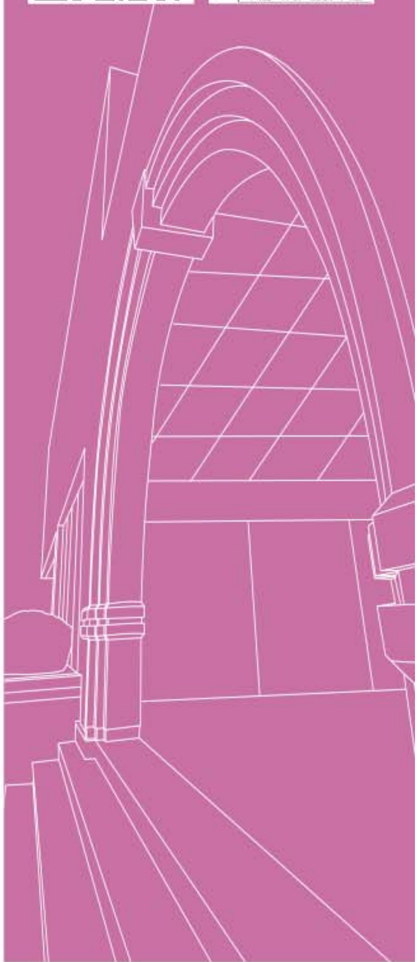
www.kwdi.re.kr 한국여성정책연구원



Knowledge Sharing on Korea's Development in Women's Policies

Policy to Encourage Female Students in STEM

Seon-Mee Shin

2014

Research Paper-19-1-4-8

KWDI
Korean Women's Development Institute

2014 Research Paper 19-1-4-8

Knowledge Sharing on Korea's Development in Women's Policies

Policy to Encourage Female Students in STEM

Author Seon-Mee Shin (KWDI)

Advisor Ji-Hye Kwon
(Center for Women in Science, Engineering and Technology)
Eunkyoung Lee (Chonbuk National University)

Reviewer Ji-Hye Kwon
(Center for Women in Science, Engineering and Technology)

Research Management Eun Kyung Kim, Jung Soo Kim
(Center for International Development & Cooperation, KWDI)

KWDI
Korean Women's Development Institute

한국여성정책연구원
www.kwdi.re.kr

2014 Research Paper 19-1-4-8

Knowledge Sharing on Korea's Development in Women's Policies

Policy to Encourage Female Students in STEM

First published on 31 December, 2014
by Korean Women’s Development Institute
225 Jinheung-ro Eunpyeong-gu
Seoul 122-707
South Korea
www.kwdi.re.kr

ISBN 978-89-8491-668-5 94330
978-89-8491-647-0 94330 (Set)

Printed in South Korea

Please cite this report as below:
Shin, Seon-Mee(2014). Knowledge Sharing on Korea's Development in Women's Policies - Policy to Encourage Female Students in STEM. Seoul: Korean Women’s Development Institute.

Korean Women’s Development Institute(KWDI) is a government-affiliated think-tank under the Prime Minister’s Office of South Korea. It has contributed to realizing gender equality, improving women’s social participation and welfare and advancing family life and state through comprehensive researches on women’s policies.

Foreword

South Korea has transformed itself from being an aid receiving country to an aid giving one after achieving an unprecedented economic growth during the past half century. Such growth was not confined to economic spheres only, but happened in many social arenas. Women's advancement was one area that has seen another dramatic transformation.

While efforts has existed to share Korea's development experience, such as Knowledge Sharing Program(KSP) spearheaded by South Korea's Ministry of Strategy and Finance(MOSF) and Development Experience Exchange Partnership(DEEP) by the Ministry of Foreign Affairs, there hardly existed initiatives to share women's advancement experiences in particular. The current study is the first of its kind and compiles the case analyses of women's development in various areas of South Korean society.

This study is an essential part of KWDI's multi-year ODA project titled "Strengthening Gender Equality Policy Infrastructure in the Asia-Pacific Region." This is a project aimed at establishing political and social infrastructure for gender-equal policy in the Asia-Pacific region. We believe South Korea's cases could serve as one model to consider for our partner countries in achieving this goal.

KWDI plans to share these case studies through various means such as policy consultation, workshops and international conferences. We will also come up with potential gender-related ODA projects that South Korean government can work with partner countries based on Korea's comparative advantage/experience. Our ultimate goal is to design a women's policy model tailored to local needs and work together to translate it into practice.

I hope the concerted efforts made by KWDI and partner countries will bring substantive changes in the lives of women in Asia.

