

# Gendered STEM: A Systematic Review and Applied Analysis of Female Participation in STEM in the United Arab Emirates

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**Abstract:** The present study aims to identify potential barriers that women in the United Arab Emirates might face if they pursue careers in science, technology, engineering, and mathematics (STEM). For this purpose, a systematic review and subsequent applied analysis of the UAE context was developed. The systematic review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and PRISMA Extension for Scoping Reviews. The review was performed on EBSCO, ProQuest, Wiley Online Library, Gale, Taylor and Francis Online, SAGE Complete, and JSTOR. The initial database search yielded 168 articles. Following a review of the corresponding abstracts, eight full-text articles that fulfilled the inclusion criteria were selected. The results obtained are discussed in the context of the UAE and help inform policy proposals and future research lines to strengthen the involvement of women in STEM careers. The study found that while women in the UAE have greater access to education in engineering and STEM fields, women's employment prospects in these sectors remain fraught.



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**Keywords:** women; engineering; United Arab Emirates; STEM; gender stereotyping

## 1. Introduction

The United Arab Emirates (UAE) has a large workforce of migrant workers who account for the majority of employees in highly skilled positions. Due to the continuous growth of the science, technology, engineering, and mathematics (STEM) fields, demand for a workforce trained in STEM is growing [1]. This could lead to high youth unemployment rates among citizens in countries that exhibit the trend, as is currently happening in the United States [2]. The Middle East and North Africa (MENA) has the world's youngest population, with more than half of its people under the age of 25 [3]. Meanwhile, the World Economic Forum [4], reports that the MENA region has the world's highest youth unemployment rate (27.2% in the Middle East and 29% in North Africa). This is partly due to a skills shortage, which is compounded each year by the influx of foreign workers [5] dominating the private sector [6].

The UAE currently has a youth unemployment rate of 7.34% [7]. Unemployed Emirati youth have criticized the education system, particularly at the high school level, for failing to prepare them for the labor market [8]. In 2019, the female unemployment rate in the emirate of Abu Dhabi was 23.8% among women aged 25 to 29. Across the UAE, female unemployment was significantly higher than male unemployment [9]. According to [10], the UAE government is working to reform the high school curriculum to prioritize STEM education [10] to ensure that Emirati youth are equipped with the necessary skills to compete for jobs in STEM sectors upon graduation.

These goals are further evidenced by the process of Emiratisation, a UAE Government initiative to place qualified Emirati men and women in government and private sector companies [11]. Emiratisation is particularly important for women, who benefit from government-sponsored gender equality programs [12]. The importance of a STEM

education is also highlighted in the UAE Vision [13], a multi-year plan for developing the country's economy.

In recent years, education officials in the UAE have prioritized education that prepares Emirati youth for jobs in the “aerospace, aviation, metallurgy, semiconductors, and nanotechnology” sectors [14]. This is in line with the UAE's National Agenda [13], which aims to create a knowledge-based economy fostering research and innovation to bolster the country's economic environment and boost its appeal to foreign investors. The UAE's new commitment to STEM education is reflected in the high STEM enrolment rates at several of the country's leading higher education institutions. Despite the belief that engineering is a male-dominated field [15], women outnumber men in enrolment at the Higher Colleges of Technology, the University of Sharjah, and United Arab Emirates University [16].

This study aims to better understand the challenging position of aspiring and working female engineers in the UAE and gather insights on the gender bias that impedes their career trajectory. For this purpose, a systematic review of eight articles and a subsequent applied analysis of the UAE context was developed. Below, we present data about the reality of women in STEM and their relationship with STEM education in the context of the UAE. Subsequently, we present the method and the results of the systematic review that support our analysis.

### *1.1. The Current STEM Landscape for Women in the UAE*

The UAE, like many countries around the world [17], is investing heavily to improve the education of women, particularly in STEM disciplines [18]. The prominent and equal participation of women in STEM higher education courses, [19], and later in the workforce, is viewed as key for the growth of Gulf State economies [19], and the UAE, in particular, has positioned STEM subjects [14] as essential for reforming the country's economy from one based predominantly on oil to one of knowledge. Additionally, the UAE encourages girls to study STEM disciplines [20] and pursue jobs traditionally dominated by men [21]. Since 2010, the UAE has been working to reform its secondary education curriculum to incorporate more STEM courses [22]. Today, even fathers motivate their daughters to study engineering [23,24], which would have been unthinkable a few decades ago.

One may argue that STEM fields are no longer considered male-only sectors in the UAE [25], as girls are actively participating in school and university-level science and engineering courses, outperforming boys in most cases since the adaptation of STEM in government schools. Emirati women have persisted in STEM education and continue to outnumber their male peers despite social, psychological, and gender preconceptions, as well as cultural difficulties with women playing leadership roles [23]. Nonetheless, while female participation in secondary and tertiary STEM education has increased in parallel with the UAE's economic development goals, the workforce continues to skew male. What is more, the disconnect between women's professional aspirations and their ability to find STEM-related jobs has not been adequately studied.

To fill this research gap, we aggregated studies from the UAE and other countries to explore the contextual challenges and opportunities for women pursuing careers in engineering and STEM fields. We gathered and analyzed secondary data on female engineering students at the Higher Colleges of Technology, the University of Sharjah, and United Arab Emirates University to determine whether the UAE provides suitable engineering employment opportunities for female graduates of engineering programs.

### *1.2. Women and STEM Representation in UAE Higher Education*

The UAE has several higher education institutions dominated by women in STEM, as shown by the data below (Tables 1–5).

