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Working Environment for Women Leadership in STEM

(Persekitaran Kerja bagi Kepimpinan Wanita dalam STEM)

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ABSTRACT

What are the qualities and work environment necessary for women leadership in Science, Technology, Engineering & Mathematics (STEM)? The objective of the study was to identify the type of work environment needed for women leadership in STEM industry. Using the Preferred Reporting Items for Systematic reviews and Meta-Analyses methodology, we identified 20 journal articles from the Scopus and Web of Science database and selected 12 studies. The results showed that pull factors are motivation, social and personal development. The push factors are gender stereotype, work life-balance, lack of authority, workload, discrimination, social impact and vigilance influence the women participation. However, gender stereotype, bias and discrimination, race discrimination, work-life balance and lack of authority become the barriers for women to lead the industry. Future studies should focus on qualitative approach, Asian context and the underrepresentation of women in STEM leadership.

Keywords: Women; leadership; working environment; STEM; discrimination

ABSTRAK

Apakah kualiti dan jenis persekitaran kerja yang diperlukan oleh wanita untuk memimpin dalam bidang STEM? Objektif kajian ini adalah untuk mengenal pasti jenis persekitaran kerja yang diperlukan oleh wanita untuk memimpin bidang STEM. Dengan menggunakan metodologi Preferred Reporting Items for Systematic Reviews and Meta-Analyzes, tinjauan literatur sistematik dilakukan menggunakan pangkalan data Scopus dan Web of Science yang mengenal pasti 12 kajian yang berkaitan dari 20 kajian Hasil kajian menunjukkan faktor tarikan iaitu motivasi serta pembangunan sosial dan personal dan faktor tolakan iaitu stereotaip jantina, keseimbangan hidup kerja, kekurangan autoriti, beban kerja, diskriminasi, impak sosial dan ketelitian mempengaruhi penyertaan wanita dalam STEM. Walau bagaimanapun, stereotaip jantina, bias dan diskriminasi, diskriminasi kaum, keseimbangan hidup kerja dan kekurangan autoriti menjadi halangan wanita untuk menerajui industri Justeru, adalah dicadangkan agar kajian masa hadapan tertumpu kepada kaedah kualitatif, konteks Asian dan penyertaan wanita yang rendah dalam kepimpinan STEM.

Kata kunci: Wanita; terajui; persekitaran kerja; STEM; diskriminasi
JEL: J1, Z0, J40, J20, J21, J28
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INTRODUCTION

Women underrepresentation in Science, Technology, Engineering & Mathematics (STEM) industry is a loss to the economy. Women participation in STEM-related skills are crucial in order to transform a country into becoming an inclusive and sustainably developed nation (Jones 1995; Peri et al. 2015). Gender imbalance is prominent in recent fields that drive the digital revolution such as artificial intelligence, cloud computing, engineering and data science. This report highlights the need to create an inclusive workplace as one of the initiatives to close the gender gap (Lewis et al. 2021). STEM organizations with homogeneous workforces are unlikely to function efficiently in a diverse and ever-changing environment (Varma et al. 2022). The Malaysian government has made numerous efforts to increase the participation of women. For example, it has implemented a law requiring businesses to report on the gender diversity index to track the representation of women on boards, in leadership

positions, and at other levels of employment. The government has also established a Women's Advisory and Consultative Council to monitor and advise the government on developing laws pertaining to women's issues (Ministry of Education Malaysia 2016). These initiatives from government are important since women-only leadership development programme may unlikely to close the continuing gender leadership gap (Loumpourdi 2023).

Regardless of the opportunity and improvement regarding the women's empowerment in the STEM industry, women's participation in the relevant fields, leadership role, and decision-making process remain insufficient. In the US less than 25 percent of women hold positions in the STEM professions and most preferred to work in the healthcare and education sectors (Beede et al. 2011). Despite high levels of achievement, most women who have performed in math-intensive fields, preferred to choose careers outside of STEM or have deserted these careers (Ceci et al. 2009). This pattern worsens in the workplace, especially in science and engineering, where only one out of seven engineers are females (Beede et al. 2011; Hill et al. 2010), This development is worrying since it appears that women's staying power is not strong enough to sustain them in lead positions in the STEM industry (Hill et al. 2010). They appear unable to rise further due to numerous challenges faced such as gender prejudice, social norms and expectations. This is a major problem since the STEM industry is widely recognized as the "job of the future" and that supports inclusive growth as well as sustainable development (Chavatzia 2017). Our aim is thus to analyse the characteristics of the work environment crucial for women to sustain in and hold lead positions in the STEM industry. Among contributing factors causal to the underrepresentation of women in the industry include lack of motivation, gender and race discrimination, work-life imbalance, unmanageable workload and misfit of personality to the nature of work. This is of great concern since the constraints limit women's ability to develop their careers as well as their leadership capability in these male-dominated fields (Sunaryo et al. 2021). The loss is also borne by the economy since the potential female workforce in STEM is not fully utilized and may impede the country's objective to achieve sustainable economic growth and in particular the goal of a digital economy. The government has long recognized that STEM is a catalyst to transform the country to a developed country status through adopting STEM-related human capital, vital resources and infrastructure (Jones 1995; Peri et al. 2015).

