

The STEM Paradox in Iran: High Female Enrollment vs Low Workforce Representation

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ABSTRACT:

More women are studying STEM, there is yet to be a solution to the STEM paradox in Iran, where women are underrepresented in STEM jobs. This research paper looks at the testing of women on their educational and technical preparedness, as well as perceived obstacles to the education-employment transition. Using a quantitative, cross-sectional design, data were collected through a structured questionnaire comprising 25 Likert-scale items organized into five dimensions: education and skills, employment opportunities, workplace environment and discrimination, family and social factors, and technology and future orientation. The analysis is based on responses from 100 participants. Descriptive statistics and agreement rates were calculated, composite scores were constructed for each dimension, and one-sample t-tests were used to assess deviations from the scale midpoint. The results indicate strong perceived preparedness in education and digital skills, as well as positive intentions to pursue STEM careers. In contrast, perceptions of employment accessibility and fairness in hiring and advancement were substantially less favorable. Workplace inequality and socio-cultural pressures, particularly related to work-family balance, also emerged as salient constraints, even as reported family support remained relatively high. All composite dimensions differed significantly from neutrality. The findings highlight a clear readiness-opportunity gap, suggesting that women's limited representation in STEM employment is shaped less by individual capability or motivation and more by perceived labor market and organizational conditions. Addressing the STEM paradox, therefore, requires policy and institutional reforms that complement educational inclusion with fair recruitment practices, transparent career progression, and supportive workplace environments.

Keywords: women in STEM, STEM education, employment barriers, gender inequality, Iran.

I. INTRODUCTION

The role of women in science, technology, engineering, and mathematics (STEM) learning has grown significantly in various national settings in the last few decades. Women are making up a large proportion of tertiary-level students in science and technology-related courses in most countries, and

this is disrupting the historical belief about the gendered nature of abilities and preferences in the technical sphere [1]. Although this has improved, educational returns have not been reflected proportionately in STEM jobs, especially technical, industrial and leadership roles. This disparity between educational achievement and labor market performance has been commonly explained as the

STEM paradox, referring to the simultaneous high level of female enrollment in STEM programs and relatively low levels of workforce incorporation [2]. The case of Iran is one that can be particularly useful to analyze this phenomenon. A high accessibility of female higher education has also been noted to have risen sharply in the country since the close of the twentieth century, and women learners are often the majority in higher education institutions as well as the representatives of most of the STEM disciplines [3]. However, participation of women in the professional labor force, especially in science, engineering and technology-dominated industries, is extremely low. This constant gap raises a question about the effectiveness of the current educational-to-employment bridges and the institutional provisions that affect the workforce integration. This mismatch, it has been slightly suggested, cannot be blamed solely on the availability of education or individual credentials, but it is the interplay of institutional structures, the structure of the labor market, and social-cultural conventions that is used to create employment styles [4].

The evidence has been gathered on the discrepancy between the educational success of women and their comparative underrepresentation in professional and managerial employment, which is being accelerated. The study conducted in Iran indicates that the high numbers of women with educational attainments were not accompanied with the equal chance to occupy decision-making positions and other economically rewarding jobs, and that they are restricted by a systemic factor not restricted to the education system itself [5]. Other Middle East environments have also been cited to report these trends particularly in the technology-based industries, where training in the technical field does not ensure any of the women to secure stable or rising mobile jobs [6]. The research studies of human resources also exhibit a structural barrier that involves gendered pattern of recruitment, constrained professional networks, and organizational culture that determines labor market results in technical professions [7]. Steinberg. According to the international studies on STEM participation, gender differences in educational processes and career paths are the

result of a combination of institutional incentives and professional market conditions rather than individual choice per se [8]. Women's participation in STEM in the applied sense of development apparently is an important subject of economic efficiency, potential innovation, and sustainable development [9]. However, comparative research can establish that there are major differences in the incorporation of genders in the subfields of STEM; engineering and technology are yet to embrace women in most of these institutions as compared to the science-based sciences [10]. These findings suggest that structural factors of the labor markets and professional environments are of utmost consideration in determination of results.

