DETERMINANTS OF WOMEN LABOR FORCE PARTCIPATION IN STEM OCCUPATIONS

Fatin Afiqah Zaimi[1], Norain Mod Asri[1], Azrina Abdullah Al-Hadi[2], Norshamliza Chamhuri[1], Hazrul Izuan Shahiri[1]

[1]Centre of Sustainability and Inclusive Development
Faculty of Economics and Management
Universiti Kebangsaan Malaysia, MALAYSIA

[2]Centre of Global Business and Digital Economy
Faculty of Economics and Management
Universiti Kebangsaan Malaysia, MALAYSIA

Corresponding Author's Email: norain@ukm.edu.my

Article History: Received: 6 June 2023, Revised: 16 June 2023, Accepted: 18 July 2023

ABSTRACT

While traditionally men have made up a sizable majority of individuals employed in the fields of science, technology, engineering, and mathematics (STEM), the participation percentage of women in these fields is relatively low. The objective of this study is to analyse the type of working environment desired by women in order to encourage them to enter in and survive the STEM industry. The study conducted a number of systematic literature reviews on women and the STEM work environment. This review is guided by the PRISMA Statement review method (Preferred Reporting Items for Systematic reviews and Meta-Analyzes). A systematic literature review, conducted using the Scopus and Web of Science database, identified 17 relevant past studies. Further analysis of these articles resulted in two main themes being identified; namely psychosocial working environment and physical working environment. The two themes were further analysed into a total of 11 sub-themes. Several recommendations are highlighted for future qualitative studies to be conducted on the working environment, on encouraging working women to participate in the STEM industry and on women employees sustaining themselves in the industry.

Keywords*: working environment, women, joining, sustaining, STEM*

1.0 INTRODUCTION

The Malaysian government aspires for more students to opt for STEM (Science, Technology, Engineering and Mathematics) subjects in order to produce more workers in these fields. Budget 2020 included RM11 million for programmes by the Ministry of Education and the Ministry of Environment, Science, Technology, and Climate Change (MESTECC) to entice more students to pursue careers in STEM sectors. Such programmes should stay up with worldwide trends, particularly the Fourth Industrial Revolution (IR 4.0), which calls for a technical workforce with the most modern skills, upgraded in response to technological advancements and anticipated future industry demands. Traditional conceptual works will accordingly be converted to automated systems. Thus, the ability to

master digital technology and online technology is a must for the workforce of the future compared to the traditional manual system-based management skills.

However, the high demand for STEM workers is predominantly met by the male workforce, which thus widens the gender gap for these jobs. For centuries, men traditionally dominated in STEM fields while women's social status as motherhood prevent them from being similarly engaged. The participation rate of women in the labour market in STEM fields is still low and they are consistently underrepresented. Gender equality in work involving STEM is necessary to ensure that scientific innovation will remain relevant and meet the needs of society. The underrepresentation of female engineers were reported by the Board of Engineers Malaysia (BEM). The statistics revealed that 26% engineering graduates in Malaysia are women, but only 6% of this pursue careers as professional engineers. A new study reported by Forbes 2020, suggested that coronavirus treatments would be safer with greater involvement of female workers thus implying that women can play a vital role in the STEM industry. The improvement in gender equality would generate large positive effect on GDP per capita and on female employment (Morais Maceira, 2017).

Although there are numerous studies on women's underrepresentation in STEM, researchers have different opinions on the types of working environment and to date are unable to provide the best solution on how to increase their participation rate and reduce the opt out rate of women in the STEM industry. In addition, most of the studies were concentrated in the United State and other western countries while none were conducted in Asian countries based on sources from Web of Science (WOS) and Scopus. So, the purpose of this article is to close the knowledge and understanding gap and to pinpoint the characteristics and types of working environments that encourage Asian women to enter and remain in the STEM sector.

The World Health Organization defined healthy workplace as one in which workers and managers collaborate to use a continual improvement process to protect and promote the health, safety and well-being of workers. Physical work environment, psychosocial work environment, personal health resources, and community enterprise involvement all play a role in how sustainable a company is. Good working environment leads to better job performance, work commitment and job satisfaction (Davidescu et al., 2020). The main question is what type of working environment that may influence women's decision whether or not to join and sustain the STEM industry? This study will focus on the working environment. Based on this research question, the purpose of this article is to analyse past studies which examined the conditions of working environment that may influence this decision. In addition, the article also identifies the relevant journals and methods of selection employed.

A brief explanation of the rationale behind conducting a systematic review is given in this section. The methodology used to find answers to the posed research questions is described in the section that follows. The results of the study's thematic analysis are provided and analysed in the third section within the framework of the systematic review of women's underrepresentation in the STEM sector. The final section covers the actions that can be made in response to the problems presented and finishes with suggestions for further study.

2.0 METHODOLOGY

The approaches utilised to gather data from the literature on the working environment that may have an impact on women's decisions to enter and remain in the STEM field are covered in this part. The PRISMA Statement served as the framework for this investigation, which made systematic use of Web of Science and Scopus resources to determine eligibility and exclusion criteria. Identification, screening, eligibility, data abstraction, and analysis were all steps in the review process.