A systematic review method was used in order to further discuss this issue. Past studies have mainly focused on 'leadership' (Amon 2017; Hart 2017: Denend et al. 2020 & Dutta 2018) as well as well as the purpose of 'joining' and 'retaining' the industry (Griffith & Dasgupta 2018; McWhirter & Cinamon 2020; Minnotte & Pedersen 2019: Ward et al. 2019; Friedman 2018; Chau & Quire 2018; Myers & Major 2017; Myers et al. 2019; Ward et al. 2019)technology, engineering and mathematics (STEM. Specifically, Myers & Major (2017) explored the moderating role of gender in the relationship between work-family balance self-efficacy and STEM commitment. This provides with the foundation to expand the understanding of the issue and apply it specifically to women leaders in STEM. This study contributes to the understanding of the problem under study, which focuses on the working conditions required by women who are currently leaders in the STEM sector. In other words, we intend to identify the working environment that are conducive for women to sustain as leaders in STEM. The main focus of the study was on the problem regarding the nature or culture of the work environment that repudiates women.

The following section will discuss the methodology followed by the result of the systematic review. The last section discusses on the recommendations for future studies.

METHODOLOGY

In this section the methods used to source articles on women and the work environment where they are leaders of the STEM industry are discussed. The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) was used including resources (Scopus and Web of Science) to conduct systematic studies, identify eligibility and exclusion criteria, review process steps (identification, screening, eligibility) and data abstraction and analysis. This approach has been summarized from the five steps with inherent quality elements.

SYSTEMATIC REVIEW PROCESS FOR SELECTING ARTICLES (PRISMA) IDENTIFICATION

There are three main stages in the systematic review process involved in selecting some relevant articles for this study. The first stage is keyword recognition, followed by the process of finding related terms and titles similar to the thesaurus, dictionary, encyclopaedia, and past research. A string search on the Scopus and Web of Science databases was accordingly developed in January 2020 (Refer to Table 1) after all relevant keywords were determined. Most importantly, this research work yielded a total of 20 articles from both databases.

TABLE 1. Keywords and searching string

Databases	Keywords used
Web of Science	TS=((“STEM”) AND (“science” OR “sciences”) AND (“technology” OR “technologies”) AND (“engineering”) AND (“mathematics”) AND (“women”) AND (“working environment” OR “working climate” OR “workplace” OR “working condition” OR “working atmosphere”) AND (“leadership” OR “administration” OR “authority” OR “management” OR “power” OR ”skill” OR “directorship” OR “domination” OR “ capacity” OR “influence”))
Scopus	TITLE-ABS-KEY ((“STEM”) AND (“science” OR “sciences”) AND (“technology” OR “technologies”) AND (“engineering”) AND (“mathematics”) AND (“women”) AND (“working environment” OR “working climate” OR “workplace” OR “working condition” OR “working atmosphere”) AND (“leadership” OR “administration” OR “authority” OR “management” OR “power” OR ”skill” OR “directorship” OR “domination” OR “ capacity” OR “influence”))

SCREENING

This first stage of screening in the identification proses eliminated duplicate articles thus leaving 20 scientific papers. In the screening process a total of 7 articles were excluded during the first stage, while 13 articles were selected in the second stage based on inclusion and exclusion criteria as determined by the researchers. The first criterion constitutes the type of literature on which researchers decide to focus as sourced only from indexed journals (research articles) since they serve as key sources of empirical data most relevant to the study. Accordingly, any publication in the form of systematic reviews, reviews, meta-analyses, meta-synthesis, book series, books, book chapters, conference proceedings and non-indexed journals were excluded from the current study.

TABLE 2. The inclusion and exclusion criteria

Criterion	Eligibility	Exclusion
Type of Literature	Indexed Journal (research articles)	Non-indexed journals, Systematic literature review journals, chapter in book, conference proceeding.
Language	English and Malay	Others
Period	1970 until 2020	<1970
Countries/ territories	All countries	No
Subject areas	Science, Technologies, Engineering and Mathematics.	Others than mention
Indexes	Social Science Citation Index, Science Citation Indexed Expanded, Arts & Humanities Citation Index	Others than mention

ELIGIBILITY

The 13 articles remaining at the third stage were screened for eligibility. One article was excluded since it did not fit the study criterion being focused on pay gap rather than on women’s demands on the STEM industry. Therefore, a total of 12 articles were accepted following the eligibility screening process.

DATA ABSTRACTION AND ANALYSIS

These 12 articles were thoroughly analysed in order to identify the appropriate and related themes and sub-themes. Through the qualitative study conducted earlier, we examined the themes based on respondent’s answers and the following discussion with the author. The process of identifying the related themes was carried out by using thematic analysis which is a set of techniques used to analyse textual data and themes. The analysis comprised four stages, namely initialization, construction, rectification, and finalization (Vaismoradi et al. 2016).