Recent conceptual literature on the STEM paradox highlights that underrepresentation can hardly be solved by only one barrier. Rather, it arises out of progressive restrictions in the educational transfers, workplace culture, and social expectations [11]. The comparative study demonstrates that despite the comparatively inclusive higher education system, women still face chronic barriers to access and retention in STEM professions [12]. Other understandings warn not to use aggregate measures of gender equality only, as this can mask local institutional and labor market processes that influence the career paths of women [13]. Recent scholarship has thus tended to put the aspects of systems of scientific and technical institutions, such as the practices of evaluations, promotions, and work norms, under closer consideration [14].

In spite of this increasing body of literature, empirical studies about Iran have tended to analyze education and employment as independent entities. Little focus has been put on how women are themselves evaluate their readiness, ability to get a job, work conditions, and socio-cultural limitation and their capacity to use technology holistically. Additionally, research with a clear inclusion of technology-related elements, as well as social and institutional drivers, is scarce.

In that regard, the current research takes a multi-dimensional approach to investigate the STEM paradox in Iran. It dwells upon how women see educational and technical readiness, access to STEM jobs, workplace situations, and gender-

specific obstacles, and takes into account the impact of family and social elements and the role of technological readiness and future orientation. Combining these dimensions, the paper aims to make clearer aspects related to the identified anomaly between STEM education and workforce representation of women, which will help in a more complicated perception of education-to-employment transitions in the technical domains.

II. METHODOLOGY

A. Research Design

The study design employed in the research is a quantitative and cross-sectional research design that will be used to determine the trends in the involvement of women in STEM education and employment. The design is descriptive/exploratory, which seeks to determine systematic differences in terms of educational preparedness, access to labor markets, workplace conditions, socio-cultural factors and other factors, which are technology-based. It is an appropriate method since this paper seeks to research the paradox of STEM rather than causal processes.

B. Instrument Development

A questionnaire with a structured format in the form of 25 statements was designed and measured with a five-point Likert scale, which ranged between 1 (strongly disagree) and 5 (strongly agree). The questionnaire was guided by the existing themes in the literature on gender inequality in STEM, labor market classification, workplace discrimination and technological preparedness. The tool was structured based on five dimensions of concepts. The first scale was education and skills that measured the attitudes of respondents towards the quality of their STEM education and the degree of technical preparedness. The second dimension, employment opportunities, evaluated the perceptions regarding access to the labor market and equity of the recruitment and hiring procedures. The third dimension, workplace environment and discrimination, was based on perceived bias, recognition of promotion barriers and how well the professional competence of women is acknowledged in STEM workplaces. The fourth

dimension was that of family and social factor which looked at how family commitments and society as a whole pressure the choice of career in women. The fifth dimension was the technology and future orientation, which measured digital competence, the influence of technology on creating job opportunities, and orientation toward further viewing of STEM careers by the respondents. Everything was developed so as to have clarity and conceptual consistency across dimensions. The increase in the scores means that there is more agreement with the statements. In a dimension that represents structural barriers or constraints (e.g. employment opportunities and workplace discrimination), higher scores indicate higher perceptions of inequality or constraint.

C. Sample and Data Collection

The analysis outcomes were informed by 100 responses, and the data were gathered in a self-administered form; a respondent had to make one observation about all the items in the questionnaire. No personal identifiable information was collected, and it was a voluntary participation.

D. Data Analysis Procedure

Analysis of the data was done in a series of steps. In the first place, the individual questionnaire items and aggregate analytical dimensions were subjected to the calculation of descriptive statistics (means and standard deviations). The rates of agreement were also calculated to indicate the percentage of respondents who would say agree or strongly agree (values of 4 or 5). Second, composite scores of every analytical dimension were created as an average of respective item responses. Finally, one-sample t-tests were conducted to test whether the composite dimension scores deviated significantly from the scale midpoint ($\mu = 3$), which served as the reference value.

