Empowering Female STEM Talent for STI: Policy Implementation and Implications

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Abstract

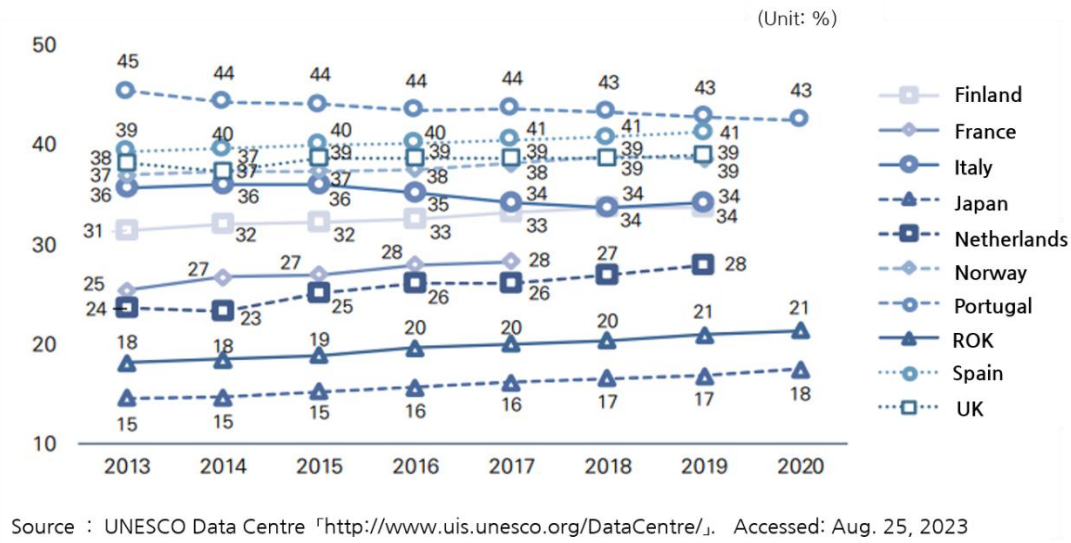
Science, technology, and innovation (STI) is a crucial means for achieving the Sustainable Development Goals (SDGs), and securing talents in Science, Technology, Engineering, and Mathematics (STEM) is the key to accelerating STI. More participation of women in STEM is the best solution to deal with the future STEM talent shortage in the face of the shrinking population trend due to the declining birth rates. Gender imbalance in STEM is prevalent around the world, and particularly, has been reported to be high in the Northeast Asian region due to traditional socio-cultural influences. The Republic of Korea (ROK) has developed government-led policies to foster women in STEM for more than two decades and has implemented 'lifecycle-based' policies and programs to provide comprehensive support to address the needs of girls and women. As a result of the Korean government's continuous efforts, there has been a quantitative increase in the number of female STEM talent, but still a significant gender gap in STEM fields. The prevalent gender imbalance in STEM fields causes wider social and economic inequality, hindering the sustainable development of our society. Gender equality has been established as a stand-alone goal of the Sustainable Development Goals (SDG 5); women's economic empowerment is an important aspect contributing to the progressive realization of SDG 5 on gender equality and is one of the top priority agenda for UNESCAP and UN Women. The empowerment of women in STEM contributes to the promotion of STI in terms of expanding the talent pool, providing diverse perspectives, handling global challenges, achieving economic growth, and improving social equity and inclusion. As such, the empowerment of women in STEM is essential for achieving sustainable development and requires both national-level efforts and cooperation between countries. Now is the time for the world to come together and take “action” to empower Women in STEM and make change happen.

Importance of Fostering Female STEM Talent to Accelerate Science, Technology and Innovation

Fostering and harnessing talents in Science, Technology, Engineering, and Mathematics (STEM) is essential for science, technology, and innovation (STI), and is critical for sustainable economic growth. As our society has faced a future talent shortage crisis due to a lower birthrate and aging population, the importance of encouraging and expanding the participation of women in the workforce and economic activities has been emphasized. Particularly, since a higher shortage of manpower in the high-tech industry is expected, it is necessary to empower female talents in the era of technological hegemony where securing talent in science and technology can become a competitive advantage. According to a report by McKinsey & Company, a global consulting group, the EU 27 member states are expected to have a supply-demand disparity of 1.4 million - 3.9 million technical professionals by 2027; if Europe can double the proportion of female technical professionals to approximately 45% (22% in 2023) or add around 3.9 million women by 2027, it can solve the talent shortage issue and gain economic benefits thanks to an increase in GDP of €260 billion - €600 billion.[i]