The first phase is the process of analysing and extracting statements from 12 articles that responded to the research questions. In the second phase, the author converted the raw data into useable data based on his understanding. The analysis identified nine main themes. In addition, 12 subthemes were recognized from other related concepts and ideas. This approach is known as qualitative content analysis used to classify the themes/ subthemes or categories/subcategories related to women leadership in STEM (Kuckartz 2019)

In the third stage, the author compared the results in order to identify any inconsistencies that emerge in the process of theme development through discussion with three other team members. A table was constructed to summarize the themes and subthemes, as identified through majority decision and followed with the qualitative content analysis (QCA) (Kuckartz 2019). Finally, several themes and subthemes were modified and regrouped as justified to ensure consistency. To verify the themes as constructed, expert reviews were discussed by

three academics experienced in writing journals articles and including qualitative experts. The expert assisted the author to validate the clarity, accuracy, relevancy, and appropriateness of the group themes. Once the theme was established the author proceeded to formulate theme statements, link the themes into theoretical models to develop the storyline. This is known as the finalization stage (Vaismoradi et al. 2016).

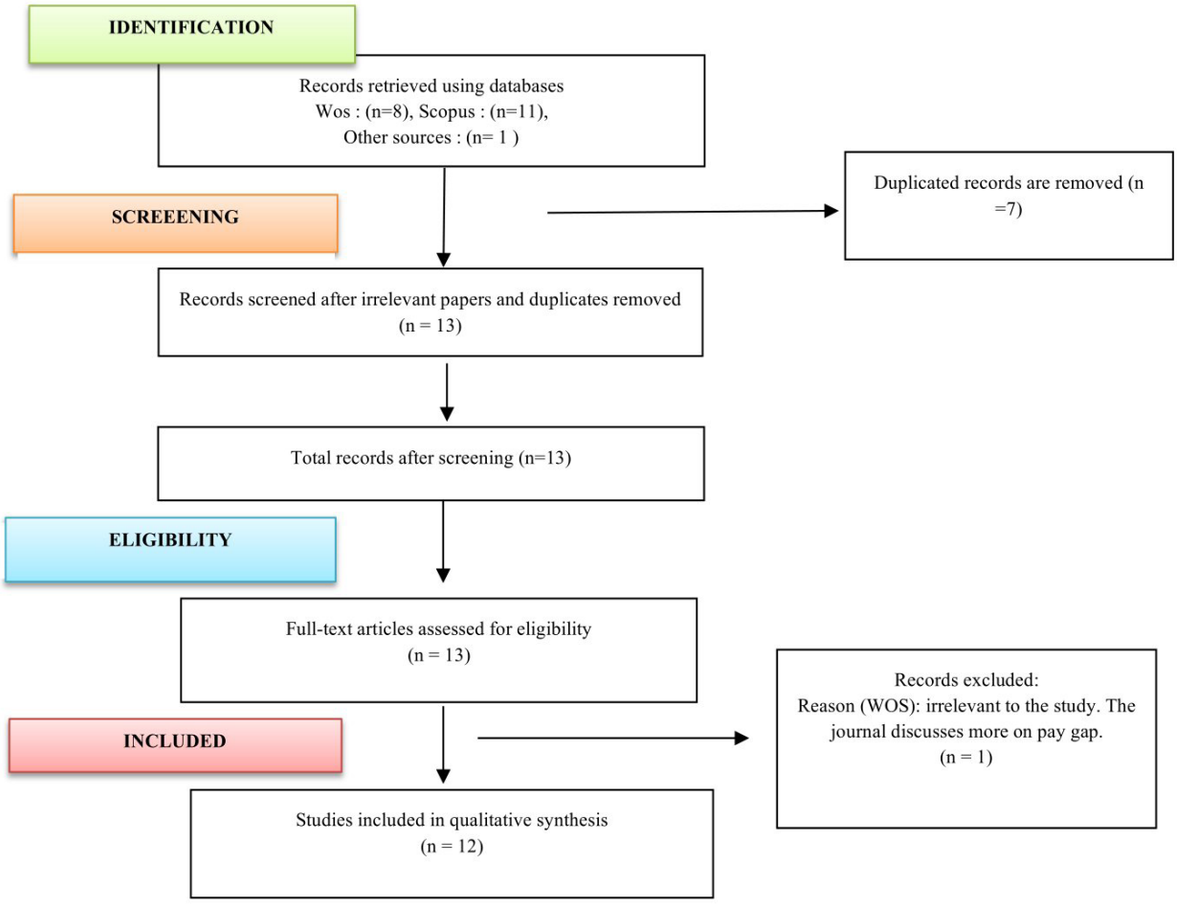

FIGURE 1. Systematic literature review flow diagram
From:" Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The Prisma Statement," Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009), PLoS Med,6(3),Copyright 2009 Moher et al.