2.1 *PRISMA*

The process of producing this systematic literature review was guided by the Preferred Reporting Items for Systematic reviews and Meta-Analyzes (PRISMA) which is widely used in the fields of economics and management. According to Sierra-Correa and Cantera Kintz et al (2015), it is able to define clear

research questions conducive to systematic research, and to identify criteria to be included or excluded, spanning a large database on literary science. PRISMA's statement allows for rigorous and accurate searches related to women's study and the preferred and conducive work environment in STEM. This methodology is suitable for identifying the work environment that women want to consider participating in STEM fields.

2.2 Resources

This study relies on two journal search sources which are the Web of Science (WoS) and Scopus. WoS is a sizable database of more than 33,000 publications, with a focus on the natural sciences, engineering, computer science, materials sciences, patents, and data sets. Scopus provides the largest database on journal abstracts and peer reviewed literature with over 30,000 journals from approximately 11,000 publishers worldwide. Scopus comprises a wide range of subjects including life sciences, social sciences, physical sciences and health sciences.

2.3 Systematic Review Process

2.3.1 Identification

Three primary steps make up the systematic review process used to choose and pinpoint pertinent publications for this investigation. The first stage is keyword recognition, followed by the process of finding related and similar terms with titles based on thesaurus, dictionaries, encyclopaedia, and past research. So, in January 2020 (see Table 1), a string search on the Scopus and WoS databases was created once all pertinent terms were identified. A total of 69 articles were found in both databases as a result of the investigation for this study.

In Stage 1, keyword searches on academic articles covering a wide range of databases and journals on the topics of working environment, women, and STEM industry were carried out. Table 1 displays the keyword sets and search parameters.

Table 1: The search string used for the systematic review process

Databases	Search String
Scopus	TITLE-ABS-KEY (("STEM") AND ("scienc*") AND ("technolog*") AND ("engineering") AND ("mathemati*") AND ("wom?n") AND ("working environmen*" OR "working climat*" OR "workplac*" OR "working conditio*" OR "working atmospher*" OR "ergonomi*" OR “working cultur*”))
Web of Science (WOS)	TS=(("STEM") AND ("scienc*") AND ("technolog*") AND ("engineering") AND ("mathemati*") AND ("wom?n") AND ("working environmen*" OR "working environmen* component*" OR "working climat*" OR "workplac*" OR "working conditio*" OR "working atmospher*" OR "ergonomi*" OR “working cultur*”))

2.3.2 Screening

First-level filtering is used to remove repetitive or duplicate articles. In this investigation, the first stage involved the exclusion of 16 papers in total. Based on some of the inclusion and exclusion criteria chosen by researchers at the second round, the remaining 53 publications were selected. The type of literature used is the first criterion, and only article papers and review papers were used as sources of empirical data. This study therefore excludes all publications in the form of book series, books, book

chapters, and conference proceedings. Also, only English-language articles were taken into consideration to prevent the typical translation issues. Such journal literature was sourced within the 2000 to 2020 period. In this study, practically all relevant papers published in the world were sourced since not many journals dealt with the research topic in the first place. In order to increase the possibility of finding comparable papers, almost all articles published in the fields of science, technology, engineering, mathematics, and management were viewed. In total, 26 articles were excluded out of the remaining 53 from the first stage, based on the criteria mentioned (Refer to Table 2).

Table 2: The inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Publication timeline	2000-2020	1999 and before
Document type	Article (with empirical data) and review	Conference proceeding, chapters in book, book series, books etc.
Language	English	Non-English
Nature of the study	Focus on working environment, women, STEM industry	Other than as mentioned

2.3.3 Eligibility

The remaining 27 articles from the first stage were further scrutinised for eligibility in the third step, which comprised a thorough manual examination of each article's title, abstract, and major body of text. Each article was carefully reviewed to make sure it met the requirements and was appropriate for use in this study in order to accomplish the research objectives. As a result, ten papers were eliminated because they lacked empirical support.

2.3.4 Data Analytic Strategy

It was decided to use a qualitative approach in this investigation. The emphasis was on particular studies that address the research questions. Particularly in the sections on abstracts, findings, and debates, all 17 of the chosen publications were assessed and examined. The information that was pertinent to the research questions was then extracted and assembled in a table. To find relevant themes and sub-themes about women and the work environment that may encourage them to enter and remain in the STEM areas, they were subjected to thematic analysis.

2.3.5 Theme classification

The factors previously identified as contributing to women's choice in joining STEM fields were then classified into emerging themes. Patterns were found in the abstracted data from all reviewed publications and from related data throughout the thematic analysis process, and they were aggregated into two primary groups. The groups were closely re-examined following which 11 sub-groups were identified. Lastly, the themes for the main groups and sub-groups were named.