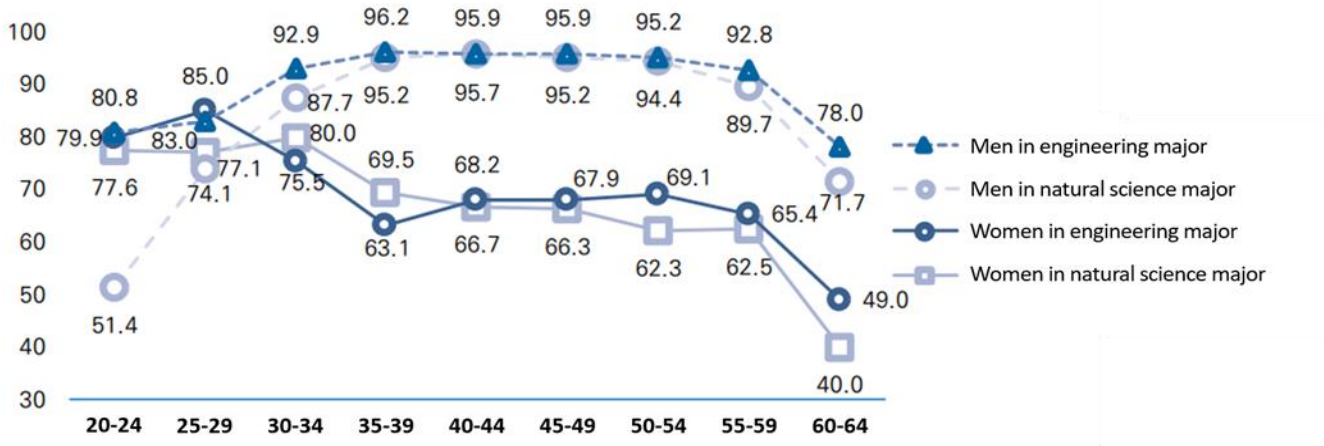
The large gender imbalance in STEM has been gradually improving around the world, but at a very slow pace. According to the World Economic Forum (WEF), the overall global gender disparity will diminish in 136 years with a significantly longer time (165 years) in East Asia and the Pacific[ii]. Approximately 30 percent of researchers in STEM are women at a global average, and the figure has remained around 30 percent for the last few years. Northeast Asia, particularly in the Republic of Korea and Japan, has seen a low proportion of female researchers, and such an imbalance is reported to partially originate from traditional sociocultural influences. As a result of comparing the proportion of female researchers in the private and public sectors, and universities in 2020 (or the latest available data), female researchers accounted for 21.4% in ROK, followed by Japan (17.5%); such status is lower than major European countries such as the UK (39.0%), Germany (28.1%), and France (28.3%).[iii] In addition to the low percentage of female researchers, the overall representation of women in STEM is low globally. The APEC Women and the Economy Dashboard 2023 indicated that women’s representation in STEM in the APEC region has remained low for the last two decades. The participation rate of women in STEM of most APEC member economies was found to be less than 35 percent[iv], as well as low proportions of female researchers and female workforce in the R&D sector.

Figure 1. Proportion of female researchers in major countries (2013-2020)



Source : UNESCO Data Centre 「http://www.uis.unesco.org/DataCentre/」. Accessed: Aug. 25, 2023

Figure 2. Labor force participation rates of natural science and engineering majors in ROK (2022)



* Data : Statistics Korea 「Local Area Labour Force Survey」.(the Second half of 2022)
Source: WISET(2022), Report on the Statistics of Women and Men in STEM in Korea

Such a slow improvement in the gender imbalance in STEM is attributable to the persistent leakage at the main stages of the female STEM talent pipeline. According to a McKinsey & Company report, the first major leakage in the female STEM talent pipeline occurs at the point of entry into higher education (university), and the second main leakage is found at the point of entry into the labor market after university. In specific, only 23% of women who majored in STEM are employed in technology fields, compared to male STEM talent (44%) (McKinsey & Company (2023). Yet, the largest leakage in the female talent pipeline can be found in the labor market dropout due to childbirth and child-rearing. In ROK, the disparity between male and female labor force participation rates after the age of 30 (for natural science and engineering majors) widens; the male participation rate remains at the 90% level, while the female participation rate drops to the 60% level for both natural science and engineering majors. Furthermore, the number of career-interrupted women due to childbirth and child-rearing is expected to be approximately 180,000 in 2022, which is considered a great economic loss for the country as a whole (WISET, 2022). The leaky pipeline not only diminishes the diversity of the scientific community but also represents a significant loss of talent and potential.