RESULT

GENERAL FINDINGS AND BACKGROUND OF THE STUDIES INCLUDED IN THE REVIEW

A total of eight studies were related to the underrepresentation of women leaders in the STEM industry as concentrated in the United States (USA), (Denend et al. 2020; Griffith & Dasgupta 2018; Hart 2017; McWhirter & Cinamon 2020; Minnotte & Pedersen 2019; Myers & Major 2017; Myers et al. 2019). Other studies focused on women underrepresentation in STEM include single articles from Australia (Ward et al. 2019), Germany (Amon 2017), Israel and Singapore (Dutta 2018; Friedmann 2018).

Based on the year of publication, two articles were produced in 2020 (Denend et al. 2020; McWhirter & Cinamon 2020), three studies in 2019, four studies in 2018 and two published in 2017 (Amon 2017; Chau & Quire 2018; Dutta 2018; Friedmann 2018; Griffith & Dasgupta 2018; Minnotte & Pedersen 2019; Myers & Major 2017; Myers et al. 2019; Ward et al. 2019). And one study was conducted in 2016 (Hart 2017).

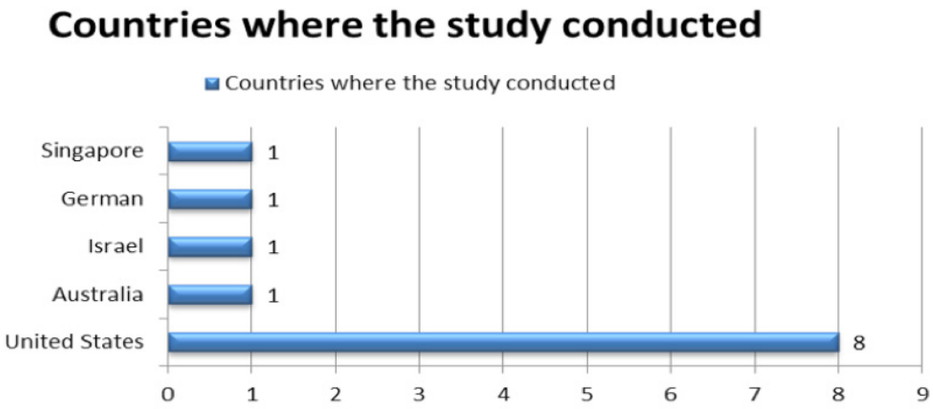

FIGURE 2. Countries study conducted

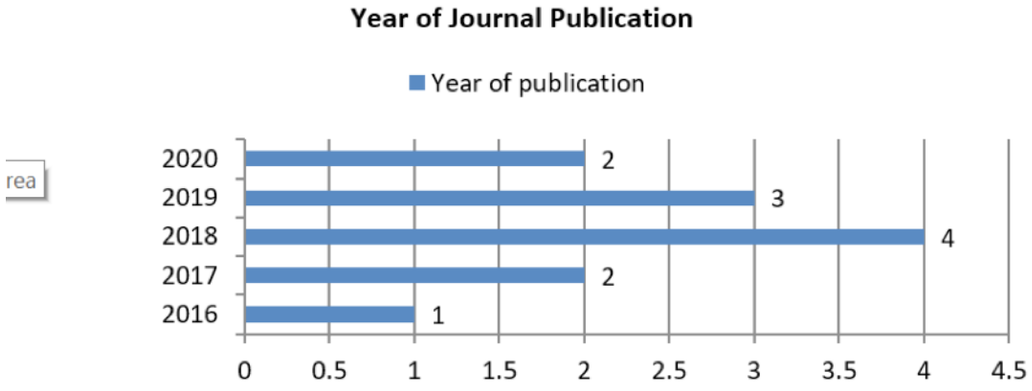

FIGURE 3. Year of journal publication

MAIN FINDINGS

This section contains discussion that focused on nine main themes sourced from 12 journal articles and analyse through thematic analysis. These themes are motivation, gender stereotype, work life-balance, social development, lack of authority, workload, perceived race equity, social impact, and vigilance

MOTIVATION

Motivation enables women to understand themselves, help them to be clear about their goals, create a positive relationship, know their ability as well as enable them to take initiatives to overcome the challenges (Van Oosten et al. 2017). Motivation can be the underlying reason that explains why people behave in a certain way or in a particular behaviour (Guay et al. 2010). It can also become the force that energize someone to do something (Scholl 2015).

Network, collaboration, inclusion, collegiality, cooperation, support, equity, fairness, role models, mentorship, accomplishment and psychological safety can be a part of motivation for women to sustain themselves in the STEM industry. Collaboration or collegiality are important as it provides women with a sense of appreciation, respect, recognition, valued, accepted, inclusion and positive social engagement. Women need to be appreciated and respected to make them feel valuable in a team. This can be achieved through collaboration by imposing a proper communication, justification of team goals and individual recognition. Women need to feel a sense of inclusion in a team to ensure they become motivated to work, such as through considering their ideas or involving them in the decision making process. (Amon 2017; Chau & Quire 2018; Griffith & Dasgupta 2018; Hart 2016; Minnotte & Pedersen 2019). Collaboration or collegiality enables women in STEM to smoothly manage multiple roles.