SLR flow diagram

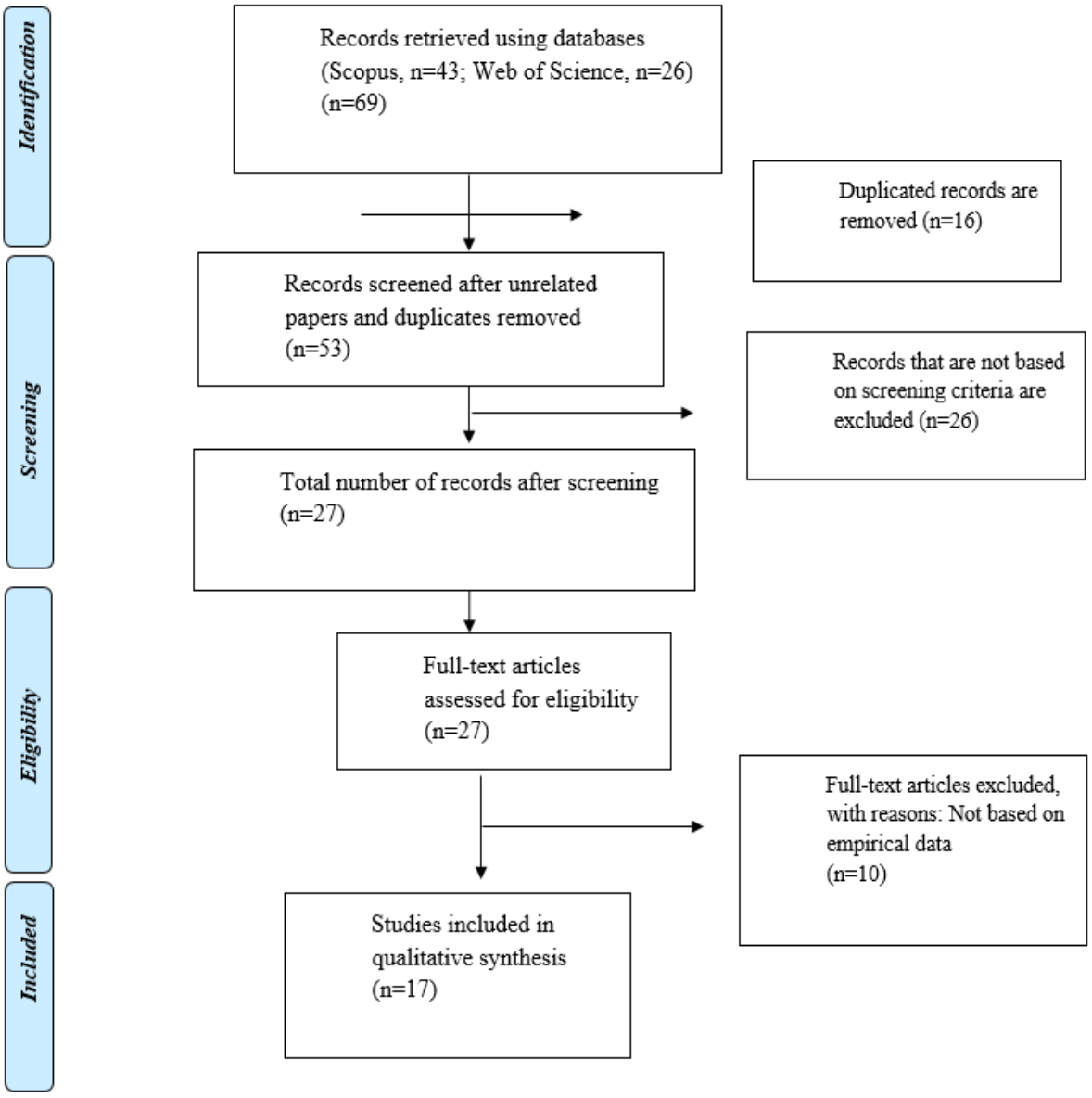

Fig 1: The flow diagram of the SLR

3.0 RESULTS AND INTERPRETATIONS

3.1 Background of Selected Articles

The analysis identified two themes and 11 sub-themes related to this study. As presented in Table 4, the two themes are "Psychosocial working environment" (with 10 sub-themes) and "Physical working environment" (1 sub-theme).

Based on the theme of Psychosocial working environment, the following past studies were recorded along their 10 sub-themes: Seven studies were focused on "Gender or race bias" (Broyles, 2009; Xu, 2015; Griffith et al., 2018; Miner et al., 2018; Aycock et al., 2019; Tran et al., 2019; Ward et al., 2019); five studies examined "Mentorship" (Paquin et al., 2011; Fuesting & Diekman, 2017; Griffith et al., 2018; Tran et al., 2019; Saffie-Robertson, 2020); four studies on "Work-life balance" (Xu, 2015; Friedmann, 2018; Minnotte et al., 2019; Ward et al., 2019); four studies on "Belonging or inclusion" (Alfred et al., 2019; Aycock et al., 2019; Ward et al., 2019; McWhirter et al., 2020); three studies on "Salary or pay gap between men and women" (Broyles, 2009; Xu, 2015; Friedmann, 2018); two studies on "Recognition" (Hart, 2016; Aycock et al., 2019); two studies on "Early interest" (Fouad et al., 2017; Alfred et al., 2019). In addition, a study each on "Sexual harassment" (Aycock et al., 2019), "Endowment" (Broyles, 2009) and "Workload" (Pedersen et al., 2018). On the theme and sub-theme of Physical working environment only one study was recorded (Hart, 2016).

Regarding publication timeline, two articles were published in early 2020 (McWhirter et al., 2020; Saffie-Robertson, 2020) and five articles in 2019. Additionally, four articles were published in 2018 (Friedmann, 2018; Griffith & Dasgupta, 2018; Miner et al., 2018; Pedersen et al., 2018) and two articles were published in 2017 (Fouad et al., 2017; Fuesting et al., 2017). Earlier studies with decreasing dates of publication are recorded as follows; Hart (2016), Xu (2015), Paquin et al. (2011) and Broyles (2009). Out of the 17 selected articles, 15 were related to studies conducted in the United States of America.

All the two themes and eleven sub-themes will be explored and recommendations suggested that may influence women to join and sustain STEM careers.