**Table 1.** HCT New Student Enrolment by High School Type and Gender—Academic Year 2019–2020 [26].

School Type	Female	Male	Total
Government	4089	568	4657
Private	318	229	547
<b>Total</b>	<b>4407</b>	<b>797</b>	<b>5204</b>

**Table 2.** HCT Enrollment by Division and Gender 2019–2020 [27].

Division	Female	Male	Total
<i>Applied Media</i>	1196	157	1353
<i>Business</i>	3972	1408	5380
<i>Computer Information Science</i>	3053	1801	4854
<i>Education</i>	947	0	947
<i>Engineering, Technology, and Sciences</i>	2541	3062	5603
<i>Health Sciences</i>	2055	220	2275
<i>Professional Careers</i>	405	96	501
<i>Technical Studies Program (TSP)</i>	77	0	77
<i>Total</i>	<b>14,246</b>	<b>6744</b>	<b>20,990</b>

**Table 3.** UAEU Enrollment by College and Gender 2017–2018 [28].

Division	Male	Female	Total
Humanities and Social Sciences	92	723	815
Science	61	465	526
Education	2	110	112
Business and Economics	143	382	525
Law	70	226	296
Food and Agriculture	18	215	233
Engineering	270	588	858
Medicine and Health Sciences	62	162	224
Information Technology	138	250	388
Master's	113	218	331
Doctorate	10	38	48
Professional Doctor of Pharmacy	22	48	70

**Table 4.** UAEU fall 2020 intake [28].

College	Male Students	Female Students	Total
Business and economics	425	1309	1734
Education	21	778	799
Engineering	1102	1904	3006
Food and agriculture	72	646	718
Humanities and social sciences	406	2897	3303
Information technology	525	954	1479
Law	180	565	745
Medicine and health sciences	172	565	737
Science	267	1599	1866
<b>Total</b>	<b>3170</b>	<b>11,217</b>	<b>14,387</b>

### 1.2.1. Higher Colleges of Technology (HCT)

Higher Colleges of Technology (HCT) is the largest higher education institution of applied sciences in the UAE. HCT offers 13 undergraduate engineering, technology, and science majors in areas such as aviation, computing, construction, energy, governance, healthcare, infrastructure support and maintenance, manufacturing, oil and gas, and telecommunications [26]. According to data from the 2019–2020 academic year (Table 1), 93% of students enrolled at HCT were female [26].

Although female students dominate all fields of study at HCT, male enrollment in engineering, technology, and science is slightly higher, with 55% of males participating in STEM disciplines (Table 2).

### 1.2.2. United Arab Emirates University (UAEU)

United Arab Emirates University (UAEU) is the UAE's flagship university, with comprehensive graduate and undergraduate programs in business and economics, education, engineering, food and agriculture, humanities and social sciences, information technology, law, medicine and health sciences, and science. All majors are fully accredited and of high quality [28].

UAEU enrollment statistics for 2017–2018 [27] show that women outnumbered men in engineering by more than 2:1 (Table 3), and intake numbers from Fall 2020 show that women far outnumber men in STEM disciplines at UAEU [28] (Table 4).

### 1.2.3. University of Sharjah

The University of Sharjah is a regional and global leader in education [29], scientific research, and the arts, with programs accredited by the UAE Ministry of Higher Education and Scientific Research. Several programs, including engineering, communication, science, and business, have received international accreditation [30]. In 2019–2020, women outnumbered men in engineering and STEM, as illustrated in Table 5 [31]. This was true in every college except Computing and Informatics.

**Table 5.** University of Sharjah intake by college and gender 2019–2020 [31].

College	Male	Female	Total
Shari'a and Islamic Studies	66	47	113
Arts, Humanities, and Social Science	231	437	688
Business Administration	147	180	327
Engineering	370	389	759
Health Sciences	53	423	476
Law	132	120	252
Fine Arts and Design	8	131	139
Communication	72	174	246
Medicine	106	198	304
Dental Medicine	55	160	215
Pharmacy	36	143	179
Sciences	26	146	172
Computing and Informatics	156	146	302
No College Designated	17	24	41
Total	1475	2718	4193

## 2. Method

To categorize the contextual barriers and challenges preventing many female engineers in the UAE from pursuing careers in engineering, we conducted a qualitative desk research study. This systematic review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [32] and PRISMA Extension for Scoping Reviews [33]. The examined literature investigated the status of female engineers from different countries and applied the findings to the UAE. The included literature review focused on opportunities and challenges faced by

women seeking employment in engineering fields. The study's published protocol has an exhaustive list of cited reviews.

### 2.1. Eligibility Criteria

The systematic review included qualitative studies that (i) focused on female engineers and gender discrimination in engineering, (ii) examined employment opportunities for women in engineering, (iii) used qualitative approaches such as case studies, narratives, or phenomenology studies, (iv) looked at enrollment in higher education, including engineering and other STEM disciplines, (v) were published in English, (vi) focused on women engineers, and (vii) were published between 2012 and 2021. Eligibility criteria was determined through a detailed review of abstracts.

### 2.2. Data Source and Search Strategy

The systematic literature search was conducted in the following databases: EBSCOhost, ProQuest, Wiley Online Library, Gale, Taylor and Francis Online, SAGE Complete, and JSTOR. Iterative searches were performed using the following keywords: "Women in STEM", "women engineers", "gender disparity", "discrimination", and "gender stereotyping". Boolean operators such as "and", "or", and "not" were also applied, as well as date range and language. The results were filtered to include only qualitative studies.