Such a gender imbalance undermines STI and sustainable growth in our society. The underrepresentation of women in STEM perpetuates gender disparities in income levels and opportunities, and further exacerbates social and economic inequalities, and the underutilization of female STEM talent can result in lower opportunities for innovation and development. In the current rapid digital revolution led by cutting-edge technology, furthermore, these imbalances and gender disparities are likely to further marginalize women. A

report by McKinsey & Company indicated that the female participation rate in fast-growing and high-demand technology fields, such as data engineers (18%), and machine learning engineers (13%), was significantly low, while expressing concerns that women cannot play an important role/show female leadership in main up-and-coming technology fields (McKinsey & Company, 2023).

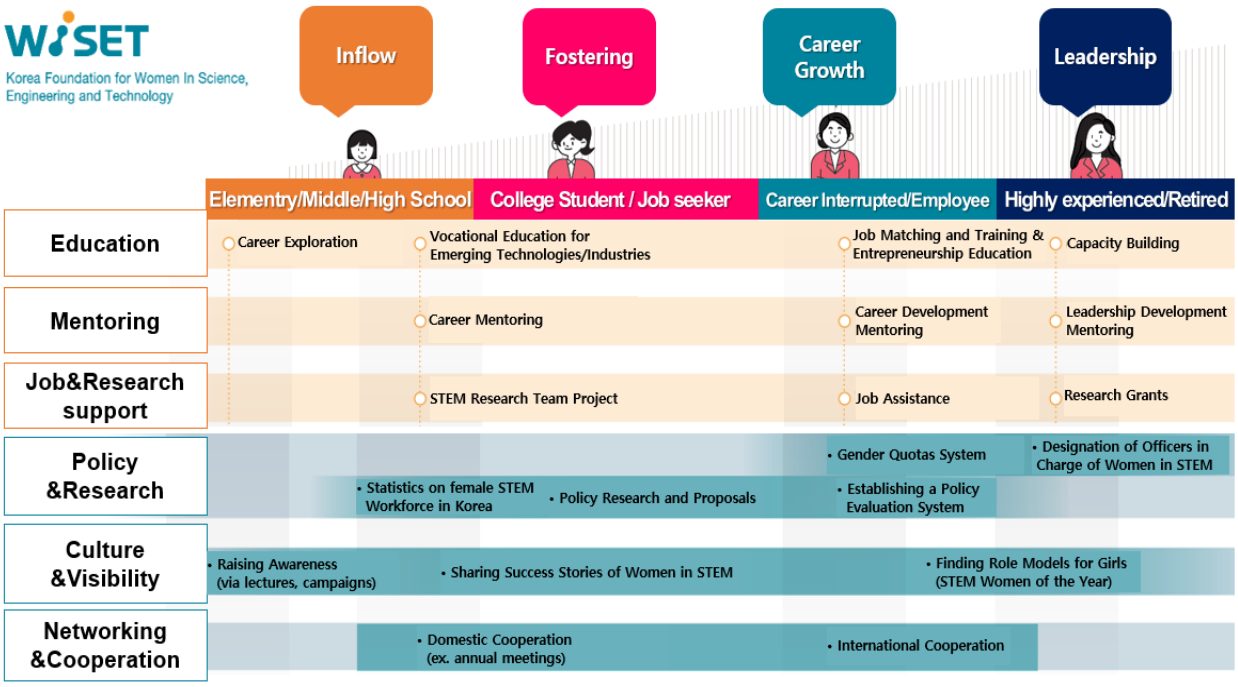
STI are crucial means of achieving the Sustainable Development Goals (SDGs). Yet STI can trigger higher inequality and exclusion if disadvantaged groups do not have the necessary capabilities to utilize the benefits of technologies and cannot take full participation in innovation processes. Inclusive growth emphasizes a fair distribution of economic growth across society and opportunities for all. In this sense, an inclusive STI system, which reflects the needs of disadvantaged groups to ensure leaving no one behind, should be developed (UNESCAP, 2021).