Myung-sun Lee, Ph. D.
President
Korean Women's Development Institute

Table of Contents

List of Tables

List of Figures

I

Background

1. Conditions at Time of Policy Introduction

The policy to increase the number of female students advancing into science and technology fields was implemented full-fledgedly in Korea since 2001. As an institutional measure to comprehensively pursue science and technology policies, the Ministry of Science and Technology initiated the enactment of the Framework Act on Science and Technology in May 2000, which was passed into law as Act No. 6353 on January 16, 2001 (Central Officials Training Institute, 2006: 8). Article 24 of the above Act stipulates the training of women scientists and engineers be adopted as a national policy[1]. Based on this law, the Ministry of Science and Technology announced policies on training and utilizing women scientists and engineers on July 3, 2001, which included the implementation of the pilot project WISE (Women Into Science and Engineering) and the program for women universities (Central Officials Training Institute, 2006: 8). Ewha Womans University was entrusted with the implementation of the WISE pilot project, and a one-on-one mentor system between women scientists and engineers and female students was set up to inspire interest in science since primary school, and prevent women university students in science and engineering from changing their majors.

In the early 2000s, the Korean government pursued various policies related to women scientists and engineers in addition to WISE, such as setting goals for the recruitment of women scientists and engineers, providing supports for research by outstanding women scientists and engineers and constructing a domestic DB on women scientists and engineers. In order to pursue these projects in a more systematic manner and with a long-term perspective,

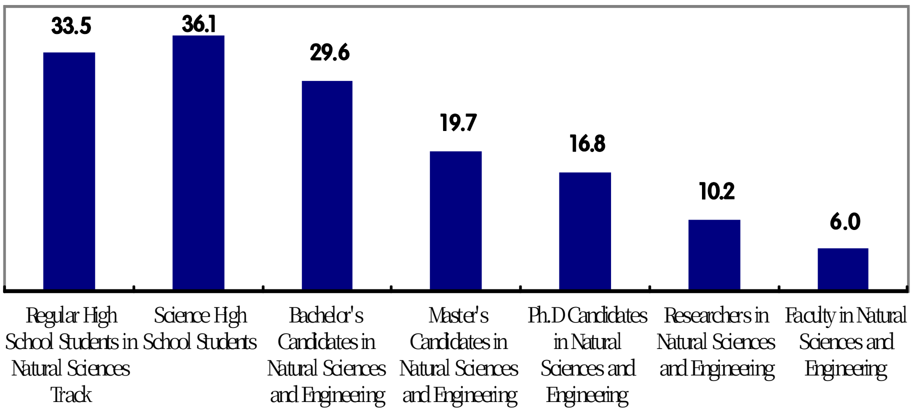
1) Article 24 (Training of Female Science and Technology Engineers). The Government shall devise the schemes to train and utilize female science and technology engineers in order to elevate the national science and technology capacity, and formulate and promote the policies for required supports so as to enable the female science and technology engineers to fully display their quality and capability.

however, there was a need to reinforce the legal basis. This led to the enactment of the Act on Fostering and Supporting Women Scientists and Technicians on December 18, 2002.

In the beginning of the 2000s, the number of women in science and technology fields was considerably low. For instance, the number of women researchers undertaking research and development activities stood at 16,385[2] in 2000, accounting for only 10.2% of the entire research population. The proportion of full-time women professors in science and engineering was much lower at 6.0% (1,149 persons). The main reason for such low proportion of women workers in science and technology fields was because more female students selected majors in humanities and social studies rather than science fields during high school and university[3]. The ratio of female students choosing a major in science and technology at high school was only slightly above 30%. For example, the proportion of female students in science high schools was 36.1%, and only 33.5% of students undertook a curriculum in natural sciences and engineering in their second and third years at regular high schools in 2000. The proportion of female students studying science and technology fields in university varied across academic degree curricula, but overall, it was lower than in the high school stage. The ratio of female students majoring science and engineering fields in bachelor programs was 29.6% in 2000, only slightly lower than the proportion of female students in natural sciences and engineering at high school, and the figure fell sharply to 19.7% and 16.8% for female students

2) The number of total researchers working in universities and public/private research institutes.
3) Students decide whether or not to pursue a career in science and technology at the end of their third year in middle school or first year in high school. Students entering science high schools begin studies in this area according to the school curriculum with a focus on mathematics and science since their first year. In contrast, students entering regular high schools study a common curriculum in their first year, and then undertake a curriculum in humanities and social studies or natural sciences and engineering, or a vocational curriculum after their second year.

in masters and doctoral programs in these fields. As can be inferred from the above, the ratio of women was low since the initial stage of the program to foster science and technology engineers, with the proportion declining as their degree levels grew higher. Therefore, a policy to encourage female students to enter into science and technology fields before they entered high school was imperative in increasing the number of women in related fields.



Sources: Korean Educational Development Institute Education Statistics Services DB.

[Figure Ⅰ-1] Ratio of female students and women in national sciences and engineering

In 2000, male and female high school students were educated separately in 54.4 percent of the regular high schools in Korea. In girls' high schools, the overwhelming majority of the students tend to select liberal art tracks while in boys' high schools, the overwhelming majority of the students tend to select natural science track.[4] Female students prefer liberal arts track which most of the female students select, and the natural sciences track is considered to be boys' area.

4) Korean high school education offers two curriculum tracks: liberal arts and natural sciences, and students have a choice between the two tracks.