### 2.3. Study Selection

Citations were downloaded using Mendeley and then exported as RIS files to Rayyan, a free web- and mobile-based systematic review software [34]. Rayyan improved the effectiveness of the search filtering and shortened the review period by accelerating the process of study selection. Abstracts of eligible articles were then evaluated to determine each paper's suitability for inclusion. We used the "include" and "maybe" functions to specify justification for inclusion.

### 2.4. Data Extraction

The following information was collected from 168 pre-selected papers and included 8 final selected papers: country of study, study rationale, design, methods, sampling and participant characteristics, data analysis, and main findings.

### 2.5. Quality Appraisal

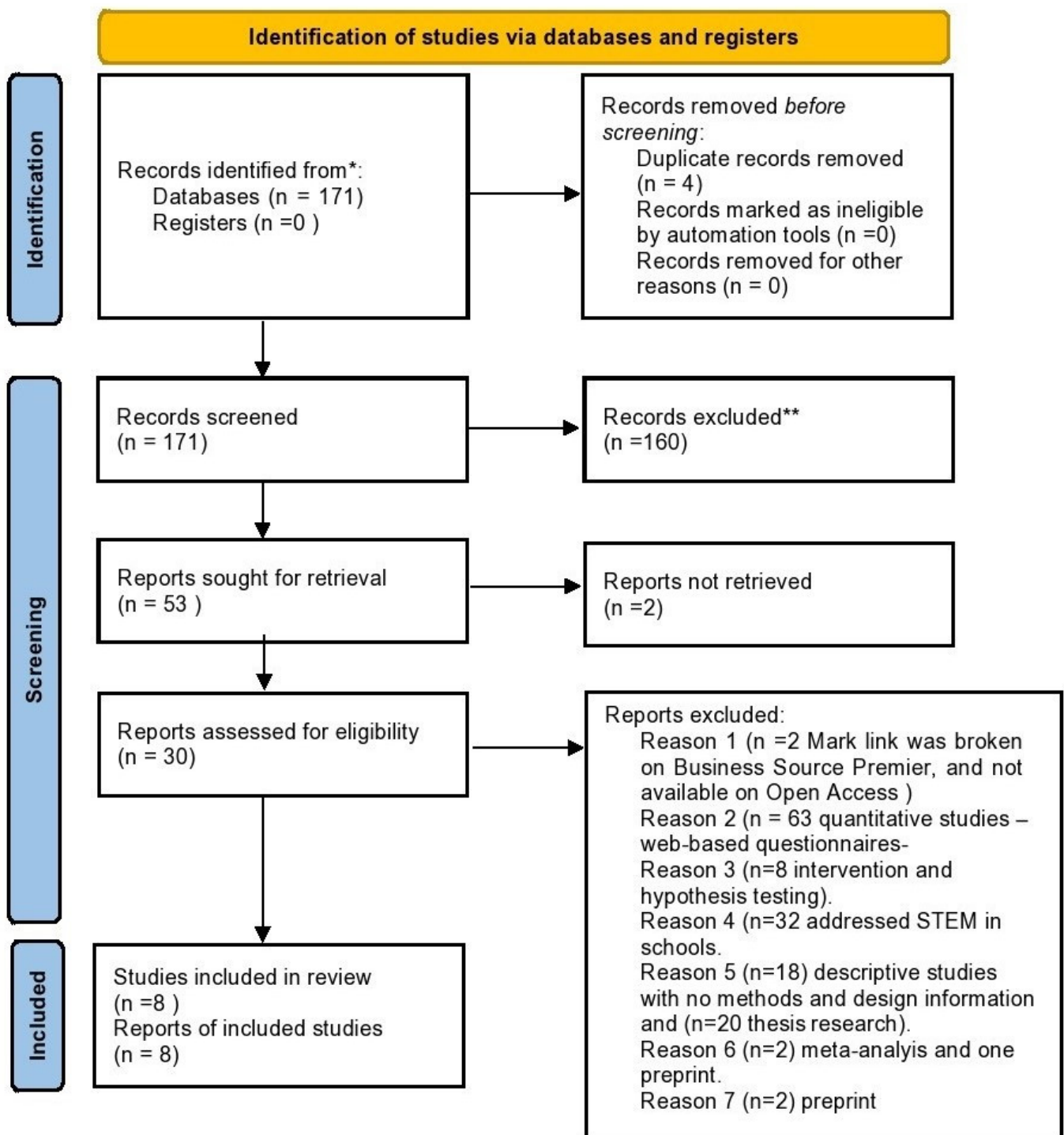
Selected studies were evaluated using the JBI Checklist for Systematic Reviews and Research Syntheses. The checklist has 11 questions, and the inclusion criteria are scored as "yes", "no", "unclear", or "not applicable" [35].

### 2.6. Data Analysis

We identified recurring themes in the selected studies and produced a narrative synthesis of the findings. Sociodemographic characteristics and key findings are presented using a table and written descriptions.

## 3. Results

Figure 1 illustrates the article selection procedure and search results in detail. We retrieved 168 articles during the systematic review. Seven databases were consulted for literature searches: EBSCOhost ( $n = 21$ ), JSTOR ( $n = 26$ ), Taylor and Francis ( $n = 34$ ), ProQuest ( $n = 18$ ), Wiley Online Library ( $n = 22$ ), Gale ( $n = 23$ ), and SAGE Complete ( $n = 24$ ). Twenty-seven articles were selected for a full-text review. Articles based on mixed methods, meta-analysis, systematic reviews, and quantitative analysis were not included in our review. Each of the 171 abstracts were examined to assess the study design, technique, and method, and studies were excluded if they were non-qualitative. Eight papers were deemed suitable for our study.



