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Gender Inequalities in STEM Careers in Developed and Developing Countries:

A Systematic Review

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***Abstract*—Gender inequalities in careers has been an issue for a long time in many parts of the world. Even in the country with the best rates of gender equality in the world, gender inequalities persist across many professions. One of the career fields where there is a lot of gender inequality is science, technology, engineering, and mathematics (STEM), which in this field is still dominated by men. This study aims to discuss gender inequalities that occur in STEM careers in developing and developed countries. The method used is a systematic literature review using a number of relevant articles from various journals. After the screening process, a number of articles obtained were studied further. As a result, many women experience gender gaps or biases in STEM careers. These gaps occur mainly in developing countries, although the results are not very significant. The gaps are felt especially in women who already have children, because their productivity is considered to decrease when they become a mother. In addition to the difficulty of women to get promotions, inequality also occurs in the provision of wages, where women sometimes get lower wages than men.**

Keywords—gender inequality, gender bias, gender gap, career gap, career fields, STEM fields, STEM careers

I. INTRODUCTION

Gender inequality is something that has been an issue from the past until now. This happens in various fields of work. One area where there is a lot of gender inequality is the field of science, technology, engineering, and mathematics (STEM), where these fields are still dominated by men. It is well known that the fields of STEM play an important role in the formation of a country's economy [1]. However, women are under-represented in both college majors and STEM occupations, and women with STEM degrees are significantly less likely to work in STEM fields than men [2].

The existence of gender inequalities in STEM is also observed in developed countries, not only in developing countries. In developed countries such as the United States, the presence of women in STEM fields tends to be low [3], some have experienced a gender bias in the past year, where the prevalence rate varies according to education level and field of study [4]. On the other hand, in Japan the government has begun to promote women in the STEM fields to meet the workforce needs in order to support the country's economic growth [5].

However, gender inequalities in STEM may not only occur because of gender discrimination. The current literature proves that there are several psychosocial factors that might explain the occurrence of gender inequality in the STEM fields [6]. This issue needs to be analyzed further. Therefore, this study aims to find out the forms of gender inequalities in the STEM fields and their causes, which occur in developing and developed countries.

II. LITERATURE

A. STEM Majors

Science, technology, engineering, and mathematics (STEM) is one of the fields of work that is in great demand. STEM fields tend to be associated with higher job growth rates, lower unemployment rates, and higher average individual incomes, when compared to other fields [7]. What's more, excellence in STEM is closely related to a country's competitiveness and creative innovations, that's why many countries invest heavily in STEM, which has made these fields develop rapidly in recent decades [8]. However, although there is ample evidence that a STEM career can be an important pathway for increase social mobility and increase individual prestige, some youth consider STEM trajectory as an unattractive option, especially in women [7].

B. Gender in STEM

Gender inequality in the STEM fields can occur since the beginning of a person learning in school. For example, when enrolling in STEM majors, most require math results as standard for exams, ability level alone cannot explain the gender gap that arises in the "screening" [9]. Studies conducted by Jiang state that in particular, women are over-represented in STEM majors that involve less intensive mathematics, and

graduates from less math-intensive STEM majors are more likely to fit in and take up non-STEM jobs [2].

Studies have revealed differences in skill patterns between men and women, where women are perceived to have stronger verbal skills than math skills, and vice versa in men [9]. This seems to be correlated with women's preference for majors and occupations. In addition, highly masculine STEM careers such as engineering or physical science are generally associated with achieving goals related to power, success, and individualism that appeal to men [10]. Studies that apply relative measures of mathematical and verbal performance as predictors of gender inequality in STEM state:

1) The average ability of male and female students is different;
2) Female students tend to prefer non-STEM pathways even when cognitively in a STEM field [9].

While the level of women's participation in STEM work may vary by country and field, what they have in common is that women struggle more than men to build successful STEM careers [11].

Women's career experiences in STEM fields are influenced by their own personal characteristics (motivation, self-efficacy, and passion), in addition to being influenced by their parents, male colleagues, and human resource practices [11].