When the policy to encourage women to enter science and technology fields began to be implemented full-fledgedly in the early 2000s, there was a high interest in the Korean government in women policies and human resources development. Accordingly, the ‘Master Plan for National Human Resources Development: People, Knowledge and Advancement’ was established in 2001. The Master Plan aimed at fostering women workers in science and technology fields in order to attract them to knowledge-based industries. It included plans to implement the WISE program, award scholarships to female students entering science and engineering colleges, and offer opportunities to study and training abroad[5].

Various policy studies (Kim Myung-ja et al., 1995; Kim Young-ok, 1996; Kim Jeong-ja et al., 1998, Roh Junghye et al,, 2000; Jung Kwanghwa et al., 2003) also emphasized the need for a policy to nurture women scientists and engineers and actively proposed related policy measures. Proposals included gender-sensitive mathematics and science education for girls in primary, middle and high schools, support in encouraging female students to choose a career in science and engineering, and improve the proportion of women professors in science and engineering colleges. Women in Science and Technology also provided basic data on the necessity and strategies for nurturing women scientist and engineer through their policy research. In addition, they were actively involved in various activities such as legislating related laws and Five-Year Master Plan.

As the advancement of women into science and technology fields attracted attention from all spheres of society, the quantity of organizations of women scientists and engineers also increased. The Association of Korean Women Scientists and Engineers (KWSE) and the Korea Women Inventors Association (INVENTOR) were established in 1993, and the Korea Foundation of Women’s

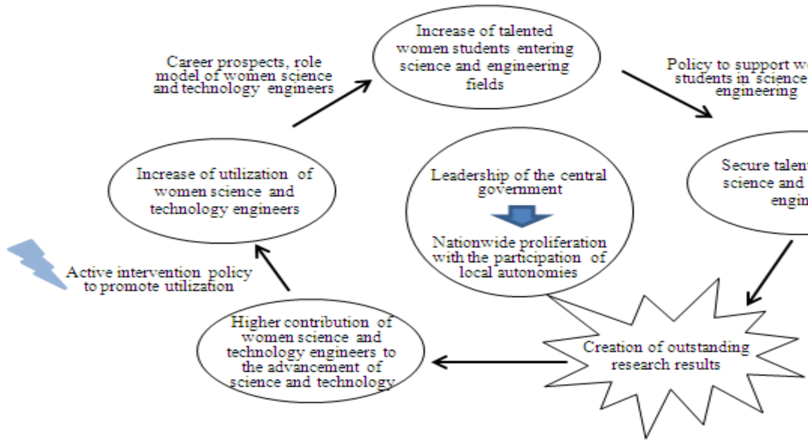
5) Government of the Republic of Korea (2001). “*Master Plan for National Human Resources Development: People, Knowledge and Advancement*”

Science and Technology Associations (KOFWST) in 2003. KOFWST is a collective organization of women's science and technology associations which started out with only 14 members in 2004, but by 2013, its membership included 40 organizations. Such associations are highly interested in fostering younger women scientists and engineers in various fields. They offer voluntary services in mentoring, internships, and workplace visits for female students, and some operate such programs themselves.

2. Policy Objectives

Based on the Act on Fostering and Supporting Women Scientists and Technicians enacted in 2002, the First Master Plan on Training and Supporting Women Scientists and Engineers (2004-2008) was set up in 2004 and the Second Master Plan (2009-2013) in 2009. In 2013, a basic research was conducted to establish the Third Master Plan (2014-2018), which was finalized in early 2014.

During the phase of the first five-year plan, the government aimed to build a virtuous cycle of training and utilizing skills of women scientists and engineers. In other words, successful women scientists and engineers are essential in promoting next generation female students to enter science and technology fields, which would lead to more qualified women workers into science and technology fields. The Korean government expressed its determination to create such virtuous cycle changes.



Sources: First Master Plan on Training and Supporting Women Scientists and Engineers

[Figure Ⅰ-2] Virtuous cycle structure for the training and utilization of skills of women scientists and engineers

The First and Second Master Plans not only include policies to increase female students entering into science and technology fields, but also policies to expand the utilization of the skills of women scientists and engineers who completed their higher degrees. Detailed policy objectives in expanding female students entering science and technology fields enshrined in each Plan are as follows:

〈Table Ⅰ-1〉 Policy objectives to increase the number of female students advancing into science and technology fields

First Five-year Plan	Second Five-year Plan
○ Maintain the proportion of female students in science and engineering colleges at a desirable level. To this end, recommend the desirable ratio of female students among new students for science and engineering majors or faculties with an average ratio of female students below 30% during the past three years.	○ Increase the target of mentoring services for female students in middle and high schools and colleges choosing careers in science and technology fields from 1,300 students in 2007 to 2,000 in 2013. ○ Increase the proportion of female students in bachelor degrees in science and engineering from 19% in 2007 to 25% in 2013. ○ Increase the number of women doctoral degree graduates in science and engineering from 700 in 2007 to 1,000 in 2013, and offer scholarships and overseas training to women workers mainly in future promising technology fields.