**Figure 1.** Prisma flow diagram. PRISMA 2020 flow diagram for new systematic reviewers which included searches of databases and registers only. \* Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/register). \*\* If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

### 3.1. Characteristics of Included Studies

We assigned nine characteristics to assess each study, including:

- (1) Citations;
- (2) Country of study;
- (3) Rationale;



- (4) Study design;
- (5) Methods;
- (6) Sampling and participant characteristics;
- (7) Data analysis;
- (8) Main findings;
- (9) Study conclusion.

The selected studies are listed below (Tables 6–13).

**Table 6.** Kemp et al. (2021) [36].

Country	UAE
<i>Aim</i>	The aim of this study was to examine female graduates' career choices in the fields of science, technology, engineering, and mathematics (STEM) to ascertain the factors that influenced their entry into, abandonment of, or persistence in STEM occupations.
<i>Study design</i>	Qualitative
<i>Method</i>	Semi-structured, open-ended questions. Questions pertained to participants' lives and careers; narratives were recorded.
<i>Sampling</i>	Purposive sampling. Sample group of 12 international (UAE citizen and expatriate) female employees who held an undergraduate and/or postgraduate degree in a STEM subject. These 12 participants were from seven countries and included seven expatriates (58%) and five UAE nationals (42%). Two-thirds (n = 8) of the participants had a close family member (mother, father, brother, or sister) who had studied and/or worked in STEM. Age ranged from 21 to older than 41 years.
<i>Data analysis</i>	Content analysis. Data were collected in transcripts of recorded interviews. All data were submitted to NVivo 10.2. The transcript content from the recorded interviews was analyzed to identify themes.
<i>Main findings</i>	Four emerging themes were observed. The first theme was the link between self-efficacy and competence. Each of the 12 participants expressed pride in their academic accomplishments, particularly in mathematics and science. Religion and personal beliefs were the second theme. There was indication that their decision was influenced by religion. The third theme was issues of family and culture. Their families inspired them to seek STEM careers. Relatives worked in STEM sectors. The last theme emphasized the value of work and social standing. Several individuals were unable to secure employment after graduation or pursued other career choices. Interviewees expressed discontent with their STEM employment. As a result, many switched careers and are now employed by non-governmental groups, launching their own enterprises, and working in retail and management. Another participant left a STEM profession because she thought engineering was not a good fit for her, even though her parents had chosen STEM for her.

Note: Kemp et al., (2021), [36] confirmed the inclusion of their research.

**Table 7.** Howe-Walsh, et al (2020). [37].

Country	UAE
<i>Aim</i>	The aim of this study was to ascertain the factors influencing Emirati women's career choices in the United Arab Emirates.
<i>Study design</i>	Qualitative
<i>Method</i>	Semi-structured interviews with 21 Emirati women working in technology in the UAE.
<i>Sampling</i>	Snowball sampling. Twenty-one women. Aged 22–36. On the one hand, we acknowledge that the study's small sample size precludes generalization and is not intended to be representative of the greater female population in the UAE. However, on the other hand, the data provide a wealth of information about Emirati women's career choices and the factors that influenced them.

Table 7. Cont.

Country	UAE
<i>Data analysis</i>	Theme-based data analysis. Authors provide little information on the statistical tools they employed.
<i>Main findings</i>	<p>The first theme was family. Each respondent stressed the critical role of family in guiding their STEM career choices. Conversations with parents about career options had influenced all the women to pursue a career that their parents regarded as appropriate. As a result, parental influence over employment choice is reaffirmed. Women desired to be recognized as role models for future generations. Additionally, there was a strong feeling that, as Arab women, they would be regarded as global role models.</p> <p>Another recurring theme was the prestige of working for a certain company. Their career choice was significantly influenced by the company's reputation, irrespective of whether the company was public or private. There is a degree of overlap between patriarchal forces and employer selection. The government assisted the women in pursuing STEM degrees. The government provided full scholarships for education and the opportunity to consult with job counsellors.</p>
<p>Note: Howe-Walsh, et al., (2020), [37] confirmed the inclusion of their research.</p>	

Table 8. Moalusi and Jones (2019) [38].

Country	South Africa
<i>Aim</i>	The aim of this study was to investigate the career advancement opportunities available to women in key mining professions in South Africa by examining their work and organizational experiences.
<i>Study design</i>	Qualitative
<i>Method</i>	In-depth unstructured interviews.
<i>Sampling</i>	Purposive sampling of eight women engineers.
<i>Data analysis</i>	Thematic analysis. Authors provided no information on the statistical tools employed.
<i>Main findings</i>	<p>Three themes recurred. By marginalizing women and pressuring them to resemble masculinity, male dominance legitimized the existence of gender boundaries. Working long, inconvenient, and irregular hours has increased women's scheduling conflicts, as they must combine workplace responsibilities with home or family caregiving responsibilities. For women working in the mining sector, motherhood has ramifications not only for professional advancement, but also for continued employment.</p>

Table 9. Martin and Barnard (2013) [39].