Table 3: Summary of study

No.	Author	Location	WOS/Scopus	Objectives	Research approach	STEM discipline	Respondent
1	Alfred, Ray & Johnson (2019)	United States	Scopus	Aim of the study is to explore the crisis of representation in STEM careers among Black and Hispanic women.	Review literature	STEM	No respondent
2	Aycock et al (2019)	United States	WOS Q2	The purpose of this study is to examine the occurrence and impact of sexual harassment on women in physics.	Survey	Science (physics)	Undergraduate women in physics. (N=455)
3	Broyles (2009)	United States	Scopus	The primary purpose of this research is to determine the relative effects of human capital, labour market structure, and employer discrimination on the gender pay gap among chemists.	-Collect secondary data -Modelling regression	Science (chemistry)	78% male and 22% female chemists working full time. (N=22,081)
4	Fouad & Santana (2017)	United States	WOS Q3	The study intends to look into aspects that may explain why women and racial–ethnic minorities choose to work in STEM fields and what obstacles they may face in doing so.	-Review literature -Social Cognitive Career Theory	STEM	No respondent
5	Friedmann (2018)	Israel	WOS Q3	The goal of this study is to determine how men and women view specific work qualities differently.	Online questionnaire	STEM	Sample 1: (N=248) Sample 2: (N=258) Respondents from United Kingdom, United States, Canada, Ireland and Australia.
6	Fuesting, & Diekman (2017)	United States	WOS Q2	The current research investigated relationships with actual or hypothetical STEM role models or advisors as a pathway to navigating communal goal processes in STEM.	Survey	STEM	Men and women college students from STEM and Non-STEM fields. Sample 1: (N = 149) Sample 2: (N = 194) Sample 3: (N = 415) Sample 4: (N = 291)
7	Griffith & Dasgupta (2018)	United States	Scopus	Aims to study on how local variations in gender composition within academic units impact workplace climate, and whether this climate subsequently predicts faculty satisfaction and turnover intentions.	Survey	STEM	Faculty in academic science and engineering departments at a large research university in North-eastern United States (N = 383)
8	Hart (2016)	United States	WOS Q1	This study explores the gendered organisational culture and how it might affect the career choices made by mid-career women STEM academics at one research university.	Interview	STEM	25 women at the associate and full professor ranks in STEM fields.
9	McWhirter & Cinamon (2020)	United States	WOS Q3	This article's goal is to suggest how Gloria Anzaldua's theory of nepalanta and nepalanteras/os might be utilised to broaden perspectives on the underrepresentation of people who are learning, working, and pursuing STEM careers.	Case Examples of Nepantlerx	STEM	No respondent
10	Miner et al (2018)	United States	WOS Q1	The purpose of this study is to investigate the many justifications for gender inequality in STEM areas that are generated by the individual lens and the societal structural lens.	Review literature	STEM	No respondent
11	Minnotte & Pedersen (2019)	United States	WOS Q2	This study investigates the relationship between psychological safety and perceived injustice as well as positive and negative aspects of the departmental environment in predicting work-life conflict among STEM faculty.	Climate survey	STEM	Respondents from STEM faculty at a midsized university located in the Upper Midwest. (N = 114)

12	Pedersen & Minnotte (2018)	United States	Scopus	Aim of the study is to explore the gendered nature of university service work among STEM faculty.	-Interview -Climate survey	STEM	Respondents from a midsized university in the Midwest. (N = 114)
13	Paquin, J. D., & Fassinger, R. E. (2011)	United States	Scopus	The experiences of nine male managers in industrial chemistry were examined in this qualitative study, along with their views on women as mentees.	Interviews	Science (chemistry)	9 white/European-American male managers in the U.S. chemical industry.
14	Saffie-Robertson (2020)	United States and Canada	WOS Q1	The purpose of this study is to acquire a deeper knowledge of women's mentoring experiences in the STEM sector.	Interview	STEM	36 women holding managerial positions in STEM organizations.
15	Tran et al (2019)	New England and United States	WOS Q1	The objective was to develop and validate the Perceived Subtle Gender Bias Index (PSGBI) for women in academia.	-Interview -Survey	STEM	Interviews with 19 women academics in STEM disciplines Survey with academic women across the U.S. (N = 882)
16	Ward, Johnson & Wilson-Wilde (2019)	Australia	WOS Q3	The study discusses barriers relevant for women in the forensic industry and offer potential solutions.	Review literature	STEM	No respondent
17	Xu (2015)	United States	WOS Q1	In terms of pay disparities, this study looks into the underrepresentation of women in STEM fields.	-Collect secondary data -Linear mixed-effects method.	STEM	College Graduates that received bachelor's degree during the 1992–1993 academic year.