Sources: First and Second Master Plans on Training and Supporting Women Scientists and Engineers

Ⅱ

Policy Details

1. Science and Engineering Major Experience Program for Female Students

The program to grant female students the chance to experience science and engineering majors began in 2001 under the title "WISE Program", but it was later changed into "Science and Engineering Major Experience Program for Female Students". It granted female students in middle and high schools opportunities to familiarize themselves with science or experience majors in science and engineering, and was implemented in the form of "Outreach Laboratory", "Early Birds' Laboratory" and "Mentoring".

A. Outreach Laboratory Program

In the Outreach Laboratory Program, undergraduate or graduate science and engineering students or professors act as mentors and visit middle and high schools to conduct experiments or practical education in mathematics, science or engineering fields for girls. Mentors are mainly comprised of undergraduate (including a few male students) or graduate science and engineering students, but sometimes, professors participate in the program as mentors. They are selected every semester or year, and visit middle and high schools after receiving mentor training, and also develop experiment-practical training programs. The developed programs are reviewed by their academic advisor. Examples of the Outreach Laboratory Program are as shown in <Table Ⅱ-1>.

〈Table Ⅱ-1〉 Examples of the Outreach Laboratory

Program title	Experiment objectives	Preparatory materials	Core terminology
What will happen if there is no air?	Utilize vacuum experimental device to explain the relation between gas pressure and volume	<An experiment for a group of four> Vacuum experimental device 1,000ml (vacuum container, pump), balloon, choco pie, incense (4cm), lighter, oil-based pen	Vacuum, air, gas, pressure, volume, Boyle's Law
Discovering plant veins	Study leaves, learn about the role of veins and dye	Sodium hydroxide, plant leaves, heating equipment, beaker, newspaper (paper), glass plate (dissecting plate), toothbrush, pigment, pipette, tweezers	Role of plant veins: channel for water and nutrients
Making canons from air	Learn about "air pressure" and by utilizing the properties of air pressure, create an air canon and conduct an experiment	Plastic cup, balloon, candle, paper cup, scissors, tape, mosquito repellent incense	Air, air pressure, air volume, power of air

Sources: Teaching Plan for the Outreach Laboratory Program (middle school program), Center for Women in Science, Engineering and Technology (WISET) Regional Agency for DGG (2012)

Attracting interested middle and high schools require the use of various methods. The most effective is by dispatching an official document to all middle and high schools under the cooperation of regional educational offices and receive applications from interested schools. When this method proves difficult, applications from interested schools are gathered by utilizing informal networks, for instance, through regional mathematics or science teacher clubs or through teachers who graduated from colleges associated with the mentors[6].

---

6) The authority to make decisions regarding career education in Korean middle schools is mainly vested in the principal of the school, and the decision to participate in the

The middle and high schools that are visited by the “Outreach Laboratory” are sometimes high schools for girls, but most of them are mixed gender high schools[7]. Although the objective of this program lies in encouraging girl students to enter into science and technology fields, boy students sometimes participate in the program if the participating school is a school for both genders. The reason is because the program itself is an activity conducted within the school, which makes it difficult to completely exclude boy students. However, the program strives to encourage as many girl students to participate so that at least 50% of the participants are girls.

B. Early Birds’ Laboratory Program

The Early Birds' Laboratory Program invites girls from middle and high schools to participate in a research project operated by college laboratories, thereby offering an opportunity to gain hands-on experience on research in science and technology fields. Science and engineering colleges are equipped with different laboratories for each faculty. Each faculty invites small groups of girl students to introduce the type of research conducted in their laboratories, and, in some form, allows them to participate in research. This enables high school students understand what it means to study in a science and engineering college and stimulate interest in science and technology research activities.

The program operated by WISET Regional Agency of Chungbuk (Chungbuk University) in 2012 is a prime example. The objective of the program was to “nurture curiosity and interest in science and engineering by enabling high school students interested in studying in these fields to gain experience related

---

“Outreach Laboratory” is also made by the principal. Teachers inform the principal of the program and acquire their authorization for participation.

7) As of 2012, 75.8% (2,404 schools) are mixed gender schools out of a total 3,173 middle schools, and only 11.5% (363 schools) are middle schools for girls. In case of high schools, there are a total of 2,322 schools of which 63.6% (1,477 schools) are mixed gender, and 18.7% (434 schools) are for girls.

to future majors in laboratories in engineering or natural sciences colleges, and thereby encourage them to move on to a major in a related field”. Six teams were installed to carry out the program. Each team was composed of a guidance teacher and four high school girls interested in research. The laboratories visited and research conducted by the six teams are as described in <Table Ⅱ-2>.