III. RESULTS

A. Descriptive Overview of Analytical Dimensions

Table I presents descriptive statistics of the five dimensions of the analysis. The findings show that the differences in domains are clear and significant,

which means that the evaluation of respondents does not follow the neutrality trends. The mean score of education and skills was high ($M = 3.72$, $SD = 0.47$), which means the perceived readiness to pursue a STEM career was high. The ratings of technology and future orientation were also positive ($M = 3.52$, $SD = 0.46$), as respondents were sure about being competent in digital activities and hopeful about their further involvement in the work with STEM. The family and social factors scored above the middle ($M = 3.29$, $SD = 0.55$), which underscores the persistence of the socio-cultural concerns in career choices. On the contrary, the lowest rated area was

employment opportunities ($M = 2.69$, $SD = 0.53$), which was far below the middle of the scale. The attitudes towards the work environment and the discrimination were moderately higher than the midpoint ($M = 3.20$, $SD = 0.54$), which implies that there is a perceived inequality in the work environment. Comparison of one-sample t-tests to the scale midpoint ($\mu = 3$) shows that all the means of the composite dimensions are significantly different to neutrality ($p < 0.001$). The comparison of the mean scores in terms of the dimensions is presented in Figure 1 that shows the difference between perceived human capital readiness and perceived accessibility of the labor market.

TABLE I: Descriptive statistics for analytical dimensions ($n = 100$)

Dimension	Mean	SD	t	p-value
Education and skills	3.72	0.47	15.34	<0.001
Employment opportunities	2.69	0.53	-5.80	<0.001
Workplace environment and discrimination	3.20	0.54	3.69	<0.001
Family and social factors	3.29	0.55	5.29	<0.001
Technology and future orientation	3.52	0.46	11.44	<0.001

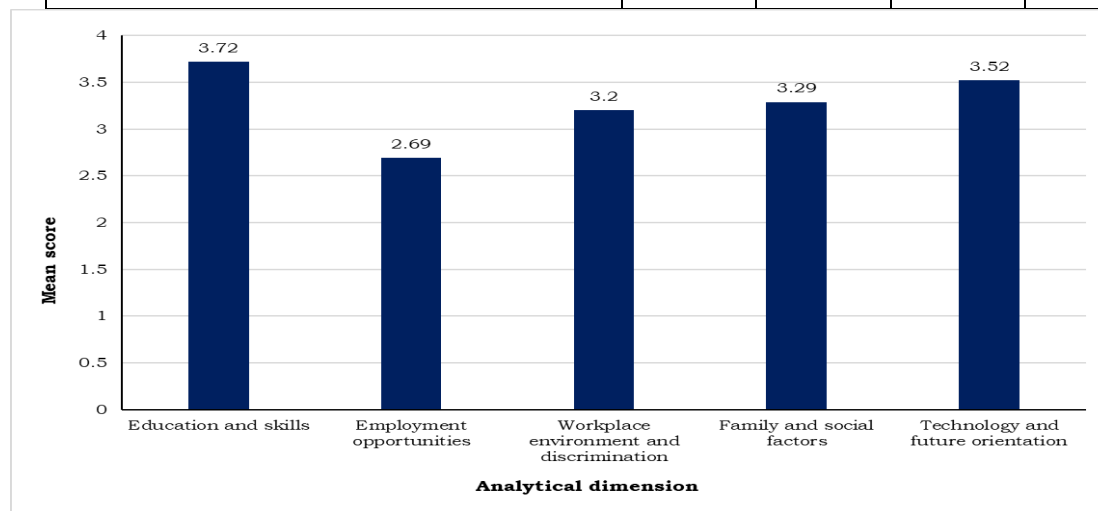


Figure 1: Mean scores across analytical dimensions

B. Education, Skills, and Technological Readiness

Item-level statistics for education and technological capacity are presented in Table II. Respondents expressed generally positive evaluations of their educational experiences. Perceived quality of STEM education achieved a mean score of 3.79 ($SD = 1.03$), with 69% of respondents reporting agreement or strong

