retaining young women in these areas. The motivation of female mentors is based on empathy, inspiration for resilience, and a desire to reduce gender gaps, which reinforces a supportive environment [61].
3. Regarding inspirational narratives in pedagogical models, the application of the heroine's learning journey model demonstrates that the use of narratives depicting stories of achievement and perseverance in STEM can increase female participation in online courses. Women see themselves reflected in these narratives, which increases their interest and engagement in STEM areas [79].
4. As related to inclusive learning environments and motivation through adapted spaces, the creation of sustainable and inclusive learning environments that foster curiosity and critical thinking has shown positive effects on the motivation and participation of college students in STEM. Renewed educational environments increase motivation and satisfaction, which may contribute to the retention of female students in STEM [81].
5. An essential aspect concerns structural support for the achievement of a balance between work, study, and personal life. In recent years, work–life balance has become highly relevant for researchers and policy makers. These measures are crucial for retaining women in STEM fields. A flexible work environment, peer support, and family support are key factors that help to reduce the attrition of women from advanced studies in these disciplines [97].
6. Gearing events such as hackathons toward gender diversity and women's participation have proven to be effective in reducing barriers and increasing women's presence at these events. Strategies such as creating supportive environments and eliminating negative stereotypes can attract more women to STEM technology areas [87].

Figure 10 presents a word cloud for research question 4, providing a visual representation of the results of the research question. The shape is random and only seeks to show a consolidated concept that resulted from the analysis of the associated research question.

4.4. Summary of Findings

The analysis of the selected articles allowed us to identify several pedagogical models and teaching strategies that play a critical role in promoting emotional intelligence, resilience, and motivation in STEM education, particularly from a gender perspective.

Regarding RQ1, the studies emphasize that pedagogical models based on active methodologies (problem-based learning, collaborative learning, and inquiry-based learning) and emotional intelligence training foster students' empathy, self-regulation, and teamwork. Tools such as ANNA help students develop self-awareness and connect their skills with professional profiles in STEM.

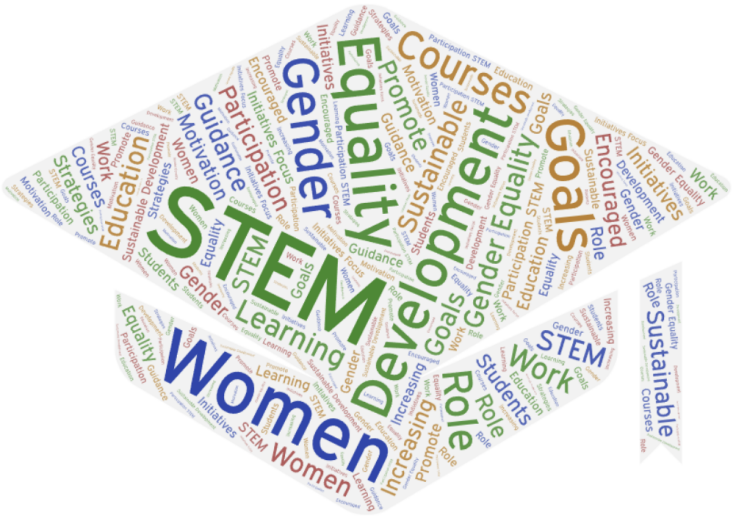


Figure 10. Word cloud linked to the outcomes related to research question RQ4.

With respect to RQ2, the main benefits of active methodologies are increased academic performance, the development of critical thinking and creativity, and higher student engagement. However, these models also face barriers such as a lack of teacher preparation, resistance to pedagogical change, and limited resources for implementation.

With respect to RQ3, the most successful initiatives include mentoring programs, the presence of female role models, digital learning platforms, and gender-sensitive workshops. These experiences have been implemented mainly in Latin America to reduce gender gaps and increase female retention in STEM fields.

Finally, with respect to RQ4, motivational strategies like the heroine's learning journey model, hackathons adapted for female participation, and work–life balance programs have proven to be effective in reducing female attrition in STEM. These initiatives create safe learning environments and foster resilience, which is essential for sustaining participation over time.