〈Table Ⅱ-2〉 Examples of Early Birds' Laboratory Program

Team	School	Laboratory which was visited in advance	Research description
1	Goesan High School	Department of Biomedical Science, Faculty of Medical Engineering, Jungwon University	Isolation and identification of plasmid DNA
2	Danyang High School	Division of Biotechnology, College of Biomedical and Health Sciences, Kongkuk University Global Campus	Exploration of chemotherapy-induced reproductive toxicological defense substances and mechanism study
3	Young Dong High School	Department of Materials Science and Engineering, College of Engineering, Korea Advanced Institute of Science and Technology (KAIST)	Production and utilization of chemical centers
4	Jecheon Girls High School	Division of Biotechnology, College of Biomedical and Health Sciences, Kongkuk University Global Campus	Western blot experiment
5	Jincheon High School	Department of Computer Engineering, College of Science and Technology, Kongkuk University Global Campus	Development of intelligent robot, smart phone programming
6	Chungwon High School	Department of Biomedical	Research on biosignal

Team	School	Laboratory which was visited in advance	Research description
		Science, Faculty of Medical Engineering, Jungwon University	processing technique

Sources: 2012 Business Report, Center for Women in Science, Engineering and Technology (WISET) Regional Agency for Chungbuk

C. Mentoring

Mentoring is a program which enables female middle and high school students and college students to meet with women scientists and engineers working in various areas to acquire detailed information on careers in related fields and prepare for the future. The role of mentor is undertaken by not only university professors, but also scientists and engineers in public research institutions and science and engineering undergraduate and graduate students.

The Mentoring Program to attract girls to science and engineering majors and careers is carried out both online and offline. Online mentoring is provided through the website (http://www.wiset.re.kr/mentoring/), mobile website (http://m.wiset.re.kr) and mentoring applications, whereas offline mentoring is provided through Lectures by Women Scientists, Women CEO Special Lecture, Science Camp, and Career Counseling Center for Female Students, among others.

In the online mentoring program, the mentee can consult with a mentor one-on-one (1:1) behind closed doors, a mentor can provide advice to several mentees (1:N mentoring), or several mentors and mentees can participate in the program (N:N). If a mentor and mentee participate actively in the program and become selected as a case of best performance, a summary of the mentoring between the Best Mentoring Couple is posted on the website. In addition, a mentor can provide advice by writing letters to numerous mentees.

An excellent example of an offline mentoring program is a joint forum hosted by the WISET Regional Agency for Chungbuk in 2012 "Why and How Science Department Store" (Table Ⅱ-3). This program offered an opportunity for middle and high school students to visit various faculties as if they were visiting shops in a department store and experience different programs.

〈Table Ⅱ-3〉 Offline Mentoring Program cases

Throw away your notebook and pencils! [Department of Mathematical Education] Fun quizzes Triangle circumcenter/inward device Zonodome system Oval billiard table	Well-being Science: Everything about the environment! [Department of Environmental Education] DO, PH, Electroconductivity analyzer experiment Making a simplified water purifier Environment-related games Eco dreamland	Discover amazing principles in science and technology! [Department of Technical Education] Learning about communication Making a grass doll Learning about architecture Bicycles, generators and waterwheels
Science hidden in cooking and dyeing [Department of Home Economics] Making garlic bread and tortillas Italian masters Fun home economics time!	Mysteries of life: Do you know 'life'? [Department of Biological Education] Making pressed flower bookmarks Growth process of chicks and ant nests Making DNA molecule model beads Taking my fingerprints	The world is connected through chemistry! [Department of Chemical Education] Ice-cream made with liquid nitrogen Chemical garden using osmotic pressure The world of chemistry through fireworks Nail art
Fun and beautiful physics [Department of Physical Science Education] Mazes and lasers Balloon cars Burglar alarms Changing shapes of metals	Scientists dreaming of humans talking with machines [Department of Computer Education] Drawing using a penpad Assembling computer parts Experiencing facial recognition	Amazing phenomena on earth, and space [Department of Earth Science Education] Observing rock flakes and categorizing rocks Daily weather conditions Save the ocean! - oceanic

	application Experiencing X-EDU robot, MAC mini	exploration Exciting world of astronomy

Sources: 2012 Business Report, Center for Women in Science, Engineering and Technology (WISET) Regional Agency for Chungbuk

2. Program to Strengthen Capability of Women Student Majoring in Engineering Colleges

The policy to increase women advancing into science and technology fields in the higher education level is focused on female students of engineering colleges. This is due to the fact that the proportion of female students in engineering reaches only 30%, and in many cases, they account for a rare few in related faculties. In contrast, the ratio of female students in natural sciences has surpassed the 50% threshold overall, and rarely does the ratio fall below 20-30% in the faculty level.

The focus of the program to strengthen the capability of women engineering majors is to support female students who, despite the challenges, entered engineering colleges and prevent them from changing majors midway or assist them so they can grow into talented engineers without falling behind. To this end, the Women Into Engineering Program was initiated in 2006. An outline of the program includes 1) the creation of a women-friendly engineering educational environment, 2) strengthening the capacity and skills of female students majoring in engineering to adapt to industrial sites, and 3) participation of female students in programs to promote industry-academia cooperation.