Country	South Africa
<i>Aim</i>	The aim of this study was to gain an understanding of women's experiences working in male-dominated fields to better understand the barriers they face and to build coping mechanisms that enable them to continue their careers.
<i>Study design</i>	Qualitative
<i>Method</i>	In-depth unstructured interviews with five participants.
<i>Sampling</i>	Purposive sampling.
<i>Data analysis</i>	The interview data were transcribed verbatim into Microsoft Excel. During the axial coding phase, data were coded according to themes.
<i>Main findings</i>	<p>When women work in male-dominated industries, a bias theme emerges. Women are susceptible to gender stereotypes and expectations. As a result of masculine rejection and discrimination, there is a dearth of true transformation. Another theme was women's persistence in occupations dominated by males. In response to these circumstances, women developed male qualities and established mentorship relationships.</p>

Note: Martin and Barnard (2013), [39] confirmed the inclusion of their research.



**Table 10.** Mlambo and Mabokela (2017) [40].

<b>Country</b>	<b>South Africa</b>
<i>Aim</i>	The aim of this study was to ascertain why women engineers in academia continue to work in a field that is widely perceived as hostile to women.
<i>Study design</i>	Qualitative
<i>Method</i>	In-depth semi-structured interviews.
<i>Sampling</i>	Purposive sampling. Nine participants. Between the ages of 20 and 45 years.
<i>Data analysis</i>	Thematic analysis. Authors provided no information on the statistical tools employed.
<i>Main findings</i>	The first theme was workplace challenges. One of the reasons cited for leaving engineering jobs was due to the profession's antagonism toward mothers. Men in the sector have preconceived notions about the conventional duties of women and are fearful of working alongside them. Another theme was the belief that being a woman makes admission into the field difficult. However, study participants did say that their superiors were supportive role models who encouraged them to stay in this field.

**Table 11.** Maji and Dixit (2020) [41].

<b>Country</b>	<b>India</b>
<i>Aim</i>	The aim of this study was to examine the effect of gender on female software engineers' job experience and career advancement in the Indian information and technology sector.
<i>Study design</i>	Qualitative
<i>Method</i>	In-depth semi-structured interviews with 21 female software engineers.
<i>Sampling</i>	Purposive sampling.
<i>Data analysis</i>	Thematic analysis. Maji and Dixit provided no information on the statistical tools they employed.
<i>Main findings</i>	The first theme of the study was workplace gender inequalities. Women are relegated to the lowest rungs of the career ladder. In many companies, women are sidelined or excluded from senior positions and assigned communications and relations jobs that are deemed gender appropriate. The second theme was stereotyping, such as making offensive jokes at work. Spatial bias manifested itself when women were not assigned to positions that require significant travelling. The third theme related to interactions between genders. When women spoke with a male coworker, they dreaded being criticized. Finally, the fourth theme was gender identity: female participants in the study said they began dressing more masculinely to fit in.

**Table 12.** Regis et al. (2018) [42].

<b>Country</b>	<b>Brazil</b>
<i>Aim</i>	The aim of this study was to identify the primary concerns and existing difficulties faced by female construction employees, as well as the best practices that could produce a more favorable work environment.
<i>Study design</i>	Qualitative
<i>Method</i>	Interviews with 17 participants
<i>Sampling</i>	Purposive sampling
<i>Data analysis</i>	Thematic analysis

Table 12. Cont.

Country	Brazil
Main findings	The first theme was acceptance. Respondents found that managers are averse to hiring women and frequently feel anxious when doing so, given the environment's strong sexism. According to engineer MA-M1, a few women placed within a facility with 100 men would almost certainly face harassment. Women also face discrimination when put in positions traditionally held by men or at the top of the hierarchy. Another theme was wellbeing. Women reported that they often felt uncomfortable at work and lacked respect and safety. Another recurring theme was infrastructure: women did indicate satisfaction with their workplace amenities [43]. Finally, authors reported that female study participants experienced sexual discrimination at the workplace.

Table 13. Dekelaita-Mullet et al. (2021) [43].

Country	United States
Aim	The aim of this study was to acquire a better understanding of the elements that contribute to women's success in STEM fields, where female representation has not yet reached saturation.
Study design	Qualitative
Method	In-depth semi-structured interviews; curricula vitae reviews
Sampling	Purposive sampling. Eight Female STEM faculty members holding full professorships in STEM disciplines.
Data analysis	Conversation analysis was used to analyze focus group discussions in this study.
Main findings	One theme found was that parents regularly encouraged their daughters to pursue STEM careers. Male mentors or advisors were encouraging and played a role in STEM career choices. Success in STEM careers is contingent upon family support and the willingness of partners to share parental responsibilities. Another recurring theme was infrastructure; women reported being satisfied with their workplace amenities. The third theme was the perceived gender division of tasks. All women engineers in this study wanted equal rights in the workplace.

Note: Dekelaita-Mullet et al., (2021) [43] confirmed the inclusion of their research.

### 3.2. Participant Characteristics

In the included studies, information was collected from a total of 87 female engineers. The youngest participant was 21 years old [36,38]. The oldest participant was 45 years old [41]. Ages were not specified in four of the studies [39,40,42,43].

## 4. Interpretation of Results

In the following section, we summarize the more significant findings from our systematic review and synthesize the emerging themes from the secondary data, which are: (1) patriarchy, (2) role models, (3) male STEM dominance, (4) female identity, and (5) a lack of opportunities. The themes were developed by entering the main findings (Tables 7–13) into Voyant, a free web-based reading and analysis software, and collated from the Voyant corpus [44] in the order in which they appear.

### 4.1. Patriarchy and Male Dominance

Patriarchal influences predominate in the UAE and many other Muslim countries. Although patriarchy is frequently discussed from a feminist perspective and is sometimes used interchangeably with oppression or marginalization of women [45,46], in Arab communities it refers to the household hierarchy of authority [47]. In [36], an unmarried Emirati woman living with her parents told researchers that she chose engineering so as not to disappoint her parents. Moalusi and Jones found [39] that a majority of respondents in their study felt familial influence had a significant impact on job selection, and that women

chose a career path deemed appropriate by their parents, particularly their fathers. As one participant in their study said: her “family has specific expectations and roles for the workplace with which they want her to work, as Emirati families have their own culture”.