III. Methodology

This article was created using a systematic literature review method. The following are the stages of the study carried out:

A. Study Identification

Articles selected from various databases such as Science Direct, SpringerLink, Taylor and Francis, SAGE Journals, and Willey Online Library, with the theme of articles related to gender inequality, gender bias, career gaps, career fields, STEM fields, and STEM careers.

B. Inclusion and Exclusion Criteria

The selection of inclusion of articles is made according to special criteria. These criteria are only studies that focus on gender inequality in STEM careers, which are published in 2016 to 2021.

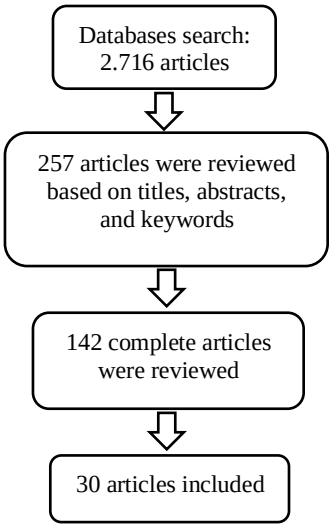

Fig. 1. Systematic literature review study process flowchart

C. Study Selection

In the first search, there were 2.716 articles. First of all, it is done filtering references that are not scientific articles. The titles, abstracts, and keywords of the remaining 257 articles were reviewed based on inclusion and exclusion criteria. The full article text of the 142 articles was then examined. Of these, 115 articles were excluded because they did not meet the inclusion criteria, leaving 30 articles to be reviewed.

D. Data Extraction

The remaining articles are evaluated, reviewed and analyzed. The 30 selected articles were then extracted to identify the relevant themes and sub-themes for the current studies by reading the titles, abstracts, before a thorough reading of the text content of the articles.

E. Quality Assessment

The quality of articles is determined based on their relevance to the purpose of writing, which is related to gender inequality in STEM careers.

TABLE I. Articles Used as Input for a Systematic Review

Year	Number of Articles	Scope
2016	2	Gender differences in STEM; gender bias in STEM.
2017	4	Self-efficacy and expectations of social belonging as mediators of gender differences in interest in STEM majors; successful experience of women in the STEM field; individual characteristics and social structure factors can influence college graduates to choose a job; gender gap in STEM
2018	1	The influence of gender and family on career aspirations.

Table 1 cont.

2019	4	The phenomenon of the disappearance of women in STEM; the role of gender in shaping faculty experiences in STEM academics; gender gap in STEM; STEM motivation in women.
2020	6	Gender differences in STEM; gender gap in STEM; gender-specific impact in STEM majors; women's participation in STEM-related fields.
2021	13	Factors in academia that contribute to gender inequality in STEM; status of women in the STEM field; career resilience in women's career development; gender-career relation pattern; gender gap in the STEM field; perceptions and interests of self-efficacy in STEM subjects; gender gap in STEM expectations; gender stereotypes; factors other than discrimination the workplace contributes to the gender gap in STEM; determinants of the gender gap in college major and job choice between STEM and non-STEM fields and quantifying how large the gender pay gap can be explained.
Total		30 articles

IV. Results and Discussion

Based on a review conducted on 30 articles, it was found that several things were causing gender inequality in the STEM field, including:

1) One of the main sources of gender inequality among women in STEM fields appears to be the demands of having a family (parenting and raising children);
2) The existence of gender-academic stereotypes that occur, where female talent is considered lacking in the STEM fields;
3) The lack of interest of women in the STEM fields itself;
4) Women's lack of confidence to have a career in STEM;
5) Gender preferences that occur in certain STEM areas;
6) The influences of the family in influencing women's career decisions; and
7) Sometimes there is still gender discrimination.

In general, there are no very significant differences in gender inequality between developing and developed countries. The presence of women in the STEM fields in both developing and developed countries tends to be low compared to men, which has occurred since the secondary and higher education levels [10,12-14]. On the other hand, men are particularly likely to be attracted to STEM fields, especially in technology [1,15,16]. In developed countries, the persistent tendency of male students to excel in math and science is very significant compared to female students [17]. This is what mainly causes male dominance in the STEM fields. However, with the development of the era, gender equality in education has recently increased [17].