The encouragement and counselling from mentors will help women to cope with negative experience, provide better opportunities and motivate them in establishing their careers (Amon 2017; Chau & Quire 2018; Denend et al. 2020; Ward et al. 2019). The study shows that women face difficulties in accessing collaborators and other networks and this may limit their career advancement to become leaders in the industry (Hart 2017). Women who don't feel valued and are continuously excluded from the work team will become too unmotivated to work let alone to lead the industry (Amon 2017). On this point it is quite important to have a woman to be a mentor in order to guide another in the STEM industry. Without such guidance

women tend to face difficult times which appear inherent in their positions in the industry (Amon 2017). The lack of mentoring women scientists may restrict the women employees to attract and seek advice, to be motivated and boost their self-confidence and self-efficiency, to teach them discipline and in working smart (Mustaffa 2019). In addition, collegiality or support from members can help to create a better environment at the workplace and even reduce the problem of work-life conflicts that may occur among STEM faculty members (Minnotte & Pedersen 2019). *Mentoring* may also persuade women from leaving a university job or industry position and help improve the department work climate with their potential contributions (Griffith & Dasgupta 2018). Mentoring session can help women to motivate each other to be successful in the industry through networking with supportive colleagues where they may obtain good recommendations for better positions or improved opportunity for promotion (Chau & Quire 2018). Conversely, the lack of rewards or mentoring support may delay self-development and collaboration which will demotivate women employees to advance to leadership positions especially in a male-dominated industry (Amon 2017).

GENDER STEREOTYPE/DISCRIMINATION AND BIASNESS

Gender discrimination is one of the factors that influence women to not become a leader in the STEM industry as it raises the barrier for women not to fly high (Denend et al. 2020; Griffith & Dasgupta 2018). Women are discriminated in terms of promotion and recruitment while men receive better opportunity to be recruited and promoted to a higher level (Chau & Quire 2018; Denend et al. 2020; Griffith & Dasgupta 2018; Hart 2016; Ward et al. 2019). This is a common occurrence for women who receive little support from employers after they return to work following their confinement and face slow career advancement (Nathan Associates Inc. 2017). In addition, women employee often feel that their department decision making are less transparent to them since they are the minority in the organization (Griffith & Dasgupta 2018).

Women in the STEM industry often face issues of sexual harassment whether verbally or physically or in some other forms that may jeopardize their careers (Ward et al. 2019). One study reported that 24% of the female employees experience sexual harassment (Fathima et al. 2020). To reduce such cases tight policies, strict punishment and gender balance among staff need to be implemented (Nogrady 2019). Women who encountered gender bias often tend to spread to spread their experience in the male-dominated STEM industry and this in turn may demotivate other women from joining the industry (Stamarski & Son Hing 2015; Amon 2017). To mitigate this, women need to be more masculine in terms of action, emotion and language in the male-dominated industry because working amongst men they tend to be conditioned with some male attributes such as being hard and complex. Men in the STEM industry are basically motivated by thinking rather than feelings and they are also more comfortable with individualized leadership style (Amon 2017; Weinrech-Haste 1981). In comparison, women in other industries women are used to more communication and are more familiar with participative and democratic style of leadership (Anderson & Hansson 2011). The gender bias occurs early since high school where science, math, physics and chemistry have been "conquered" by male students who have stamped their masculine traits and attributes on STEM and this stereotype was simply extended into the later workplace (Archer et al. 2010; Cvencek et al. 2010; Hand et al. 2017; Weinreich-Haste. 1981).

However, the issue and stereotyping worsen when women are considered as less competitive and not capable of holding leadership position as was the expectation in traditional gender roles where females should be at home tending to domestic chores (Eagly & Wood 2012). This context, women often claim that their career paths journey are difficult in a male-dominated industry since they receive fewer opportunities to be promoted to a higher level due to gender discrimination (Chau & Quire 2018). In other circumstances women may act passively in male-dominated industry so as not to threaten men's job opportunities (Myers et al. 2019). Gender discrimination has become a barrier for women to pursue a lead role in the STEM industry. Several actions need to be taken to address the issue and prevent the STEM industry from male domination and to permit more women to join it and build their careers up to lead positions. At the minimum the gender gap ought to be closed.

WORK LIFE-BALANCE

The underrepresentation of women in STEM industries also appear to be related to work life balance. This balance help women to find value in their job and also to acquire a sense of meaning over their family lives (Amon 2017). Women are usually reported to experience higher levels of work-to-life conflict than men (Minnotte & Pedersen 2019; Myers & Major 2017). This may be due to a sense of motherhood responsibility and a cultural norm relegating household chores to women as mentioned in the congruity theory. According to the perspective of willingness to prioritize work over family, women are more likely to focus on their family compared to men who traditionally focus on their jobs (Hakim 2002). By offering flexible work arrangements for employees, especially women may help to make balanced arrangements between work and family (Ward et al. 2019).