In summary, the evidence gathered through this systematic mapping demonstrates that the integration emotional intelligence, resilience, and motivation within STEM education is progressively shaping new pedagogical practices that move beyond traditional cognitively centered models. These inclusive approaches enhance student engagement and academic performance and contribute to reductions in gender disparities by fostering safe, collaborative, and supportive learning environments. However, the success of these strategies largely depends on institutional support, teacher training, and the adaptation of pedagogical resources to specific socio-cultural contexts. These findings highlight the need for continued research and innovation to consolidate pedagogical models that integrate socio-emotional dimensions as essential components of equitable and sustainable STEM education.

5. Reflections on the Findings

Reflections on the findings of this work highlight the positive impact of inclusive pedagogical models in STEM for sustainability education, integrating key competencies such as emotional intelligence, resilience, and motivation. Focusing on gender equity and the renewal of teaching methods allows learning to become a dynamic and collaborative process, where students are active protagonists. These models not only improve academic performance but also foster fundamental values of cooperation and solidarity, contributing to the integral development of students and the construction of a sustainable and equitable society. In addition, the review highlights that emotionally safe learning environments can reduce dropout and motivate women in STEM, strengthening their capacity to face academic challenges.

Inclusive pedagogical models have been shown to have a positive impact on the development of key competencies such as emotional intelligence, resilience, and motivation in students in STEM areas. Some studies highlight that the inclusion of gender perspectives and the integration of active methodologies in STEM education help to overcome the barriers faced by women in these fields, favoring sustainability in education. Several studies highlight the importance of addressing gender barriers to promote equal opportunities in STEM, which is directly related to the SDGs, especially SDG 5 on gender equality. Initiatives that promote female participation in STEM are found in various universities, such as in Mexico and Argentina [104]. These experiences show progress towards sustainability in education by reducing gender disparities in key areas of development. Emotional intelligence has been related to academic performance, especially in the context of inclusive education. A study conducted with university students in Spain reveals that those more interested in including the gender perspective in their education showed higher levels of satisfaction with their lives and better emotional development, which translates into a positive impact on their academic performance [56].

Inclusive pedagogical models improve not only emotional intelligence but also students' resilience. Methods such as project-based learning and service learning have been implemented to facilitate the integration of students in the STEM field, especially for women, by providing them with hands-on experiences and emotional support in real contexts [105].

Future Research and Implications: Based on the findings, several key directions for future research emerge:

- Expanding empirical validation: Building on this conceptual mapping, future studies are encouraged to empirically assess how emotional intelligence, resilience, and motivation influence learning outcomes in various STEM environments.
- Developing teacher training programs: More research is needed on the best practices for training educators in inclusive pedagogical methods, particularly those that incorporate socio-emotional learning and gender-sensitive approaches.
- Longitudinal studies on student retention: Investigating the long-term effects of inclusive STEM education on career choices and workforce participation would provide valuable insights into the effectiveness of these models.
- Policy integration: Exploring how institutional policies can better support the adoption of inclusive pedagogical strategies will be crucial for ensuring their sustainability and scalability.

It is important to clarify that the emphasis on emotional intelligence in STEM education does not seek to reinforce essentialist assumptions that associate emotionality exclusively with women. Rather, we advocate for a pedagogical model that values emotional intelligence as a universal and trainable competency that is beneficial for all students, regardless of gender. As highlighted by Vázquez Valencia and Campos Uscanga [43],

integrating emotional education in STEM settings can foster more equitable and inclusive learning environments without relying on gendered stereotypes. Furthermore, this pedagogical model emphasizes emotional competencies, which are often neglected in traditional STEM education, as key components of inclusive and equitable learning environments for women [29]. However, it is important to recognize that gender is only one dimension of exclusion in STEM education. Factors such as socioeconomic status, ethnicity, and disability also intersect with gender, often compounding barriers to access and retention. Incorporating an intersectional approach allows for a deeper understanding of how multiple forms of disadvantage operate simultaneously and guides the development of more holistic and responsive pedagogical strategies [106].

It is essential to clarify that the call for the integration of emotional intelligence into STEM education is not based on assumptions that women are inherently more emotional or less analytical than men. Rather, our position seeks to challenge these binary and essentialist frameworks. Emotional intelligence is promoted here as a universal human competency that can benefit all learners. We align with feminist perspectives that critique the marginalization of emotional knowledge in STEM and advocate for pedagogies that validate diverse ways of knowing and being [107]. By incorporating emotional literacy, we aim to foster inclusive, equitable, and human-centered learning environments—not to reinforce stereotypes, but to dismantle them [108].