Table 4: SLR Summary

No	Author	Psychosocial										Physical
		Sexual harassment	**Gender/ Race Biased**	**Salary/ Pay Gap**	**Recognition**	**Endowment**	**Work-life balance**	**Workload**	**Mentorship**	**Belonging/ Inclusion**	**Early interest**	**Institutional support**
1	Alfred et al. (2019)									/	/	
2	Aycock et al. (2019)	/	/		/					/		
3	Broyles (2009)		/	/		/						
4	Fouad et al. (2017)										/	
5	Friedmann (2018)			/			/					
6	Fuesting et al. (2017)								/			
7	Griffith et al. (2018)		/						/			
8	Hart (2016)				/							/
9	McWhirter et al. (2020)									/		
10	Miner et al. (2018)		/									
11	Minnotte et al. (2019)						/					
12	Pedersen et al. (2018)							/				
13	Paquin et al. (2011)								/			
14	Saffie-Robertson (2020)								/			
15	Tran et al. (2019)		/						/			
16	Ward et al. (2019)		/				/			/		
17	Xu (2015)		/	/			/					
Total by Sub-themes		**1**	**7**	**3**	**2**	**1**	**4**	**1**	**5**	**4**	**2**	**1**
Total by themes		**30**										**1**

3.2 The Themes and Sub-Themes

3.2.1 Gender Biased

A major sub-theme contributing to the women's decision relating to STEM fields is "Gender biased" which was the subject of seven studies. Gender biased refers to a person who was meted treatment based on gender identity. Griffith et al. (2018) defined gender biased as a comparison made between men and women, gender differences in professional satisfaction, gender inequities and unfairness whereas Broyles (2019) focused on gender discrimination.

Gender biased in STEM fields causes women to leave the industry in their mid-career. Factors related to such bias include a lack of flexible work practices and childcare (Xu, 2015; Ward et al., 2019), pay gaps (Xu, 2015; Broyles, 2019), lack the sense of belonging in male-dominated workplace (Ward et al., 2019; Aycock et al., 2019), discrimination, harassment and sexism (Aycock et al., 2019), conscious and unconscious bias in recruitment and promotion practices (Xu, 2015; Ward et al., 2019), and lack of mentors, sponsors and visible female role models (Griffith et al., 2018; Tran et al., 2019). These findings from the review reaffirmed that the gendered experience still exists in STEM disciplines.

In STEM fields, there are significant disparities in the human capital of men and women (Broyles, 2009). Since women are less likely than men to seek careers in STEM fields, there are fewer female graduates working full-time than male graduates (Xu, 2015). In a survey and interview, Tran et al. (2019) found that gender inequality was worse for women working in fields where men predominate. Additionally, a survey by Griffith et al. (2018) revealed that female employees are more likely to perceive their workplace climate as being less positive, feel less satisfied with their professional lives, and be more likely to consider leaving in an environment where there are fewer than 25% women. Griffith et al. (2018) also confirmed that women typically have lower levels of job satisfaction in STEM fields with significant gender imbalances. An unfavourable environment, less transparent governance, and inadequate gender equity all had a significant impact on this.

Miner et al. (2018) looked at the various causes of gender inequality in STEM areas from both an individual and a social structural perspective. The authors made the case that gender inequality in the workforce, notably among women in STEM fields, is a social-structural issue that requires attention from all members of society. To achieve gender equity, retention and promotion of women talent should be focused on at the mid-career stage since this is the crucial time for career-building (Ward et al., 2019), including gender equality, diversity and inclusion which are important for operational effectiveness.

3.2.2 Salary/Pay Gap & Endowment

The next sub-themes recognized in the literature review were "Salary gap" with three studies (Broyles, 2009; Xu, 2015; Friedmann, 2018) and "Endowment" with one study (Broyles, 2009). Using the use of an online survey, Friedmann (2018) determined that the primary factor influencing women's career decisions was pay. Further, women with STEM jobs have higher earnings than those in non-STEM jobs (Xu, 2015; Friedmann, 2018). This is an encouraging finding, since women may be more attracted to STEM fields in their choice of career given that salary is their most important consideration. Nonetheless, Xu (2015) noted that the gender pay gap in STEM had widened over time and that males often earned more than women.

In Broyles' (2009) study, variations in endowments, particularly those based on experience and education, accounted for 83 percent of the gender wage disparity, whereas potential discrimination accounted for 17 percent. Thus, pursuing graduate education after a first degree for women is more common in STEM disciplines. Also, there are more women with graduate degrees in STEM areas than in non-STEM subjects, although their numbers still represent a small portion of total male postgraduates in STEM (Xu, 2015). Graduate education in STEM can however be a disadvantage to women's career. Broyles (2009) established that time spent pursuing graduate education was negatively related to women's earning throughout their career due to the shortened job experience which consequently affected their pay level. Human capital theory also claimed that the wage gap between men and women was due to women's decreased productivity at work as a result of interruptions from childcare and other home responsibilities. This result agreed with that of Xu (2015), who found that married women in STEM occupations suffered numerous earning penalties at the same time as their

expanding family responsibilities. Women are also more likely to hold lower paying positions due to work functions and employer discrimination (Broyles, 2009).

As long as there is a substantial salary gap between men and women, efforts to influence the latter to join and sustain STEM fields will face limited success. The provision of a government financial incentive for adherence to federally enforced pay equity criteria is one strategy suggested by Broyles (2009) to achieve female pay equity in STEM occupations. Additionally, Friedmann (2018) suggested campaigns should be conducted and focused on the importance of high salary.

3.3.3 Recognition

Two studies reported on the sub-theme of "Recognition". Worker recognition reinforces particular behaviors that result in better performance. It also defines job promotion according to Hart (2016). Aycock et al (2019) proved that recognition given to women's work ability is an important attribute to their success. Conversely, the lack of recognition may lead to the imposter phenomenon which is the belief, through internal experience, that one's success is not achieved through genuine ability (Aycock et al, 2019). This phenomenon is supported by Ward (2019) who suggested that supporting talented female employees can eschew them from the feeling of being under-sponsored and the consequent loss of self-confidence. On the other hand, Hart (2016) proposed that women in STEM fields must play both the masculine and feminine roles to get ahead of their jobs and to be ideal workers. If they don't, it could impede their ability to grow in their careers by causing isolation, prejudice, and marginalisation. Most feminists would probably object to such paternalistic proposition. Most women though will probably agree that work recognition is an important key to motivation in STEM fields but this is subject to more refined observations that is deemed necessary to identify the types of recognition or rewards most impactful on female employees.