Such findings were not unique to Arab countries. Parental support was also found to influence career choice in Dekelaita-Mullet et al. [43], which was conducted in the United States. Even though one of the study’s participants revealed that her father never finished high school, he surrounded his daughter with encyclopedias, telescopes, and chemistry sets. Many study participants reported being taught technical and mechanical skills by their fathers. Dekelaita-Mullet et al. also report that fathers often help build confidence in their daughters to succeed in a male-dominated [43]. STEM environment. We could speculate that fathers became involved in their daughters’ career choices out of an interest in ensuring financial stability for their children.

In [37], fathers in the UAE used the prospect of employment with prestigious government and private businesses to persuade their daughters that engineering or other STEM disciplines are logical career paths. Some of the Emirati participants reported that their mothers also wanted to see them become financially independent [36]. As one participant noted, her mother, a homemaker, wanted her to have a degree, as her mother called that her “weapon” [37].

#### 4.2. Role Models

In male-dominated fields, female role models or mentors are essential for closing the gender gap, and in the UAE, there is no shortage of women in STEM fields with a desire to serve as role models for other women. To nurture this instinct, Howe-Walsh et al. [37] urge governments in the Arab Middle East to promote women to leadership positions and celebrate them as role models and ambassadors to motivate future generations to pursue STEM careers. In one of the South African studies, we analyzed [39], participants expressed a need for role models but expressed some hostility about accepting advice from men, as this would reinforce the belief that men are the “gatekeepers” of science. Instead, participants indicated that they sought assistance from female family members, friends, and colleagues. Participants in another South African study [38] also emphasized the relevance of female mentors to their career success. As one participant in [37] indicated, female engineers in South Africa’s mining sector are more empathic. This participant said that her manager, who is a man, doubted her skills as a mining engineer, and in turn, led her to doubt herself. She said a female manager would have been more supportive in helping her further her career as an engineer.

Meanwhile, [42] found that the women in STEM in the US who participated in their study were not opposed to men serving as mentors. One of the study’s participants said that she had failed multiple modules and that it was only through the intervention of her male mentor that she was able to improve her academic performance. Nonetheless, the findings of several studies discussed here indicate that women working in traditionally male-dominated STEM industries are more comfortable with female role models [38,42] and benefit when “ambassadors” advise them about workplace expectations and how to deal with male animosity.

#### 4.3. Male STEM Dominance

While participants in one of the South African studies [39] viewed men in STEM professions as “gatekeepers” of science, which contributed to the gendered power dynamics at work, they dismissed the phenomenon as a cultural problem. This view was supported by the work of [43], which found that women in the United States accepted the masculine science paradigm that prevails in STEM [43]. Similarly, female software engineers in India [41] observed a vertical gender segregation, with women in technological leadership roles underrepresented. According to that study, vertical gender segregation was most prominent in the duties allotted to women.

Regis et al. found that in Brazil, male coworkers are often given more demanding responsibilities on the job [42]. For example, in construction, women were only permitted to work on projects that were nearly completed. Men would take care of the more complicated components of the project, leaving more basic duties, such as grouting, finishing, and cleaning, to women. In South Africa, Martin and Barnard [39] recorded similar observations.

What we discovered from participant feedback in the studies discussing male dominance is that women in engineering and STEM fields are obliged to accept male dominance as a common cultural phenomenon. As one participant in the Brazilian study noted [43], managers “value” male contributions to engineering projects more than female contributions. What is more, even if female engineers are assigned to a project, male coworkers, acquaintances, and family members are often unsupportive.

#### *4.4. Female Identity*

As discussed in Sections 4.2 and 4.3, the failure of male bosses to support and listen to female colleagues in male-dominated STEM professions can sour the office climate. To compensate, some women believe they must alter their identities to appear and act more like their male counterparts [42]. In Brazil, one of the participants in [42] said that to survive in a male-dominated workplace, she needed to act tougher around her male colleagues, believing that exhibiting masculine behavior earned male respect. In their study of Indian software engineers, [41] found that women attempt to blend in by dressing and acting more masculine [41].

#### *4.5. Lack of Opportunities*

Women engineers perceive the lack of opportunities as due to the gendered hierarchical structure of engineering and STEM professions. One of the technicians in the Brazilian study [41] mentioned that women are rarely promoted on construction sites and that they have limited opportunities to grow [41]. In many cases, women abandon male-dominated careers, believing that it is impossible to thrive in an environment where women are not openly welcomed. In South Africa, [39] discovered that one of the reasons why participants left the engineering profession was due to the sector’s hostility toward women with families [39]. Similarly, a participant in one of the UAE studies [36] left the engineering profession for a job in retail and management, in part due to this stigma. Several other participants in the same study changed occupations and went to work as entrepreneurs or for non-governmental organizations.

### **5. Discussion and Conclusions**

Through our qualitative desk research study, we found that although access to engineering and STEM education has improved for women in the UAE, the path to employment in a related field remains precarious for female STEM graduates. For women who do find work in STEM fields, few are made to feel welcome, as their contributions go unacknowledged. Many reported being sidelined or had trouble being promoted amid male antagonism. The situation in study countries is so bad that many women working in engineering and STEM have to accept male-dominated hostility as part of their profession or leave the profession altogether [36]. To shift the male-dominated paradigm in engineering and STEM, we conclude that the onus lies on human resource departments to do more to recruit female engineers and women in STEM for senior positions. We also recommend diversity training in the workplace. There were certain limitations to our study. For example, it omitted quantitative and mixed-methods research in favor of focusing exclusively on qualitative data.