agreement. Digital skills readiness received the highest mean score among all indicators ($M = 4.04$, $SD = 0.99$), with an agreement rate of 76%, indicating strong confidence in technological competence. Technology was also widely perceived as an employment enabler ($M = 3.98$, $SD = 0.95$). Confidence in technical skills remained above the midpoint ($M = 3.52$, $SD = 1.19$), although agreement levels were comparatively lower,

suggesting some heterogeneity in self-assessment. These results are depicted in Figure 2, where all education- and technology-related indicators exceed the midpoint of the Likert scale. The

findings suggest that deficits in education or technological readiness are unlikely to account for women's underrepresentation in STEM employment.

TABLE II: Education and technological capacity: item-level statistics (n = 100)

Indicator	Mean	SD	Agreement (%)
Perceived quality of STEM education	3.79	1.03	69.0
Confidence in technical skills	3.52	1.19	52.0
Digital skills readiness	4.04	0.99	76.0
Technology as an employment enabler	3.98	0.95	75.0

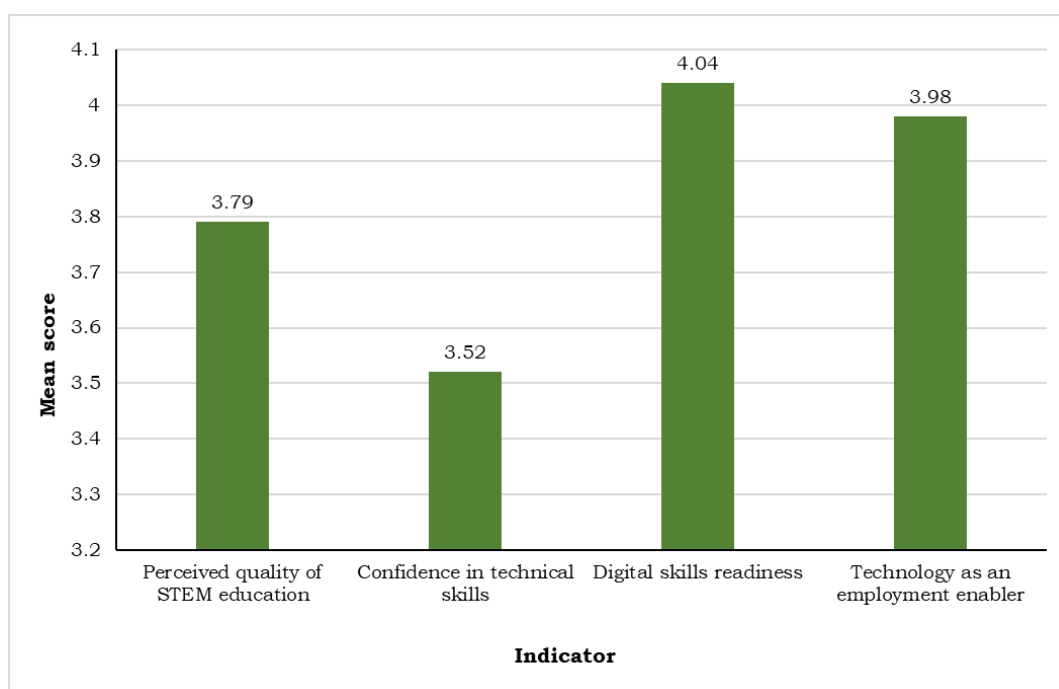


Figure 2: Mean scores for education and technology-related indicators

C. Employment Access and Workplace Inequality

Indicators related to employment access and workplace conditions reveal substantially less favorable evaluations. As shown in Table III, perceived equality in STEM hiring was rated low ($M = 2.69$, $SD = 1.19$), with only 25% of respondents indicating agreement. Similarly, the perceived ease of finding relevant STEM employment received a low mean score ($M = 2.65$, $SD = 1.10$). Perceptions of workplace inequality were more pronounced. Respondents reported

relatively high levels of perceived employer preference for men in STEM positions ($M = 3.56$, $SD = 1.25$) and limited promotion opportunities for women ($M = 3.37$, $SD = 1.19$). Awareness of the technical competence of women was medium ($M = 3.26$, $SD = 1.12$), meaning that it is partially and irregularly recognized in the workplace setting. The comparison between a high level of educational preparation and limited access to employment is also highlighted in Figure 3, which contrasts the levels of agreement of education-related and employment-related indicators.