〈Table Ⅱ-4〉 Program to strengthen capability of women majors in engineering colleges

Category	Description	Detailed content
Improvement of engineering curriculum	Improvement of a gender-sensitive engineering education system	Improvement of gender-sensitive courses and development of new textbooks Creation of a gender-sensitive educational atmosphere Development of a gender-sensitive instruction and study techniques
Strengthening capability in majors	Program to enhance on-site adaptability	Development of courses and participatory programs to enhance self-confidence in basic and intensive majors of female students in engineering colleges
	Program to promote industry-academia cooperation and employment	Increase of affection for engineering-related work through programs to experiment, practice and gain work experience through industry-academia cooperation

Sources: WISET website (www.wiset.re.kr)

A. Improvement of gender-sensitive engineering courses

It is necessary to improve the educational environment of engineering colleges dominated by male-oriented culture in order to attract more female students to engineering colleges and foster them to become talents in related fields. Most engineering college professors and 70% of students are male. More often than not, there are only a couple of female students in a faculty. Many male professors and students have no sisters or went to boys schools after primary school, thereby becoming unwittingly oblivious to the difficulties of female students in a male dominative culture and unable to communicate with students of the opposite sex.

Efforts to improve the engineering education system from a gender-sensitive perspective was carried out using various methods. Among the most popular was the development of gender-sensitive instruction and learning techniques. For instance, the Department of Control Engineering devised an educational program based on the preconception that male students preferred combat robots, whereas female students liked pretty dolls. This was changed to a study of high-performance robots created by highly-regarded women scientists home and abroad.

Gender-sensitive lecture guides are also prepared and offered to professors so they can not only encourage female students to harbor a greater interest in engineering education, but also assist them in understanding the field. For example, below is a lecture guide devised and presented by the WISET Regional Agency for Dongnam (2013):

- Encourage participation of students after taking into consideration varying inclinations amongst students
- Set up a cooperation-based learning strategy, such as group activities
- Allow composition of teams that can nurture different individualities
- Check the sharing of different roles in team activities
- Encourage creative reports and assignments
- Apply diverse evaluation methods and standards
- Encourage the equal participation of both genders in machinery operation or activities of a representative nature
- Provide detailed feedback to students
- Utilize textbooks written in careful language
- Allow sufficient time
- Compliment all students equally
- Refrain from trying to know everything about the students
- Nurture self-confidence in students
- Avoid stereotypes

Workshops and seminars on gender-sensitive lecture methods are also held with the participation of engineering professors. These events introduce not only instruction techniques, but also Korea's major policies on women workers. Some colleges diagnose problems in the education provided by their engineering colleges from a gender-sensitive perspective and conduct surveys on professors and students for ways of improvement.

B. Program to enhance on-site adaptiveness

One of the greatest challenges for female engineering majors seeking jobs after graduation is, in general, a weaker adaptability to workplaces compared to male students. Companies requesting recommendations for new graduates are inclined to prefer male students over female students because of this problem. Therefore, their on-site adaptability skills must be enhanced in order to nurture female students in engineering colleges.

Programs for this purpose include internships, courses on engineering and design which reflect onsite demand, programs to improve utilization of experimental and practical training equipment, corporate and factory visiting programs, programs on educating basic knowledge for professionals, and programs to assist with recruitment.

For example, Kunsan University is well-known for installing a women-only laboratory on electricity, machinery and equipment and providing special training sessions for female students so they can operate the equipment effectively. In 2012, Chonnam National University heard that a large shipbuilding conglomerate located in Jeonnam Province would be recruiting women workers with Computer Aided Design (CAD) skills and conducted a customized education program for female engineering students so they could acquire the necessary IT capabilities.

C. Program to promote industry-academia cooperation and employment

Programs to promote industry-academia cooperation and employment include conducting surveys for worker demand by related industry, credit-recognition courses to assist female students develop their careers, career consulting, lectures to develop interview skills as women engineers, lectures on using computers, special lectures on finding jobs, such as on leadership, meetings with recruitment officers and human resources mangers, and mentoring programs.

For instance, Inha University has been operating a liberal arts course titled 'Engineering and Women' for several years where famous women scientists and engineers are invited to give special lectures. The themes of lectures and lecturers for 2012 were as follows:

- If I were you (female professor of an engineering college)
- Patent lawyers and intellectual property rights (female patent lawyer)
- Understanding communication between men and women (female professor)
- Hybrid in your future (female engineer at a large electronics conglomerate)
- Future design process through research and development (female researcher at a research institute affiliated with a large conglomerate)
- IT and women workers (female executive of a telecommunications company)
- Devising job-landing strategies by understanding the corporate environment (career consultant)
- Communication and understanding each other (female professor)
- Women and machine engineering (female engineer at a public

corporation)
- Being successful at work (female engineer at a public organization)
- Rocket and I (female scientist at a national research institution in science and technology)
- Women power (female engineer at a construction company)

3. Program to Support Female Undergraduate and Graduate Team-based Research

The program to support research for female undergraduate and graduate teams commenced as “WATCH21” under the initiative of the Ministry of Commerce, Industry and Energy in 2004. The abbreviation for ‘Woman’s Academy for Technology Changer in the 21C’, WATCH21 is a program providing support to research teams where a female engineering graduate student is the project leader. The objective of this program was initially to foster women graduate students studying in engineering fields into highly qualified engineering and technical workers and cultivate leadership skills. Detailed goals of the program are as follows:

- Provide a chance to experience the entire research process, from setting up research plans, conducting experiments/practice, writing reports and presentation, by taking responsibility for a small research task
- Provide a chance for the advisor, female graduate, undergraduate and high school students to become a team, construct vertical and horizontal networks with other participants and meet with their role models
- Acquire multi-level educational effect through the research program, including research, education, mentoring, sociality, adaptiveness to

organizational society, and writing and leadership skills

From 2004 to 2012, teams were composed of one female student in the masters or doctoral program, two female engineering undergraduate students, and four to five high school girls. The role sharing among team members are as shown in <Table Ⅱ-5>.