Work-life balance became one of the limitations for women to be in the STEM industry. Women were perceived to face a conflict between time spent for work and time for family commitment such as preparing food, laundry, parental responsibility and managing household. Women employee also need to show commitment to their work by shouldering an extra effort and prioritizing their

work as well as spending more time on it. This should help them to be promoted to a higher level. However, the conflict innate in the work-life balance shows that leadership position for women in STEM can be quite challenging as it is very stressful, requires extra work, long hours commitment and a huge sacrifice in order to be in line with men or to better them. Women nevertheless still perceive family as one of the important social supports and they assume themselves responsible in managing it. The only consider it as work when they find a work-life balance in their job since personal and family life are closely are closely entwined in a women's feelings of life satisfaction and success (Amon 2017). As such, if women appear to be as committed as men in STEM career despite losing their work-life balance and self-efficacy they invariably won't last longer in their job or they may opt for early retirement (Hawks & Spade 1998). The separation of home from the workplace and the fixed working hours have become the disadvantageous for women to participate in the labour market (Ministry of Women and Family Development 2003). This is also closely related to the conflict for women to balance her personal life and work requirement since increasingly more time will be needed on the job.

SOCIAL AND PERSONAL DEVELOPMENT

From another perspective, women seek social development in their career as well as personal skills and potential (Denend et al. 2020). Women don't perceive leadership as a personal achievement but as a way for others to develop and to create a positive relationship with colleagues. In addition, women also seek to contribute to the society through their job (Amon 2017). In a situation where women face limited access in their career priority given to men in the department they feel shunted aside from aspiring to leadership position (Hart 2017). *Self and social development* is another factor that is necessary to retain women in the STEM industry and to ensure them a career advancement and an opportunity to develop their personnel skills. Hart (2016) stated that women's efforts in most STEM fields are rarely seen in comparison to that of men when it comes to getting promoted and given a better opportunity, despite having the same level of education and talents. This is an issue that should be addressed to prevent women from losing interest in becoming STEM leaders and quitting the industry due to perceived inability or failure to contribute to the company's social development (Amon 2017). As a result, organizations that offer a robust employee self-development programme will tempt more women to join and foster their aspiration to lead the profession.

LACK OF AUTHORITY

Women are valued less than their male colleagues due mainly to the perceived lack of credibility, self-worth and confidence, as reinforced by their lower wages, hiring decisions, lower competency evaluations, less readiness to mentor, and fewer invitations to speak at conferences (Handley et al. 2015). Similar issues occur in most of sectors but especially so in STEM. Women carry little authority in decision making, have low influence and subjected to enforced obedience. It becomes a struggle for women who aspire to be a leader in male-dominated industry since they felt less respected by their own colleagues. Women also felt that their subordinates do not take their directives or instructions seriously and that they require more legitimacy which thus make them felt less empowered as a leader (Amon 2017; Denend et al. 2020). The lack of opportunity to involve in decision led to underrepresentation of women in the STEM industry. Women were often perceived as bossy when they give ideas or involve themselves in decision making instead of being seen as a legitimate leader (Chau & Quire 2018). *Lack of authority* will demotivate women to be a leader in the STEM industry. To work in a male-dominated industry is already a tough struggle in itself but to lead the industry will present a formidable challenge for women. Some senior women in this industry often mention that they were constrained by insufficient authoritative power to make decisions, influence, or enforce obedience. Women supervisors prefer to use transformational leadership style to approach their subordinates since they feel the lack of authority as a leader. Senior women leaders realise that male subordinates will not willingly follow their directives seriously and that they need to build legitimacy to overcome this (Amon 2017). In extreme cases women are regarded as bossy when they try to legitimately lead their team members (Chau & Quire 2018). This poses a serious barrier for women to sustain themselves in the STEM industry let alone to take lead positions.

WORKLOAD OR DIVISION OF LABOUR

Workload assignments are one of the barriers that restrict the career path for women, in particular their inability to allocate their work time. Some women also claim that gendered division of labour exists in their departments (Hart 2017). The nature of work for women, as related to workload issue, seems to be more difficult since they need to overwork and overcompensate in order to be recognized (Sandberg 2015; Chau & Quire 2018). Similarly, hidden, and unmanageable ***workload*** reduce the ability for women to thrive in the STEM industry (Hart 2017). Women simply have to work harder in order to be perceived as competent as men, especially in technical skills, to ensure they sufficiently qualify for promotion to a leadership level in a skills industry (Jasko et al. 2020)