TABLE III: Employment access and workplace inequality (n = 100)

Indicator	Mean	SD	Agreement (%)
Equality in STEM hiring	2.69	1.19	25.0
Ease of finding STEM employment	2.65	1.10	20.0
Employer gender preference	3.56	1.25	58.0
Promotion inequality	3.37	1.19	55.0
Recognition of women's skills	3.26	1.12	40.0

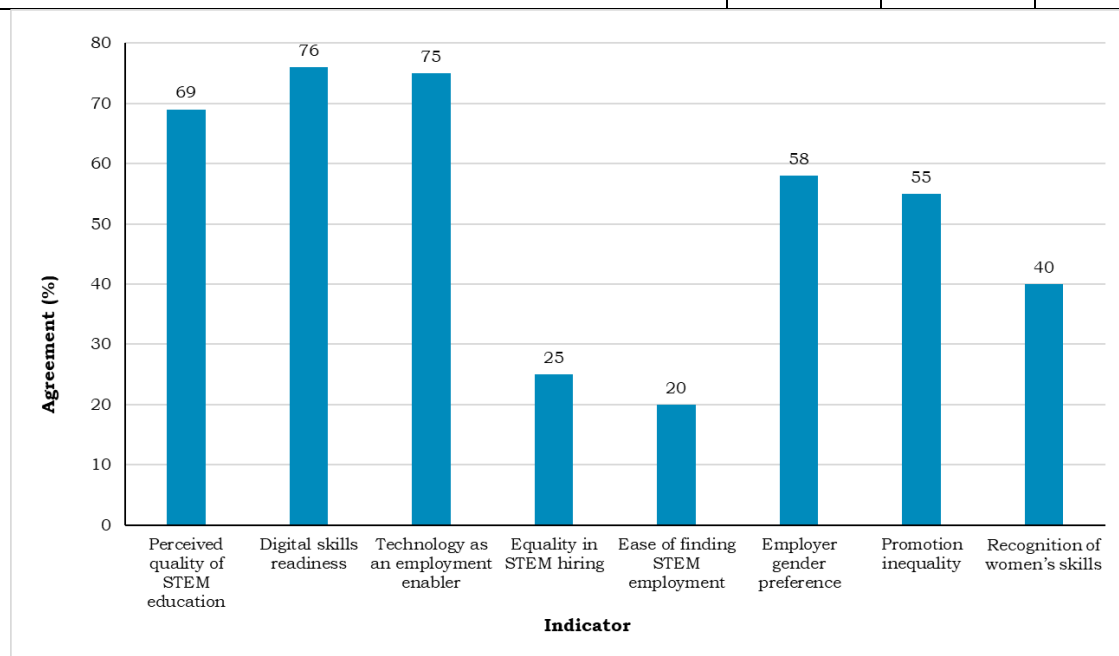


Figure 3: Agreement levels across selected education, employment, and barrier indicators

D. Family, Social Norms, and Career Orientation

Table IV provides results associated with socio-cultural influences and career orientation. According to the respondents, there was a significant pressure due to family-related needs ($M = 3.54$, $SD = 1.19$) and high expectations of society where the family needs were placed ahead of career ($M = 3.76$, $SD = 1.09$). The problem with work-family balance and STEM careers was also widely reported ($M = 3.55$, $SD = 1.24$).