In addition, it is important to highlight that many of the studies reviewed in this mapping were conducted in Latin American countries. This implies that, in addition to gender differences, cultural and linguistic specificities may influence both pedagogical practices and students' perceptions of emotional intelligence, resilience, and motivation.

For example, in several Latin American contexts, emotional expression tends to be more socially accepted and integrated into classroom interactions, which may facilitate the inclusion of emotional intelligence training in STEM education. Likewise, mentoring programs or female role models in STEM may need to be adapted to local realities, considering factors such as social expectations about women's roles, family responsibilities, and access to technology, which vary significantly across regions. Educational environments in Latin America are often shaped by strong social inequalities, diverse cultural values, and language variations that may affect how inclusive pedagogical models are designed and implemented.

Therefore, while this study's findings provide relevant insights for the global STEM education context, it is essential to acknowledge that local cultural and linguistic factors may condition the transferability and effectiveness of these pedagogical initiatives in other geographical settings.

At last, this study reinforces the importance of integrating inclusive pedagogical models into STEM education to foster equity, motivation, and student well-being. While challenges remain, the growing body of research suggests that a shift towards holistic, student-centered learning will play a pivotal role in shaping the future of STEM education, making it more inclusive, effective, and sustainable.

6. Study Limitations

It is crucial to recognize the possible limitations of this work, such as the manual selection of scientific articles through database search engines. The choice of specific keywords to filter the literature could entail risks of bias in extraction, which requires a thorough review to confirm the accuracy of the obtained results. The methodology focused mostly on academic publications in English from 2018 onward, leaving out contributions in other languages. This approach gave priority to recent journal articles and academic conferences, thereby ensuring the relevance of the collected data.

7. Conclusions

This systematic mapping study provides a structured synthesis of the existing literature on inclusive pedagogical models in STEM education, emphasizing the role of emotional intelligence, resilience, and motivation in promoting gender equity and sustainability. By organizing and categorizing research on these socio-emotional competencies, this work highlights their influence on student retention, academic performance, and engagement, particularly for women in STEM. Unlike prior research that addresses gender disparities mainly from a structural or policy perspective, this study underscores the pedagogical dimension, demonstrating how emotionally supportive learning environments and active teaching methodologies can foster greater inclusion and academic success.

A key contribution of this study is its comprehensive overview of trends, gaps, and emerging research areas within this field. The findings suggest that while there is growing recognition of the importance of socio-emotional skills in STEM education, there remains a lack of systematic frameworks guiding their integration into curricula. Additionally, this study aligns with global sustainability goals (SDG 4 and SDG 5) by emphasizing the transformative role of education in fostering equity and long-term learning success. As a reference framework, this research provides insights for educators, policymakers, and institutions seeking to implement evidence-based pedagogical strategies that enhance student motivation, emotional well-being, and academic persistence in STEM disciplines.

Inclusive pedagogical models and active methodologies are fundamental for the development of emotional intelligence in STEM students. By integrating socio-emotional skills such as self-awareness and empathy and fostering a growth mindset, these methods improve not only participation and engagement but also understanding of complex concepts. Although they present logistical and resource challenges, their implementation enhances essential skills such as communication and resilience, contributing to students' academic and professional success in a collaborative and nurturing environment.

From research question 1 the following can be concluded: This response highlights how pedagogical models that promote gender equity foster empathy and social justice in STEM students, sensitizing them towards inclusion in their future environments. The incorporation of emotions and caring by STEM educators strengthens emotional intelligence, teaching students to manage their emotions and value empathy and responsibility. Inclusive environments at events such as hackathons help reduce impostor syndrome, improving women's confidence. Tools such as ANNA promote self-awareness, helping students recognize their strengths and explore diversity in STEM. In addition, inquiry-based learning and the presence of female role models in early education strengthen emotional skills and motivation. Finally, the visibility of women in architecture shows the relevance of female role models in building resilience and confidence in students.

From research question 2, the following can be concluded: Applying active methodologies in STEM education improves academic outcomes while nurturing essential skills like creativity and problem solving. Furthermore, initiatives such as service learning, the heroine's learning journey model, and the inclusion of female role models play a crucial role in increasing women's participation, motivation, and retention in STEM. These approaches address gender disparities and foster supportive educational environments.