RACE DISCRIMINATION

Race discrimination has also become an issue for women especially in the STEM industry. According to Griffith and Dasgupta (2018), women felt that white faculty members received preferential treatment in their

department compared to blacks in the USA. In addition, black people were also downgraded on their ability to study in the STEM industry and this has created a barrier for them to improve their career path. Black people are also being discouraged by their own advisors and lecturers as revealed in a USA study on racism (Myers et al. 2019). Several studies found ***Race discrimination*** as an issue in the STEM industry. Race discrimination refers to selected people being given different treatments on the basis of belonging to a different group. According to the USA study the kind of discrimination encountered was related to skin colour between black and white people. Black people were often discriminated upon in their opportunity to enrol in colleges and even in work recruitment. This situation made it harder for black people, especially women, to enter the STEM industry in the USA (Griffith & Dasgupta 2018; Myers et al. 2019). This kind of discrimination should be alleviated and people should be given equal opportunity based on their ability. The perpetuation of such discrimination will only restrict the goals to involve women in the STEM industry.

SOCIAL IMPACT

Activities and goals in a company that benefit society will motivate women to boost their self-esteem and be interested in learning more about their job not just in the STEM industry. According to Amon (2017), women tend to seek out activities that can produce a broader impact on society, colleagues, or the public, such as teaching, mentorship, services, and organizational leadership. This highlights the significance of social impact in motivating, attracting, and retaining women in the industry. According to Amon (2017), women enjoy activities that allow them to contribute to society because it makes them feel more valuable and connected to the public. They are driven not only by a desire to advance their careers, but also by a desire to better the lives of others. As a result, women's participation in social activities is crucial for the experience gained in order to become a good leader.

VIGILANCE OR COMPLEXITY

Women are erroneously perceived as having complex personality and this has resulted in difficulties for them to adapt in the STEM industry which is dominated by men. Many men conversely perceived as being simple and resist being complicated and therefore do not match well with women. This apparent difference has created barriers for women and men to work together. Attribution for job success shows that women apply social and interpersonal skills more than technical skills in their leadership style (Jasko et al. 2020; Riggio 1986) in the former, numerous things are considered such as other people's thought and feeling, impression and other superfluous attributes (Amon 2017). Men however focus more on their technical skills that are goal-related (Cheryan et al. 2017). Research also reveals that STEM are more relevant with brilliance and technical skills rather that motivation and effort (Bian et al. 2018). Meta Analysis study has shown that men's success in a masculine and other task is due to their ability and skill while women's success in masculine tasks is more due to their effort in motivation, personal skill and impression which seems to be unstable attributes (Rosenthal et al. 1996; Andrews 1987; Swim & Sanna 1996)

Vigilance or complexity attributed to women's complex personality requires many factors to consider such as selfcare, organization, colleagues and their own task. People's thoughts and feelings really matter for women since it is their persona to be considerate so that everyone will be comfortable with their own decisions (Amon 2017). In addition, women are particular about other people's impression on them in term of attires. They prefer feminine attires like high heels and jewellery in contrast to the norms in the STEM industry which tend to limit such preference. The female mystic and persona contradicts the simplicity and avoidance of complication perceived in men (Amon 2017). This contradictory personalities between the two genders make it difficult for women to thrive in a male-dominated industry

DISCUSSION

In this section, the discussion will be separated into two sections; the *push and pull* elements that need to be improved in order to attract women to lead in the STEM industry, and the *barriers* that prevent women from leading in this area that need to be removed.

PUSH AND PULL FACTOR

In order to encourage women to continue their careers and in leading the STEM industry several factors need to be improved to encourage them to be a part of the industry. Several points in motivation theory, as raised by Maslow (1943), Herzberg (1966), Alderfer (1972) and McCelland (1985) dealt with what motivates people in their live and organizations. The most relevant theory related to the organization as discussed by Herzberg (1966) concerned hygiene factors where relationship should exist between peers, superiors and subordinates to ensure they are well motivated to do their job. Similar argument was touched on by other authors (McCelland 1985; Maslow's 1943; Alderfer 1972). Motivational theory thus supports the findings of this study and also in several other studies, that collaboration or collegiality is important in conferring women a sense of appreciation, respect, recognition, valued, accepted, inclusion and positive social engagement. This factor, as supported by the theory, enable us to understand the behaviour of an individual, which is useful in the managerial context. It should also be understood that women's emotion is vital in order to stay put in an organization (Minnotte & Pedersen 2019).

Women are also concerned about self and social development in the STEM industry, where they aspire to secure and guarantee career advancement and an opportunity to develop their personal skills before seeking for leadership positions (Myers & Major 2017). If their positions are constrained by discrimination that may hinder them from achieving their goals they may opt for change in their career. This possible outcome is consistent with the theory of motivation by Herzberg (1966) which states that motivating factors are necessary where advancement or promotion opportunities exist for the employee in order to enable them to lead the industry. Any bias will impose barriers preventing women from achieving higher positions (Hart 2017). In addition, women also feel the need to contribute to society to enable them to acquire a sense of worthiness in assuming their job (Amon 2017).