Nevertheless, immediate family support of women who joined STEM professions was comparatively high ($M = 3.95$, $SD = 1.12$). Seriously, career intention in STEM was not negative ($M = 3.80$, $SD = 1.02$), which means that the decreased workforce engagement is not caused by a lack of interest or desire to pursue it. The balance of replies in the career intention is depicted in Table IV, indicating that most of the respondents are in agreement or strongly agree with intentions to be employed in a STEM-related job.

TABLE IV: Socio-cultural factors and career orientation (n = 100)

Indicator	Mean	SD	Agreement (%)
Influence of family responsibilities	3.54	1.19	56.0
Societal expectations prioritizing family	3.76	1.09	71.0
Difficulty of work-family balance	3.55	1.24	61.0

Family support for STEM careers	3.95	1.12	69.0
Career intention in STEM	3.80	1.02	68.0

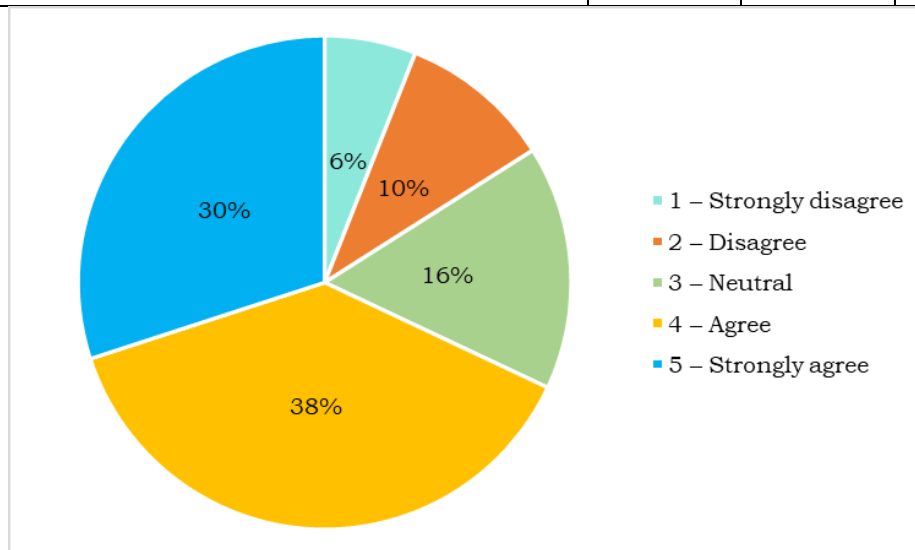


Figure 4: Distribution of responses for career intention

IV. DISCUSSION

The results of the present study indicate that there is a definite gap between perceived readiness of women in STEM careers and their judgments on access to labor markets and equity in the workplace. The respondents indicated that they had a lot of confidence in the quality of their STEM education, technical competence, and digital readiness, meaning that lack of human capital is unlikely to be the cause of the lack of women's participation in STEM employment. Conversely, the views regarding the fairness of hiring practices, the availability of job opportunities, and the hopes of career growth were of significantly low quality. This trend indicates that the constraints are considered to be most visible at the labor market entry and early career advancement points. On the one hand, women do not see themselves as unprepared to respond to technical and professional requirements, but, on the other hand, they do not assess the working opportunities as restricted and the career growth as inequitable. The fact that positive career intentions are still maintained despite these perceived barriers is also a further indication that the limited involvement in STEM employed is not mainly due to the lack of motivation or disengagement but rather it is due to the larger circumstances that influence individual career decisions. The findings

also bring out the contribution of socio-cultural and institutional aspects towards the formation of these outcomes. Respondents indicated that there was a constant strife between career goals and family or societal demands, especially in work-family balance. Meanwhile, the perceived family support levels were fairly high. Combined, these results indicate that the perceived constraints are not directly related to the immediate household but rather more directly tied to the wider social norms and institutional organization of the career opportunities. In that respect, the noted low representation of women in STEM employment can be interpreted as a perceived lack of fit between education systems that develop technical skill and labor market systems that are perceived to be less accommodating and are unable to retain this talent.