〈Table Ⅱ-5〉 Roles of team members of the WATCH21 Program

Team Member	Role
Graduate student	In charge of overall research project Provide guidance and mentoring to participating undergraduate/high school students
Undergraduate student	Undertake research project Provide guidance and mentoring to participating high school students
High school student	Undertake research project
Advisor	Provide guidance and advice on research, and a research environment Cooperate on (mandatory) visits to women scientists and engineers in industries/research institutes
Guidance teacher	Cooperate in conducting special lectures in participating schools (mandatory) Encourage and guide high school students to participate in the program

During this period, the team-based research support program supported 476 teams and 3,304 female students by injecting a budget of 300 million to 500 million Korean won on an annual basis. A variety of research fields were supported in the program, including architecture/civil engineering, machinery/aterials/ships, bioengineering/food engineering, electric/electronic/semi-conductor, data processing/computer, and chemical engineering/environment.

〈Table Ⅱ-6〉 Participants to the female undergraduate-graduate team-based research programs

Category	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
No. of research teams	40	50	40	62	60	63	45	52	55	476
No. of students	273	372	292	433	423	445	315	366	385	3,304

Sources: WISET website

The teams supported by this program can be divided into two types after 2013. The first type is a regional engineering convergence research team, similar to previous research teams. In other words, a female graduate student, two undergraduate students and a few high school students compose a team, which is supported by a university professor, two high school teachers, and one female mentor at a company. The number of such teams reached 70 in 2013, and each team was awarded a research grant of 5 million Korean won. The second type is an engineering intensive research team led by an outstanding female graduate student in an engineering masters or doctoral program. Four female undergraduate students participate as co-researchers. The advisor of the graduate student and a female mentor at a company also form the team. Thirty such teams were awarded with 6 million Korean won in 2013.

The objective of the engineering intensive research team is to create opportunities for outstanding women engineering students to exhibit leadership in producing research results (theses, patents, enterprise etc). Outstanding graduate students in charge of the research include 1) a female student whose thesis is announced in an internationally-recognized academic journal, 2) a female student who won an award from a related academic society for announcing an outstanding thesis, 3) a female student who submitted an outstanding thesis or discovery and was awarded at a domestic/overseas science and technology thesis competition or science and technology competitive exhibition, or 4) a female student with outstanding school grades recommended by the head of an engineering university.

Each team submits their research results in the form of a thesis, which are evaluated at the end of the year, and outstanding theses are awarded. The female students that participated in the teams take part in the year-end awarding ceremony and join to create a festive atmosphere. Bonds between the professor-guidance teacher-student are encouraged after the program comes to an end. The titles of research theses submitted by participating teams in 2012 are as follows:

- Design of Footbridge using Advanced Composite Materials
- A Study on the Planning of Conversion Design for Deteriorated Residence Areas in Jeju Special Self-governing Province
- Development of Seismic Energy Reduction Device using Magnets
- A Study on Structural Materials for Design of Lightweight Floating Houses
- A Study on Technology of Fixation for Carbon Dioxide using Oyster Shells