From research question 3, the following can be concluded: This research underscores the role of inspiring faculty in reducing STEM dropout rates, with mentoring and the showcasing of successful women acting as key motivators. The Universidad Tecnologica de Bolivar tackles gender gaps in engineering through scholarships, mobility, and leadership initiatives. A systematic review identified personal, environmental, and behavioral factors affecting girls' STEM participation, highlighting the need for supportive learning environments. Gender-focused STEM education has been shown to aid female refugees in terms of

integration and well-being. The Matilda Latin America Open Chair and Cornish College's space science unit both demonstrate the empowering impact of female role models on women's and girls' engagement and enjoyment in STEM.

From research question 4, the following can be concluded: This analysis underscores the relevance of applying inclusive and gendered pedagogical approaches in STEM education to improve the retention of women. The inclusion of female role models and mentoring spaces provides emotional and professional support, encouraging retention. In addition, inspirational narratives, such as the heroine's learning journey model, increase female participation by providing stories of perseverance. Sustainable learning environments that promote critical thinking and curiosity enhance female students' motivation. Finally, work–study–life balance, along with work flexibility and family support, is essential reduce dropout in STEM.

As Cohen points out, safe and collaborative educational environments foster learning and develop socio-emotional competencies, supporting academic performance and student retention [35].

Alternatively, findings indicate that integrating socio-emotional competencies like emotional intelligence, resilience, and motivation into STEM pedagogy can substantially advance gender equity and inclusion. However, the analysis acknowledges limitations, including the heterogeneity of contexts and methodologies in the reviewed studies, which may affect the generalizability of the results. Future research should employ longitudinal designs and comparative approaches to validate and expand these findings across diverse educational settings.

Inclusive pedagogical strategies require contextualized and sustained implementation, with teachers playing a central role. However, barriers such as limited training in emotional intelligence and resistance to pedagogical change persist. To address these challenges, teacher training programs that combine practical tools with a focus on enhancing socio-emotional competencies are recommended.

While inclusive pedagogical models show promise, their implementation faces significant systemic barriers that must be critically addressed to ensure long-term success. One major challenge is the institutional inertia that resists pedagogical innovation—rooted in traditional STEM curricula prioritizing technical mastery over inclusive and socio-emotional dimensions [109]. Structural constraints such as limited teacher autonomy, rigid accreditation standards, and an over-reliance on high-stakes assessments are significant inhibitors of transformative teaching methods [110,111].

As identified in our review, teacher resistance often emerges from deeper systemic conditions: insufficient institutional backing, limited access to professional development in inclusive pedagogies, and the absence of recognition or incentives for the adoption of student-centered strategies [112]. These limitations are further reinforced by cultural and organizational biases, particularly those embedded in hiring, promotion, and leadership practices. These continue to marginalize women and under-represented groups in STEM faculties [113].

Multilevel and systemic strategies are required to address these challenges. At the institutional level, transformational and distributed leadership models can foster an environment that supports pedagogical experimentation and promotes gender-sensitive teaching reforms [114]. Policy-level initiatives should incorporate benchmarks for inclusive pedagogy into accreditation, teacher evaluation, and funding schemes. Simultaneously, professional development programs grounded in critical pedagogy must cultivate reflective educators capable of challenging systemic inequities [108,115].

In sum, overcoming these systemic barriers involves technical adjustments and ideological shifts, redefining how knowledge, participation, and academic success are framed in STEM education. Inclusive transformation must be cultural, structural, and sustainable.

The findings also have practical implications for public policies. Integrating inclusive models in STEM aligns with the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 5 (Gender Equality). Educational institutions and policymakers should prioritize these strategies to ensure equitable and sustainable learning environments. Initiatives such as mentorship programs for women in STEM, emotional support programs, and active teaching methodologies can drive meaningful progress in gender equity and educational quality.

It is important to note that the effectiveness of inclusive pedagogical strategies may vary significantly depending on cultural, institutional, and linguistic contexts. While many of the studies reviewed herein are rooted in English-speaking countries, there is a growing body of research from Latin America that highlights the importance of localized approaches [116]. For example, programs such as "Mujeres en Ciencia y Tecnología" in Mexico and "Yo Quiero Ser Ingeniera" in Chile emphasize the role of language, cultural identity, and systemic inequalities in shaping STEM participation. Incorporating regional insights is essential to develop pedagogies that are not only inclusive but also contextually relevant [117].