In conclusion, despite the high proportion of female engineers and STEM graduates in the UAE, workforce inclusion is not always assured. Further research is needed to strategize how to improve STEM employment opportunities for women and repair the “leaky pipeline” from the classroom to the job site [48]. While solutions to various aspects of gender prejudice have been presented at the institutional, organizational, and individual

levels, the evidence presented in this study demonstrates the persistence of gender bias in STEM. Given the dysfunctional symptoms connected with professional development, recruitment, and daily interactions with men in the workplace, gender equality in the STEM workplace demands a comprehensive transformation.

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## References

- Li, Y.; Wang, K.; Xiao, Y.; Froyd, J.E. Research and Trends in STEM Education: A Systematic Review of Journal Publications. *Int. J. STEM Educ.* **2020**, *7*, 11. [CrossRef]
- Trading Economics. United States Youth Unemployment Rate. Available online: <https://tradingeconomics.com/united-states/youth-unemployment-rate> (accessed on 19 July 2021).
- World Bank. Overview. Available online: <https://www.worldbank.org/en/region/mena/overview> (accessed on 19 August 2021).
- Introduction; World Economic Forum. 2021. Available online: <https://www.weforum.org/> (accessed on 19 July 2021).
- John, I. Middle East Firms Expect Skills Shortages. *Khaleej Times*. 17 July 2020. Available online: <https://www.khaleejtimes.com/business/local/middle-east-firms-expect-skills-shortages-> (accessed on 19 August 2021).
- International Labor Organization. United Arab Emirates. 2015. Available online: [https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11110:0::NO::P11110\\_COUNTRY\\_ID:103495](https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11110:0::NO::P11110_COUNTRY_ID:103495) (accessed on 22 July 2021).
- UAE: Share of Unemployed Youth. 2019. Available online: <https://www.statista.com/statistics/688669/uae-share-of-unemployed-youth/> (accessed on 19 August 2021).
- International Council on Security and Development. *Unemployed Youth in the UAE: Personal Perceptions*; Diane Publishing: Upland, CA, USA, 2010.
- UAE: Female Unemployment Rate in Abu Dhabi by Age Group. 2019. Available online: <https://www.statista.com/statistics/898147/uae-female-unemployment-rate-in-abu-dhabi-by-age-group/> (accessed on 19 August 2021).
- Eltanahy, M.; Forawi, S.; Mansour, N. STEM Leaders and Teachers Views of Integrating Entrepreneurial Practices into STEM Education in High School in the United Arab Emirates. *Entrep. Educ.* **2020**, *3*, 133–149. [CrossRef]
- Emiratisation—The Official Portal of the UAE Government. Available online: <https://u.ae/en/information-and-services/jobs/vision-2021-and-emiratisation/emiratisation> (accessed on 19 August 2021).
- Geronimo, A. UAE Leadership Supports Emirati Women to Excel in STEM Fields. Available online: <https://www.tahawultech.com/region/uae/uae-leadership-support-emirati-women-to-excel-in-stem-fields/> (accessed on 19 August 2021).
- Vision 2021. About. Available online: <https://www.vision2021.ae/en> (accessed on 19 August 2021).
- Emirati Engineering Grads Are Ready to Build the Country. Available online: <https://www.ku.ac.ae/emirati-engineering-grads-are-ready-to-build-the-country> (accessed on 19 August 2021).
- Murphy, F. Engineering a Gender Bias. *Nature* **2017**, *543*, S31. [CrossRef] [PubMed]
- Ghafour, H. Emirati Women Break with Tradition to Study in Record Numbers. *Financial Times*. 10 December 2016. Available online: <https://www.ft.com/content/1f84dbf4-a5ad-11e6-8898-79a99e2a4de6> (accessed on 19 August 2021).
- Lynch, S.J.; Burton, E.P.; Behrend, T.; House, A.; Ford, M.; Spillane, N.; Matray, S.; Han, E.; Means, B. Understanding Inclusive STEM High Schools as Opportunity Structures for Underrepresented Students: Critical Components. *J. Res. Sci. Teach.* **2018**, *55*, 712–748. [CrossRef]
- World Economic Forum. *The Future of Jobs and Skills in the Middle East and North Africa: Preparing the Region for the Fourth Industrial Revolution*; Executive Briefing; World Economic Forum: Geneva, Switzerland, 2017.
- Alblooshi, H.A.; May, L. Engaging Women to Study STEM through Empowerment: A Case from the United Arab Emirates (UAE). In Proceedings of the 2018 IEEE Aerospace Conference, Big Sky, MT, USA, 3–10 March 2018; IEEE: Piscataway, NJ, USA, 2018; pp. 1–5.