Policy Achievements and Limitations for Women in STEM in ROK

The Republic of Korea has implemented policies for the empowerment of women in STEM led by the government for the past 20 years. In 2002, "Act on Fostering and Supporting Women Scientists and Technicians" was enacted in response to the need for a policy to support women in STEM to solve the supply and demand of STEM talent and secure national competitiveness, since then, the policy began to be implemented in earnest. After the enactment of the Act, a five-year mid- to long-term national plan, "the First Basic Plan for Fostering and Supporting Women in STEM (2004~2008)" (hereinafter referred to as the Basic Plan[v]) was provided. Since then, there have been the Second Basic Plan (2009 - 2013), the Third Basic Plan (2014 – 2018), the Fourth Basic Plan (2019 – 2023), and the Fifth Basic Plan (2024 – 2028) to promote women in STEM[vi].

Moreover, a dedicated institution based on the Act - Korea Foundation for Women in Science, Engineering, and Technology (WISET) – was established, and since its establishment, it has carried out a great diversity of government-funded projects for empowering women in STEM. WISET is a public institution under the Ministry of Science and Technology and provides services tailored to the lifecycle of women in STEM. In detail, it supports more female students in elementary, middle, and high schools to become interested in STEM fields and choose a career path, as well as female university and graduate school students to build their capacities and find employment. It also provides employment support for the reemployment of women who experience career interruption due to childbirth or child-rearing, as well as mentoring and training programs for working women to help them grow as leaders. Furthermore, beyond providing a simple training or program, it plays roles in analyzing problems through research and investigation to propose new policies, and in creating a culture by promoting more female role models and running diversity and inclusion campaigns.

Figure 3. WISET Programs



* Source: WISET(2022), 2022 WISET Brochure[vii].

The Korea government's major policy efforts to empower women in STEM include investments in STEM education, gender equality policies, support for female entrepreneurs, and allocation of R&D funding. A distinctive feature of the Korean government's policies for women in STEM is that it implements programs that are 'tailored to women's lifecycle'. Mentoring programs, customized capacity development education to increase female leadership, and support for reemployment of career-interrupted women have been put in place to address the leaky pipeline of per life cycle for women in STEM. Over the last two decades, the ROK government's continuous efforts have brought a quantitative increase in the number of women in STEM. More female students chose to study sciences and engineering, and the labor force participation rate of women in their 30s and 40s has increased, creating a broader growth base for women in STEM.

However, despite such progress, there are still many challenges such as high rates of career interruption, a low utilization rate of systems supporting work-family balance, and low representation of women in leadership positions in STEM. These challenges are attributable to entrenched gender biases and stereotypes, cultural and social norms, and work-life balance issues, which continuously hinder the participation and advancement of women in STEM. Moreover, the ROK policies for women in STEM show the limitations of government-led policies. These policies have led to significant improvements in women's representation in the public sector, whereas there are challenges in scaling up to the private sector. For instance, the ROK government has set a good example in terms of improvement of women's representation in the public sector. The establishment of the "Plan for the Expansion of Women's Participation" successfully increased women's participation in government committees from 26% in 2012 to 40% in 2017, and similar plans have been carried out in government ministries and agencies, and other public institutions[viii]. However, female executives in Korea's top 100 companies in 2023 account for only 6 percent, with very few companies actively adopting best practices from the public sector. The failure of scale-up to the private sector is attributable to the lack of incentives for companies to adopt the system, and the high likelihood of requiring costs for companies to implement government policies. Additionally, in a competitive business environment, government-led policies are perceived as a lower priority than the business issues at hand. These limitations can be handled through active participation and collaboration between the government and the private sector, clear communication regarding policy goals and benefits, appropriate support and incentives for encouraging private sector participation, and a strong regulatory framework with effective enforcement mechanisms. Building trust, fostering partnerships, and interest coordination between the government and the private sector are also essential for successful policy diffusion and implementation.