One of the most common forms of gender inequality in STEM fields is salary issues. A study conducted by Xu in 2017 in the United States, stated that gender inequality in salary and status in STEM jobs is significant [3]. According to a report from a 2018 survey at the US census bureau, women who work in computer, engineering, and science are only paid about 80.7% of the average man's annual income [15]. Nonetheless, positive career outcomes, such as better earnings and greater job satisfaction, are associated with individuals having jobs that match their college major [3].

Gender inequalities also occurs in women who have careers in STEM academics. Research conducted by Casad et al in 2021 in the UK and US suggests that there are three factors that may contribute to gender inequalities in STEM academics: underrepresentation and negative stereotypes; lack of social network support; and bad academic climate [18].

Another issue related to gender inequalities that occur are gender discriminations. A study conducted by Tokbaeva in 2021 in Sweden, stated that in developed countries such as Sweden, gender discriminations still occur even though it does not happen overtly [19]. Even in a country as developed as France, women are more often given less valuable tasks at work and less promoted than men [20]. In a study conducted by Hägglund in 2021 in OECD member countries, gender disparities in STEM were higher in countries with greater post-industrial restructuring of the labor market, where women were directed to avoid the STEM sector [21].

In some developed countries such as the US, Japan, and Israel, factors that contribute to the gender gaps in STEM fields include women's and men's differing occupational preferences and talents; coupled with the demands of bearing and raising children is a major source of the gender gaps we find today in STEM [22], leading to a lack of female presence in STEM work. Another thing that causes gender inequalities in the STEM fields, namely the level of women's self-efficacy which tends to be lower in the STEM fields [23,24]. However, the prevalence of gender biases that occur in the STEM fields varies according to the level of education and field of study [4].

In a developing country such as Cambodia, the number of women pursuing STEM careers in urban areas appears to be higher than in suburban areas [25]. One reason is that in developing countries, gender stereotypes and the influences of families in influencing women's career decisions seem to be very strong [26]. As happened in China, where the lack of women who have a career in STEM is caused by the low achievement motivation of women compared to men in STEM majors, where this happens because of lower career expectations from parents and gender stereotypes from culture have a negative impact on women's achievement motivation [27]. Surprisingly, gender stereotypes even occur in developed countries such as Norway, England, and Italy, where male STEM majors prefer and support their fellow male students than female students [28].

In a developing country with a strong patriarchal ethos like Ghana, women lack the support to go to school and have a career, so women who eventually succeed in STEM fields experience a lot of gender bias during their careers [29]. The level of education of parents is also known to be very influential on the level of career aspirations of a child. Girls whose mothers have secondary or tertiary education tend to

show higher interest in STEM fields than girls whose mothers have less education [30].

It is undeniable that in a number of countries there are still many gender inequalities in various fields of work, especially in the STEM fields. This is more common in developing countries than in developed countries. In fact, it turns out that these inequalities occur not only because of gender discriminations, but mainly because of the lack of interest and talent of women in this field since secondary and higher education. In addition, women are sometimes limited by the demands of housework and taking care of children, making STEM fields less attractive. Whereas in certain STEM fields, sometimes there is a higher preference for women, where women are prioritized over men. Policy makers, such as governments and companies in the STEM fields, need to take actions that can close gaps in their respective countries. This can be done by addressing the potential causes of inequality, which lead to gender inequalities [17], for example encouraging gender neutrality in STEM work as a sign of professionalism [31]. Another thing that is also important to do in the world of education is to foster interest in STEM careers in students as early as possible and educate students about gender neutrality, increase awareness of discrimination, combat bias and harassment [32]. School-based interventions can also be undertaken to attract more young women into the STEM fields [33].

V. CONCLUSION

Based on the results of the study, gender inequalities in the STEM fields occur in both developing and developed countries in various forms, such as:

1) The number of women who have careers in the STEM fields are still low;
2) Gender discriminations, gender inequalities in pay, and status in STEM occupations are significant, but positive career outcomes, such as better earnings and greater job satisfaction, are associated with individuals who have jobs that match their college major;

The prevalence of gender biases occur in the STEM fields, but the incidence varies according to the level of education and field of study.

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