3.3.4 Work-Life Balance

There are four studies that focused on the women's "Work-life balance" in STEM fields. Conflict between work and personal obligations arises when it is challenging to take care of personal and family demands. In contrast to women, men regarded STEM fields as being more gender-compatible and as offering them more social support, according to Friedmann's (2018) research. In addition, women are more likely than men to have career disruptions and have higher levels of work-life conflict (Minnotte et al., 2019). Friedmann (2018) performed an online questionnaire study and discovered that the two most significant employment criteria as evaluated by women were compensation and the capacity to balance work and family obligations. Xu (2015) went on to point out that women in STEM occupations faced various wage penalties at the same time as their expanding family responsibilities. Hence, low level ability to combine work and family in a career would thus decrease its value and attractiveness for women employees more so than for men.

Hence, the value of STEM occupations would rise and women would be more likely to participate in the workplace with a favourable family-work balance. Ward et al (2019) came to a similar conclusion that flexible work arrangement is especially important to women's advancement at STEM careers. Also, the Minnotte et al. (2019) survey discovered that perceived injustice was linked to higher conflict while a positive departmental atmosphere characterised by psychological safety will minimise the amount of work-life conflict. Hence, Xu (2015) recommended that the company promote a family-friendly workplace that supports women managing both home and career in order to boost the participation of women in STEM disciplines.

3.3.5 Workload

There is only one study conducted on the effect of workload on women in STEM field. Pedersen et al. (2018) specified workload as the amount of service work performed. Women in STEM viewed service work or obligations as overwhelming and isolating (Pedersen et al., 2018). Service employment was considered problematic because it interferes with crucial professional obligations, such as lowering research productivity, and also lowers the quality of personal life by having an immediate negative influence on health and family.

Many people will undoubtedly concur with the statement that women in STEM see service work unfairness more often than men, and that this causes a decrease in job satisfaction, an increase in intellectual isolation, an increase in interpersonal conflict at work, and an increase in stress (Pedersen et al., 2018). Conversely, there is no report on positive feedbacks achieved by women from service work that shows improvements rather than shortcomings. Service works such as mentoring and advising students can be viewed as means of connection that encourage more women to join the STEM fields.

3.3.6 Mentorship

A total of five studies concentrated on "Mentorship" effect on women in STEM. Paquin et al (2011) emphasized the importance of mentoring, which is valuable in terms of career advancement. Women who had in-department mentors said that mentoring was helpful and were more likely to experience a collegial climate, which implied greater professional satisfaction and lower retention risk (Griffith et al, 2018). Some, however, believed that receiving mentorship meant they were less capable, and they wanted to prevent this possible view by continuing to be autonomous (Saffie-Robertson, 2020). However, having a mentor should not hurt women's career development since they are guided to unlimited access on opportunities.

The under-mentoring of women is due to the lack of support from employer organization (Saffie-Robertson, 2020) and the lack of available mentorships (Tran et al, 2019; Paquin et al., 2011). According to Griffith et al. (2018), one key tactic for a fruitful mentoring relationship is that participants benefit more from mentoring when they are given the choice of their mentor rather than having one assigned to them. According to Saffie-Robertson (2020), a protégé and mentor match, the mentor's dedication, and trust in the mentor are all prerequisites for an effective mentoring relationship. STEM majors preferred a mentor whose actions provided opportunity for the community to achieve both collective and agentic workplace goals (Fuesting et al, 2017; Saffie-Robertson, 2020). However, to find such mentors in the STEM fields was a challenging experience especially for women. Much debate on the subject was reported in the literature focused on issues such as formal and informal mentorship mentoring. An interview conducted by Paquin et al (2011) found that both formal and informal monitoring have their respective advantages and disadvantages. The former for example has the advantage of the company's support including financial backing. However, mentor and protégé generally meet far less frequently as compared to informal mentorship.

In conclusion mentorship is able to assist the protégé in gaining experience which is extremely important in career development. According to Paquin et al. (2011) and Saffie-Robertson (2020), organisations should take the initiative in establishing and fostering work environments that value mentoring across employee differences and incorporate mentoring into their organisational culture. This includes the development of networking groups.

3.3.7 Sexual Harassment

There is only one study focused on effect of "Sexual harassment" on women in STEM fields. Sexual harassment is a form of gender discrimination that encompasses three distinct, but related dimensions; namely, sexual coercion, unwanted sexual attention, and gender harassment (Aycock et al, 2019). Severe sexual harassment creates an unfavorable workplace environment or may result in an adverse employment decision. According to research by Aycock et al. (2019), in the majority male-dominated STEM sectors, about three-quarters of female employees reported experiencing physical gender harassment or unwelcome sexual attention. As a result, many women who continue in STEM areas experience a diminished sense of belonging and are more likely to experience the imposter syndrome. Sexist gender harassment such as being ignored, treated differently or being put down because of sex or gender difference will reduce their belief in ability-driven work success. Conversely, they may increasing perceive that success can be fostered through external factors such as luck and impression or expectation of others. As illustrated in this one study, sexual harassment experienced in their career discouraged women employees from improving their capability in STEM. Job advancement doesn't usually depend on luck since fostering success due to ability has its advantages. Thus, eliminating everyday sexism is important for women's advancement in a STEM career (Ward et al, 2019). In the sole example of sexual harassment (Aycock et al, 2019) in the literature no information on the perpetrators was available, either on

gender or staff status. The perpetrator should be quickly rehabilitated to avoid perpetuating the unfavorable work place environment.