Policy Recommendations for Implementing SDGs and Fostering Female STEM Talent

Science, technology, and innovation (STI) are critical means for achieving the Sustainable Development Goals (SDGs), and securing STEM talent is key to accelerating STI. More participation of women in STEM is the best option to deal with the future STEM talent shortage in the face of the shrinking population trend due to the declining birth rates. Furthermore, the prevalent gender imbalance in STEM causes wider social and economic inequalities, which hinder the sustainable development of our society. Gender equality has been established as a stand-alone goal of the Sustainable Development Goals (SDG 5); women's economic empowerment is an important aspect contributing to the progressive realization of SDG 5 on gender equality and is one of the top priority agenda for UNESCAP and UN Women. The empowerment of women in STEM contributes to the promotion of STI in terms of expanding the talent pool, providing diverse perspectives, handling global challenges, achieving economic growth, and improving social equity and inclusion.

As such, the empowerment of women in STEM is essential for achieving sustainable development and requires both national-level efforts and cooperation between countries. At the national level, there should be efforts focusing on attracting and training female students to be interested in STEM, improving systems to support women's participation in STEM (e.g., work-life balance system), increasing female leadership in STEM, and promoting a culture with diversity, equity, and inclusion, on the basis of the current status and diagnosis of women in STEM in each country. The female underrepresentation in STEM is not a problem of any one country alone, and international cooperation is essential to bring synergy effects. Furthermore, it is necessary to find out best practices (e.g., policies, systems, and practices) through case studies on the empowerment of women in STEM and actively share and disseminate them. Additionally, it is necessary to find common problems and areas with slow improvement around the world,[ix] and create an international cooperation system to devise measures to address them. In specific, preparing a regular forum for discussions on women in STEM, establishing a consultative group, setting specific targets, and identifying priorities can be considered, and it is necessary to continuously monitor implementation progress. Here, along with the public sector, various policy stakeholders, particularly the private sector, should be involved from the beginning of the discussion to increase public-private synergies, and contribute to creating an STI ecosystem through a careful design of the system.

References

APEC (2023), The APEC Women and the Economy Dashboard 2023

McKinsey & Company (2023.1), Women in tech: The best bet to solve Europe's talent shortage

UNESCO Data Centre. Available at http://www.uis.unesco.org/DataCentre/

United Nations, Economic and Social Commission for Asia and the Pacific (ESCAP) (2021). The Future is Equal: Gender Equality in the Technology Industry.

WISET(2022), Report on the Statistics of Women and Men in STEM in Korea

WISET(2023), Policy & Statistics. Available at https://www.wiset.or.kr/eng/

WISET(2023), STEM Workforce in STEM in Korea 2022

World Economic Forum (WEF) (2021). The Global Gender Gap Report 2021. Available at http://www3.weforum.org/docs/WEF_GGGR_2021.pdf

[i] McKinsey & Company 2023. 2022 GDP data from Statista, tech contributions to GDP in 2022 from the Organisation for Economic Co-operation and Development (OECD), and McKinsey and Eightfold AI analysis

[ii] The Global Gender Gap examines the gap between men and women across four fundamental categories: Economic Participation and Opportunity, Educational Attainment, Health and Survival, and Political Empowerment (WEF, 2021).

[iii] UNESCO Data Centre, see http://www.uis.unesco.org/DataCentre/

[iv] APEC 2023.

[v] The Basic Plan suggests mid- to long-term policy goals and directions for fostering and supporting women in STEM, as well as vision, policy goals, and strategies for achieving the policy goals for each period of the Basic Plans.

[vi] The 1st plan was established in 2003, and noticeable accomplishments were made as the 3rd plan finished, including (i) increase in the percentage of female newly employed for full-time research positions from 22% in 2008 to 30% in 2017, (ii) increase in conversion to flexible working hour systems from 556 women in 2015 to 5,487 women in 2017, and (iii) increase in the participation rate in economic activities for women in their 40s in STEM from 57% in 2012 to 61% in 2017.

[vii] See https://www.wiset.or.kr/prog/pblcte/eng/sub01_05_02/01/list.do

[viii] The ROK Government has institutionalized gender mainstream via four policy tools, namely (i) gender impact assessment, (ii) gender-responsive budgeting, (iii) gender-responsive statistics, and (iv) gender-responsive education. For example, the enactment of The Gender Impact Analysis and Assessment Act requests central administrative agencies and local governments to conduct gender impact analyses and assessments on newly enacted or revised bills, ensuring the consideration of gender equality perspectives in legislation.

[ix] Examples: female students' low interest in STEM, lack of educational opportunities for female students or women in remote areas, underrepresentation (or low visibility) of women in STEM, workplace disadvantages (e.g., gender discrimination and bias), career interruption, gender segregation of jobs in high-tech industries, etc.