Finally, a holistic approach that links academic, emotional, and social dimensions in STEM education is essential. While the initial results are promising, further efforts are needed to incorporate these strategies into global educational policies. Collaboration among institutions, governments, and communities will be key to maximizing the impact of these initiatives and achieving educational transformation that meets the demands of the 21st century.

7.1. Recommendations for Implementation

To support the adoption of inclusive pedagogical models in STEM, institutions should develop structured training programs that combine theory and practice. These programs may include workshops on emotional intelligence, resilience-building strategies, and gender-sensitive teaching practices, alongside mentoring schemes and reflective teaching communities [118]. Successful implementation requires institutional support, time allocation for training, and recognition of inclusive teaching efforts as part of professional development and academic advancement [119].

7.2. Recommendations for Practice

Based on the analyzed literature, several best practices emerge for the integration of emotional intelligence and gender equity into STEM education:

Curricular Integration: Include explicit learning outcomes related to emotional regulation, empathy, and collaborative problem solving in STEM syllabi.

Teacher Training: Offer professional development for STEM educators focused on inclusive pedagogies and socio-emotional learning (SEL).

Mentorship and Role Models: Promote programs that connect students with diverse STEM professionals, especially women in leadership roles.

Gender-Responsive Evaluation: Design assessments that value teamwork, reflection, and process—not only technical accuracy.

Policy Alignment: Encourage institutional policies that support equitable access, retention, and recognition of women in STEM pathways.

These strategies aim to create emotionally supportive and inclusive environments that enhance participation and performance for all learners, particularly those from underrepresented groups.

Author Contributions: A.B.-M. and M.D.-R. led the structuring of the systematic mapping, actively participating in the study, analysis, and presentation of the results, in addition to contributing to the article's writing. J.M.-G. and E.S.-V. collaborated in the planning of the systematic mapping, as well as in the writing, reviewing, and formatting of the text. J.D.-A. and A.B.-M. enriched the study with their methodological support; expert perspectives; and the creation of graphs, tables, and conceptual diagrams. A.B.-M. supervised the research stages to ensure compliance with the established methodological standards. J.M.-G. contributed to the validation of the results, ensuring the accuracy and consistency of the findings. M.D.-R. was responsible for managing and organizing the bibliographic references, ensuring that the citation and reference formats met the journal's requirements. All authors participated in the final editing and review of the manuscript and approved its final version for publication. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors have declare no conflicts of interest.

Appendix A

Table A1. Articles used to Analysis and Results of systematic mapping.

Num.	Title	Cite	Year
1	Working with Women in ICTD	[68]	2017
2	Prioritising action to accelerate gender equity and health for women and girls: Microdata analysis of 47 countries	[100]	2018
3	Sustainable food systems, health and infectious diseases: Concerns and opportunities	[94]	2019
4	Increasing gender diversity in STEM: A tool for raising awareness of the engineering profession	[60]	2019
5	Just urban futures? Exploring equity in "100 Resilient Cities"	[89]	2019
6	Besides Zaha or Adenowo: Investigating the Visibility Status of Female Architects as Role Models for Students of Architecture	[83]	2019
7	Sustainable Environments in Education: Results on the Effects of the New Environments in Learning Processes of University Students	[81]	2020
8	Research Priorities for Achieving Healthy Marine Ecosystems and Human Communities in a Changing Climate	[71]	2020
9	Aprendizaje servicio en educación superior entre España y México. Hacia los ODS	[76]	2021
10	Individual-Centred Approaches to Accessibility in STEM Education	[57]	2021
11	The Role of Coffee Production and Trade on Gender Equity and Livelihood Improvement in Tanzania	[91]	2021
12	Eliminating global learning poverty: The importance of equalities and equity	[85]	2021
13	Expanding Opportunities: A Framework for Gender and Socially-Inclusive Climate Resilient Agriculture	[86]	2021
14	Solar for all: A framework to deliver inclusive and environmentally sustainable solar irrigation for smallholder agriculture	[70]	2021
15	Analysis of Research on the SDGs: The Relationship between Climate Change, Poverty and Inequality	[98]	2021