3.3.8 Sense of Belonging or Inclusion

Four studies discussed women's "Sense of belonging" or "Inclusion" in STEM fields. Aycock et al (2019) defined sense of belonging as the extent to which a person believes that they are valued and accepted as legitimate members of the field. The researchers also showed that sexual harassment produced negative sense of belonging related to women's persistence in STEM fields. According to Ward et al. (2019), who concurred with their findings, one of the strategies to keep women in the STEM workforce is to create an inclusive workplace culture by doing away with everyday sexism. According to Alfred et al. (2019), women who learn their first lessons about exclusion, self-doubt, and losing interest in STEM while in college are more likely to drop out or transfer to non-STEM programmes later on.

Alfred et al (2019) recommended adopting diverse practices to foster the retention and advancement of women in STEM professions. Yet, according to McWhirter et al. (2020), such strategies might not adequately address and foster their inclusion and sense of belonging in STEM education and businesses. Therefore, it is essential that women's abilities, experiences, and ideas be utilised in order to improve inclusion within STEM (McWhirter et al, 2020). It is crucial for people in supervisory, executive, or other leadership positions to engage the experience and viewpoints of female employees to inform on practises and policies in the business in order for the measures established for this goal to be successful.

3.3.9 Early Interest

Two studies were focused on the "Early interest" sub-theme which investigated the forces that impede and support career development of women in STEM fields (Fouad et al, 2017; Alfred et al, 2019). According to Alfred et al (2019), the intersection of race, class, gender, and social class constituted the factors that nurture early interest in a STEM field and which either drive or diminish the appeal at the early stage. Additionally, he stated that career development in STEM disciplines starts in the family and community and was influenced by social messaging about women's conventional roles in the male-dominated STEM industries. In order to effectively promote diversity, equity, and inclusion, early education must be the starting point and higher education and the workplace must follow. Alfred's contention that a positive learning experience might promote the growth of self-efficacy and outcome expectations was furthered by Fouad et al. (2017). In addition, he found that self-efficacy in math and science is crucial for career development, particularly in promoting the interests, goals, and activities of one's chosen profession. He also stressed the need of ensuring maths achievement as a means of gaining entry into college and subsequently preparing for STEM employment. Further, interest is an important component of motivation, which cultivates persistence in studying science, technology, engineering, and mathematics. However, some readers may question the possibility of environmental barriers arising from the family, teachers and peer attitudes which may prevent successful experiences in women's early interest in STEM.

3.3.10 Institutional Support

There was only one study focused on the effect of "Institutional support" on women in STEM fields (Hart, 2016). The study by Tran et al (2019) found no difference in institutional support between women according their race or ethnicity, academic rank, tenure status, discipline or gender ratio. Hart (2016) however discovered that institutional support was gendered and exerted impact on women's career advancement. His interview surveys revealed that women's career paths in STEM professions were neither smooth or linear because institutional policies frequently prevented them from advancing their careers. Institutional practises that restrict access to networks, distribute unfair workloads, generate ambiguity, and foster antipathy towards female employees will impede the leadership's ability to promote them, severely hindering women's advancement in STEM professions. Hart (2016) accordingly suggested rebuilding gendered organizations that would recognize and reward achievements by their female employees and which do not marginalize and discriminate on gander basis.

4.0 DISCUSSION

In this systematic review two main themes were identified from the 17 selected journal papers examined. These were psychosocial working environment and physical working environment. Under the first main theme 10 sub-themes were further identified; namely, sexual harassment, gender or race biased, salary or pay gap, recognition, endowment, work-life balance, workload, mentorship, belonging or inclusion and early interest. Only one sub-theme, institutional support, was identified under the second main theme of physical working environment.

Based on the study, it can be summarized that the psychosocial working environment together with the physical working environment play vital roles in encouraging women to join and sustain the STEM industry in providing for a safe and healthy working condition. STEM fields have traditionally employed mostly male workforce. This long established situation may have led men to harbor the misperception that women are less suitable to occupy STEM fields by virtue that as nurturing mothers they may require extra leaves to manage their children and family. This constant need to balance their official duties with household responsibilities, would in consequence result in women being less productive employees compared to male workers.

The first step to increase women participation in the STEM industry is thus to create the conducive working condition that allows for fair opportunity to women employees the rights for career progression and advancement as enjoyed by their male counterparts, and not to be handicapped by their domestic responsibilities. This initiative should provide women with ensured and adequate opportunity and encouragement for them to venture into the STEM industry.

5.0 CONCLUSION

The main purpose of this study is to systematically review the factors that may influence the participation of women in STEM fields, as well as to propose ways of addressing the identified problems. This study offers several significant contributions to extant knowledge and practical solutions. The main contributions are the findings that provide answers to the research questions in the SLR, where factors causal to women underrepresentation in the STEM industry are identified. Accordingly, possible solutions were suggested to increase their participation thus indirectly reduce the opt out rate. The review concluded that the main constraints impeding women's decision to join and sustain STEM fields are the psychosocial working environment and physical working environment.