The determined discrepancy between educational preparation and employment opportunity is relatively related to the previous studies on the gender equality paradox, showing that high performance in technical subjects does not always lead to the levels of professional achievements. Research in mathematics and STEM education has also revealed gendered expectations and institutional discourses to have impacts on the post-educational career paths, despite similar levels of skill [15]. Other studies involving women in

superior training in STEM also indicate that technical competence tends to feel uncertainties when the trainees transition into professional life [16]. These results are similar to the current results, whereby faith in abilities is accompanied by low beliefs in opportunity. This interpretation is also reinforced by the sociological study of the workplace visibility, which suggests that good representation in education does not mean the same level of recognition and acknowledgement in the working environment, especially in the Middle East and North African workforces [17]. Comparative works in the Asian and Middle Eastern setting also allude to the fact that the heightened access to higher education cannot be done without an institutional transformation in the labor markets [18]. Studies of career advancement in scientific and research organizations note that the discernment of evaluation standards, promotion methods, and organizational conventions are determinants of long-term career sustainability that is frequently uninfluenced by personal qualifications [19]. Technology and ICT industries also provide evidence of the relevance of organizational and contextual variables when mediation of women's career paths takes place, beyond technical confidence [20]. Extended political and economic arguments further propose that the policies and institutional incentives of the workforce might be reinforced or alleviated through labor market policies and institutional incentives to support or inhibit gendered workforce results [21]. Research on Muslim women in STEM also indicates the significance of professional experiences in a certain situation and in social and institutional contexts [22].

The implications of the findings are a number of policy and practice implications. Programs that aim to increase the involvement of women in STEM teaching and learning will not solve the inequality in labor market unless they engage in the recruitment, assessment, and promotion policies. It is possible to improve transparency and accountability in recruitment processes to minimize the feeling of inequality at the entrance to the labor market. The continuity of positive career motivation is an indication that women can react well to the alteration in opportunity structure, and therefore institutional-level reforms can prove

very successful in enhancing workforce integration. Career progression systems and working culture can also be very critical aspects in retention, not necessarily recruitment. In a larger context, the findings highlight the significance of making investments in education consistent with the structure of labor markets so as to assure the effective exploitation of existing human capital, and have consequences on the capability to innovate and economic performance.

There are a few things that are worth noting. The cross-sectional design only captures perceptions at one point in time and fails to consider the variation between career stages. Self-reported measures can also bring about subjectivity, especially during an assessment of equity and opportunity at workplace. Moreover, the analysis does not distinguish between particular STEM subfields, which can have different working dynamics. Future studies can use longitudinal designs to investigate the relationship between educational preparation and employment, as well as career progression in the future. Qualitative methods can also help offer more insight into the experience of institutional practices in particular organizational settings. Comparative cross-sectoral or cross-national research would also contribute to better knowledge on the circumstances in which educational benefits are most successfully translated into being and working.

V. CONCLUSION

This paper explored the STEM paradox in Iran through a cross-sectional sample survey of 100 individuals and a five-dimension scale that has the following dimensions: education and skills, employment and job opportunities, workplace environment and discrimination, family and social dimension, and technology and future orientation. Results suggest that there is a steady discrepancy between perceived preparedness and perceived labour market absorption. The respondents indicated a high level of educational and technical preparedness and digital competence, as well as positive expectations of pursuing STEM careers. Compared to that, the ratings on accessibility of employment and hiring equity were significantly lower, and the sense of limited progress and gender-based work-related relationships were

noticeable. Even when reported family support of women STEM careers was quite high, family and social pressure, especially in work/family balance, was also salient. Combined, these trends indicate that the major obstacles to the integration of women in the STEM workforce are seen to exist in the education-to-employment and the organizational context of the workplace, as

opposed to individual ability and desire. Policy efforts should therefore complement educational inclusion with reforms that strengthen fair recruitment, transparent advancement, and supportive organizational cultures, enabling women's technical capital to translate more effectively into sustained STEM employment.

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