Table A1. *Cont.*

Num.	Title	Cite	Year
16	Mobilising evidence, data, and resources to achieve global maternal and child undernutrition targets and the Sustainable Development Goals: an agenda for action	[102]	2021
17	Juggling between work, studies and motherhood: The role of social support systems for the attainment of work–life balance	[97]	2021
18	Educational initiatives for bridging the diversity gap in STEM	[59]	2021
19	Quí-Bot-H2O Challenge: Integration of computational thinking with chemical experimentation in early ages including gender, inclusive and diversity patterns	[73]	2021
20	Towards a bottom-up approach to inclusive digital identity systems	[95]	2021
21	Women's Motivation to Mentor Young Women Students in STEM Areas: A Study Case in Mexico	[93]	2021
22	The experience of women students in engineering and mathematics careers: a focus group study	[79]	2021
23	Motivating Female Students for Engineering Courses	[62]	2021
24	Resetting education priorities during COVID-19: Towards equitable learning opportunities through inclusion and equity	[82]	2021
25	The role of universities in the inclusion of refugees in higher education and in society from the perspective of the SDGS	[78]	2022
26	Role Modeling as a Computing Educator in Higher Education: A Focus on Care, Emotions and Professional Competencies	[72]	2022
27	Towards gender balance in modern hackathons: literature-based approaches for female inclusiveness	[87]	2022
28	Mapping the Academic Profile of the Computer Science Student from School to University: Pathway Tracing and Gender Analysis	[74]	2022
29	Contribution of Social Psychology Research to the Sustainable Development Goals (SDGs). Bibliometric and Content Analysis of Spanish Publications	[65]	2022
30	Using Inquiry-Based Learning and Role Modelling as a Motivator for Increasing the Participation of Girls in Space Science	[66]	2022
31	Analysis of the retention of women in higher education STEM programs	[46]	2023
32	Emotional Intelligence, Quality of Life, and Concern for Gender Perspective in Future Teachers	[56]	2023
33	Guidance and support of women in engineering programs at Universidad Tecnologica de Bolivar	[47]	2023
34	Trabajar los ODS en el aula de personas adultas mediante textos memorialísticos: género, interculturalidad y multimodalidad	[84]	2023
35	Trends in child marriage, sexual violence, early sexual intercourse and the challenges for policy interventions to meet the sustainable development goals	[90]	2023
36	Does Women's Empowerment Influence Multidimensional Poverty? Empirical Insight from Rural Odisha of India	[101]	2023
37	Disentangling the link between social determinants of health and child survival in Nigeria during the Sustainable Development Goals era: a hierarchical path analysis of time-to-event outcome	[103]	2023
38	Facing post-pandemic challenges in engineering education: Promoting global collaborations in Latin America	[63]	2023
39	Women inspiring women in STEM professional careers: Journeys from Latin America	[75]	2023
40	La igualdad de género y los Objetivos de Desarrollo Sostenible: aportes desde la Educación Superior argentina	[77]	2024
41	Enabling Indian Women Career Reentry in Technology—A Learning Journey	[92]	2024
42	Empowerment and integration of refugee women: a transdisciplinary approach	[58]	2024
43	Environmental Governance and Gender Inclusivity: Analyzing the Interplay of PM2.5 and Women's Representation in Political Leadership in the European Union	[96]	2024
44	Heroine's Learning Journey: Motivating Women in STEM Online Courses Through the Power of a Narrative	[61]	2024
45	Motivation of STEM Doctoral Students Integrating Sustainable Development Goal 14: Life Below Water into Their Research: An International Study	[64]	2024
46	A Systematic Review Using Feminist Perspectives on the Factors Affecting Girls' Participation in STEM Subjects	[40]	2024
47	Making frugal innovations inclusive: A gendered approach	[88]	2024
48	Health equity, mental health, and partnerships to build back after COVID-19: Multistakeholder perspectives at a United Nations event	[99]	2024
49	Media Literacy in Enhancing Women's Participation Towards Sustainable Development Goals in Indonesian Plantation Communities	[67]	2024
50	Assessing SDG 4 indicators in online and blended higher education within conflict zones: A case study of northern India's higher education institutions	[80]	2024
51	A gender perspective on the role of technology in democratic development through wartime civic engagement	[69]	2024

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