The study offers suggestions to assist government policy makers in developing the national employment policy that encourages women's participation in the STEM industry. In addition, the findings may serve as guidelines for employers to offer and improve the work environment so that it is in line with the needs and aspirations of women employees. This should enable them to sustain their carriers, and in the long term increase women's participation in STEM fields without adversely affecting overall productivity. Finally, the study contributes positive findings for women workers through ensuring better and conducive work environment and conditions that should motivate them to continue and expand their contribution to the national STEM industry.

ACKNOWLEDGEMENT

This work was supported by the Geran Kursi Kepimpinan Wanita, PKW-2019-002.

REFERENCES

Alfred, M. V., Ray, S. M., & Johnson, M. A. (2019). Advancing women of color in STEM: an imperative for US global competitiveness. *Advances in Developing Human Resources*, *21*(1), pp. 114-132.

Aycock, L. M., Hazari, Z., Brewe, E., Clancy, K. B., Hodapp, T., & Goertzen, R. M. (2019). Sexual harassment reported by undergraduate female physicists. *Physical Review Physics Education Research*, *15*(1), 010121.

Broyles, P. (2009). The gender pay gap of STEM professions in the United States. *International Journal of Sociology and Social Policy, 29*(5/6), pp. 214-226.

Davidescu, A. A., Apostu, S. A., Paul, A., & Casuneanu, I. (2020). Work Flexibility, Job Satisfaction, and Job Performance among Romanian Employees—Implications for Sustainable Human Resource Management. *Sustainability*, *12*(15), pp. 6086.

Fouad, N. A., & Santana, M. C. (2017). SCCT and underrepresented populations in STEM fields: Moving the needle. *Journal of Career Assessment*, *25*(1), pp. 24-39.

Friedmann, E. (2018). Increasing women's participation in the STEM industry: A first step for developing a social marketing strategy. *Journal of Social Marketing*, *8*(4), pp. 442-460.

Fuesting, M. A., & Diekman, A. B. (2017). Not by success alone: Role models provide pathways to communal opportunities in STEM. *Personality and Social Psychology Bulletin, 43*(2), pp. 163-176.

Griffith, E. E., & Dasgupta, N. (2018). How the demographic composition of academic science and engineering departments influences workplace culture, faculty experience, and retention risk. *Social Sciences, 7*(5), pp. 71.

Hart, J. (2016). Dissecting a gendered organization: Implications for career trajectories for mid-career faculty women in STEM. *The Journal of Higher Education*, *87*(5), pp. 605-634.

McWhirter, E. H., & Cinamon, R. G. (2020). Old Problem, New Perspectives: Applying Anzaldúan Concepts to Underrepresentation in STEM. *Journal of Career Development*, *48*(6), pp. 877-892.

Miner, K. N., Walker, J. M., Bergman, M. E., Jean, V. A., Carter-Sowell, A., January, S. C., & Kaunas, C. (2018). From "her" problem to "our" problem: Using an individual lens versus a social-structural lens to understand gender inequity in STEM. *Industrial and Organizational Psychology*, *11*(2), pp. 267-290.

Minnotte, K. L., & Pedersen, D. E. (2019). Department Environment and Work-to-Life Conflict Among Faculty in the STEM Fields. *Journal of Family Issues*, *40*(10), pp. 1299-1320.

Moher D., Liberati A., Tetzlaff J., Altman D.G., The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med.*, *6*(7): e1000097.

Morais Maceira, H. Economic Benefits of Gender Equality in the EU. (2017). *Intereconomics 52*, pp.178–183.

Pedersen, D. E., & Minnotte, K. L. (2018). University service work in STEM departments: Gender, perceived injustice, and consequences for faculty. *Sociological Focus*, *51*(3), pp. 217-237.

Paquin, J. D., & Fassinger, R. E. (2011). Male Managers'perceptions Of The Role Of Mentoring In Women's Career Advancement In The Chemical Industry. *Journal of Women and Minorities in Science and Engineering*, *17*(1), pp. 51-68.

Saffie-Robertson, M. C. (2020). It's Not You, It's Me: An Exploration of Mentoring Experiences for Women in STEM. *Sex Roles*, pp. 1-14.

Sierra-Correa, P. C., & Kintz, J. R. C. (2015). Ecosystem-based adaptation for improving coastal planning for sea-level rise: A systematic review for mangrove coasts. *Marine Policy*, *51*, pp. 385-393.

Tran, N., Hayes, R. B., Ho, I. K., Crawford, S. L., Chen, J., Ockene, J. K., Bond, M., Rayman, P., Dean, B., Smith, S., Thorndyke, L., Frankin, P., Plummer, D., & Pbert, L. (2019). Perceived Subtle Gender Bias Index: Development and validation for use in academia. *Psychology of Women Quarterly*, *43*(4), pp. 509–525.

Ward, J., Johnson, R. N., & Wilson-Wilde, L. (2019). Gender equity: how do the forensic sciences fare? *Australian Journal of Forensic Sciences*, *51*(sup1), pp. S263-S267.

Xu, Y. (2015). Focusing on women in STEM: A longitudinal examination of gender-based earning gap of college graduates. *The Journal of Higher Education*, *86*(4), pp. 489-523.