20. Dubai Electricity & Water Authority (DEWA). Available online: <https://www.dewa.gov.ae/en/about-us/media-publications/latest-news/2020/08/dewa-emirati-female-engineers-raise> (accessed on 19 August 2021).
21. Almurshidi, G. STEM Education in the United Arab Emirates: Challenges and Possibilities. *Int. J. Learn. Teach. Educ. Res.* **2020**, *18*, 316–332. [CrossRef]
22. Houjeir, R.; Al-Kayyali, R.A.-A.; Alzyoud, S.; Ahmad-Derweesh, B. UAE Females in STEM Higher Education. In Proceedings of the 2019 Advances in Science and Engineering Technology International Conferences (ASET), Dubai, UAE, 26 March–10 April 2019; IEEE: Piscataway, NJ, USA, 2019; pp. 1–6.
23. Pasha-Zaidi, N.; Afari, E. Gender in STEM Education: An Exploratory Study of Student Perceptions of Math and Science Instructors in the United Arab Emirates. *Int. J. Sci. Math. Educ.* **2016**, *14*, 1215–1231. [CrossRef]
24. UAE National Youth Agenda. Available online: <https://councils.youth.gov.ae/en/download-file/183> (accessed on 19 August 2021).
25. Zaatari, S. More Women Are Taking up STEM Opportunities in UAE [Internet]. 2019. Available online: <https://gulfnnews.com/uae/education/more-women-are-taking-up-stem-opportunities-in-uae-1.60765781> (accessed on 19 August 2021).
26. About HCT: Higher Colleges of Technology. Available online: <https://hct.ac.ae/en/about-hct/> (accessed on 19 August 2021).
27. HCT Fact Book. Available online: <https://hct.ac.ae/wp-content/uploads/2020/08/HCT-FACT-BOOK-2019-20.pdf> (accessed on 19 August 2021).
28. United Arab Emirates University. Overview. Available online: <https://www.uaeu.ac.ae/en/about/aboutuaeu.shtml> (accessed on 19 August 2021).
29. Student Enrollment. Available online: <https://www.uaeu.ac.ae/en/about/ss@uaeu/student-enrollment.shtml> (accessed on 19 August 2021).
30. University of Sharjah Home. Available online: <https://www.sharjah.ac.ae/en/Pages/default.aspx> (accessed on 12 August 2021).
31. Accreditation. Available online: <https://www.sharjah.ac.ae/en/about/agc/Pages/Accreditation.aspx> (accessed on 19 August 2021).
32. PRISMA. Available online: <http://www.prisma-statement.org/> (accessed on 19 August 2021).
33. Tricco, A.C.; Lillie, E.; Zarin, W.; O'Brien, K.K.; Colquhoun, H.; Levac, D.; Moher, D.; Peters, M.D.J.; Horsley, T.; Weeks, L.; et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann. Intern. Med.* **2018**, *169*, 467–473. [CrossRef] [PubMed]
34. Ouzzani, M.; Hammady, H.; Fedorowicz, Z.; Elmagarmid, A. Rayyan—A Web and Mobile App for Systematic Reviews. *Syst. Rev.* **2016**, *5*, 210. [CrossRef] [PubMed]
35. Critical Appraisal Tools. Available online: <https://jbi.global/critical-appraisal-tools> (accessed on 19 August 2021).
36. Kemp, L.J.; Ahmad, N.; Pappalardo, L.; Williams, A. Career Calling: Women STEM Graduates in the United Arab Emirates. *Gen. Manag. Int. J.* **2021**, *36*, 169–188. [CrossRef]
37. Howe-Walsh, L.; Turnbull, S.; Khan, S.; Pereira, V. Exploring Career Choices of Emirati Women in the Technology Sector. *J. Organ. Eff. People Perform.* **2020**, *7*, 96–114. [CrossRef]
38. Moalusi, K.P.; Jones, C.M. Women's Prospects for Career Advancement: Narratives of Women in Core Mining Positions in a South African Mining Organisation. *SA J. Ind. Psychol.* **2019**, *45*, 11. [CrossRef]
39. Martin, P.; Barnard, A. The Experience of Women in Male-Dominated Occupations: A Constructivist Grounded Theory Inquiry. *SA J. Ind. Psychol.* **2013**, *39*, 12. [CrossRef]
40. Mlambo, Y.A.; Mabokela, R.O. 'It's More Flexible': Persistence of Women Engineers in the Academy. *Eur. J. Eng. Educ.* **2017**, *42*, 271–285. [CrossRef]
41. Maji, S.; Dixit, S. Gendered Processes and Women's Stunted Career Growth: An Exploratory Study of Female Software Engineers. *Qual. Rep.* **2020**, *25*, 3067–3084.
42. Regis, M.F.; Alberte, E.P.V.; dos Santos Lima, D.; Freitas, R.L.S. Women in Construction: Shortcomings, Difficulties, and Good Practices. *Eng. Constr. Archit. Manag.* **2019**, *26*, 2535–2549. [CrossRef]
43. Dekelaita-Mullet, D.R.; Rinn, A.N.; Kettler, T. Catalysts of Women's Success in Academic STEM: A Feminist Poststructural Discourse Analysis. *J. Int. Womens Stud.* **2021**, *22*, 83–103.
44. Voyant Tools Help. Available online: <https://voyant-tools.org/docs/#!/guide/about> (accessed on 19 August 2021).
45. Becker, M. Patriarchy and Inequality: Towards a Substantive Feminism. *Univ. Chic. Leg. Forum* **1999**, *1999*, 21.
46. Omvedt, G. "Patriarchy:" The Analysis of Women's Oppression. *Insurg. Sociol.* **1986**, *13*, 30–50. [CrossRef]
47. Alexander, A.C.; Welzel, C. Islam and patriarchy: How robust is Muslim support for patriarchal values? *Int. Rev. Sociol.* **2011**, *21*, 249–276. [CrossRef]
48. Alhashmi, T. Cracking the Glass Ceiling: Arab Women in Technology. Available online: <https://agsiw.org/arab-women-technology> (accessed on 19 August 2021).