Based on SLR performance, women's participation is important in order to provide a role to other female employees as well as motivation through mentorship program. They need to acquire and feel a sense of being valued at their workplace which may sustain them in the industry and this can be achieved through a better collegiality, support, inclusion and respect where women may feel comfortable at work. Several recommendation on this issue including offering faculty mentorship program by employers, incentivize departmental collaboration, structured networking opportunities (Amon 2017; Hart 2016), encouraging wider inclusion (Chau & Quire 2018) and proffering sponsorship to talented female employees to represent senior levels (Ward et al. 2019). In the first place company should also recruit and retain more women in the STEM industry in order to ensure gender parity (Griffith & Dasgupta 2018). The parity should strengthen government efforts in formulating an effective policy or regulations that enable a healthy workplace environment for women. In addition, the company need to involve women in activities and enable them to interact and contribute to the society at large such as in Corporate Social Responsibility (CSR). This should motive female workers and provide them relief outlets from workplace stress. In summary, the pull factors are motivation, social and personal development efforts. On the other hand, the push factors are gender stereotyping, work life-balance, lack of authority, workload, discrimination, social impact and vigilance.

BARRIERS

Barriers refer to the factors that become obstacle that demotivate women from seeking leadership in the industry (Michopoulou & Hilton 2021). These include *Gender stereotyping, gender bias and discrimination* which may hinder women from joining the STEM industry. This is in line with Herzberg's (1966) motivation theory under hygiene factors where company policies and supervision must be fair and clear to every employee since any unfairness can demotivate women employees, especially from seeking lead positions in the industry. Women that experienced gender bias or even ***race discrimination*** will demotivate other women not to remain loyal to the industry (Amon 2017). For instance, the bias on women's ability and work commitment is attributed to their maternal profiling. As a future mother women are perceived to be potentially less capable and less committed to their work. This unconscious bias by employers may hinder women from joining the STEM industry as they feel unwelcome by the organization or industry. In consequence women prefer carriers with less power and authority in the labour market (Correl et al. 2007; Sassler et al. 2017).

Due to the issue, intervention from the Ministry of Women, Family and Community Development is needed to break this unhealthy culture through effective enforcement in order to rid bias in worker recruitment and promotion. Organizations in the STEM industry should ensure that the worker recruitment process is free from any gender bias, offer women equal pay and good work conditions and also job security. The industry should also ensure the recruitment and promotion processes are merit-based and linked to key performance indicators, implementing initiatives to support post-natal mothers returning to work strive for gender balance in public and stakeholder engagement activities and to celebrate and give credit to high achieving women employees (Ward et al. 2019). These measures should mitigate negative social norms and prejudices against the role and status of women in society and in the labour market which tends to limit their involvement in economic activities (Ministry of Women and Family Development 2003). On another note, *Work-life balance* also represent a crucial issue that should be promoted in the implementation of policies on recruiting and worker retention (Welch et al. 2011) such as advancement, retention, and securing leadership positions. Although reasons for these disparities are multifactorial, policies that do not support work-life integration contribute to the problem. The objective of this descriptive study was to compare the faculty work-life policies among medical schools in the Big Ten conference. Methods: Each institution's website was accessed in order to assess its work-life policies in the following areas: maternity leave, paternity leave, adoption leave, extension of probationary period, part-time appointments, part-time benefits (specifically health insurance. Offering flexible working arrangement for employees may assist women to balance between family and work requirement. However, workers on flexible arrangement should not be disadvantaged as long as they can complete the jobs assigned to them with the provision of sufficient resources for them to work effectively (Ministry of Women and Family Development 2003; Ward et al. 2019). Further, the *lack of authority* demotivates women employees from striving for leadership role in the STEM industry as consistent with Mc Celland's (1985) motivational theory. It is thus imperative that women employees in STEM need to be encouraged

with empowerment as legitimized by their designated position as industry leaders (Amon 2017; Denend et al. 2020). Lastly, gender differences in personality between male and female employees make it difficult for women to survive in a male-dominated industry as characterized by STEM (Amon 2017). In summary, the barriers faced by women who aspire for lead positions in the STEM industry are *gender stereotyping, gender bias and discrimination, race discrimination, work-life balance and the deprivation of legitimate authority.*

CONCLUSION

This systematic review has highlighted the underrepresentation of women in the STEM industry. It provides a clearer understanding on the reasons why women choose to leave the industry and the constraints they face in striving for lead positions. The author suggests that future studies should apply more qualitative approach since its in-depth analysis can provide detailed explanations on the issue in the STEM industry. Qualitative analysis can generate clearer and more accurate results given its improved transparency and higher capacity for rigorous review methods which employ new and diverse systematic approach to research synthesis (Berrang-Ford et al. 2015). In addition, future researchers should also undertake wider study on the underrepresentation of women in Asia given the limited information reported for the region (Hill et al. 2010). The study scope should also cover its root causes among students at the school level.

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