Ⅲ

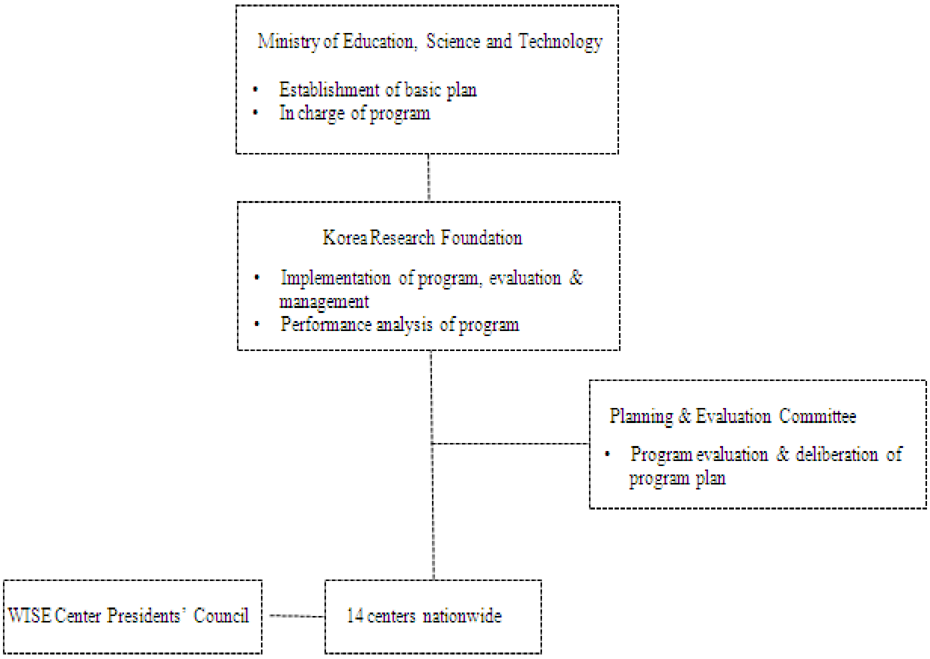
Implementation Process

Three programs were introduced: Science and engineering major experience program for female students, the program to strengthen capability of women student majors in engineering colleges and the program to support female undergraduate and graduate team-based research. Each program was adopted separately with independent implementation systems, which were integrated in 2011.

1. Implementation Prior to Integration

A. Implementation of the science and engineering major experience program for female students

The program to grant girls the chance to experience engineering majors began in 2001 under the title “WISE (Women into Science and Engineering)”. In the first year, Ewha Womans University undertook the pilot project, but in the second year, four additional universities participated in the pilot project and five WISE Centers were installed in those schools. This project expanded nationwide and, prior to integration in 2011, there were 14 centers in 14 schools. Among these centers, the WISE Center at Ewha acted as the base center.



Sources: '08 Master Plan for WIE and WISE Programs, Ministry of Education, Science and Technology (2008)

[Figure Ⅲ-1] WISE Program implementation system

Schools interested in hosting WISE Centers took part in an open competition by region and finalists were selected through an evaluation system. But the number of applications were always identical to the number of hosts needed, and the competition was not fierce. This also means that there were not many women professors who had the determination to operate a WISE Center[8]. The annual budget for each center was approximately from 120 million to 150 million Korean won. In the early stages, all centers were provided with the

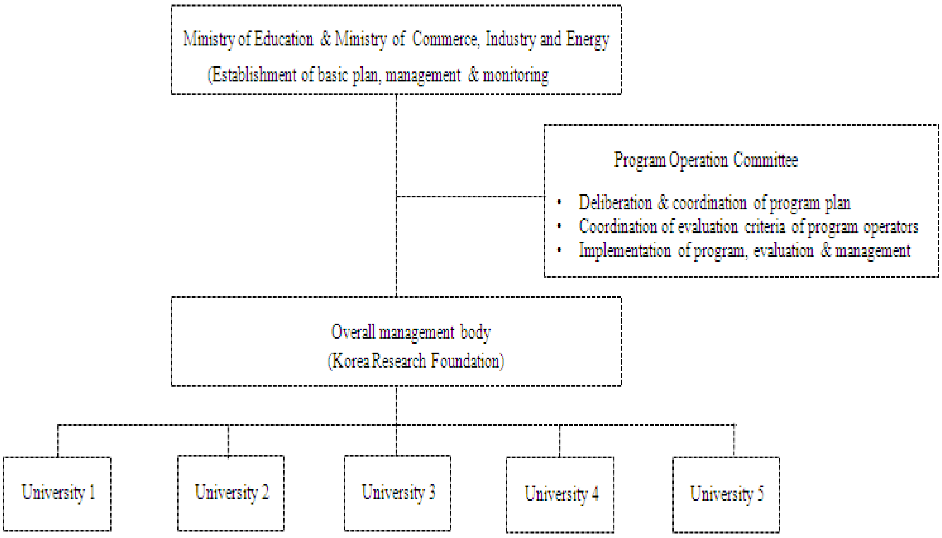
8) It is assumed the operation of a WISE Center did not have a positive influence on the evaluation of professors. In general, universities evaluate professors on their research results, but the operation of a WISE Center was likely to be time consuming, resulting in a lack of time in producing such results. Nevertheless, women professors who did operate WISE Centers believed as educators, there was great value in science education for female students.

same amount of budget, but the budget was later provided on a differentiated basis according to annual evaluation results.

In the beginning, each center autonomously decided which programs to operate, but with the accumulation of evaluation results, centers started to share outstanding programs. As a result, there were programs that were operated commonly in all centers and specialized programs customized to different regional characteristics. At present, programs include the Outreach Laboratory Program, Early Birds' Laboratory and Mentoring Program. In the past, there were other programs such as science fairs, or programs for preschoolers and primary school students, but after a series of evaluations, they stopped their operations. However, the detailed contents of the three programs currently offered vary by center. There are similar programs due to an effort to share effective programs, but because of varying availability of human and physical resources by center, each center offers unique programs.

B. Implementation of the program to strengthen capability of women majors in engineering colleges

The program to strengthen the capability of female students in engineering colleges was first initiated under the title "Women into Engineering Program (WIE)". In 2006, the Ministry of Education and Human Resources Development and the Ministry of Commerce, Industry and Energy began this project with the objective of training women multi-players needed at industrial sites. The fact that Kunsan University installed laboratories for the exclusive use of female students had a great influence. Until the implementation process was integrated in 2011, five engineering universities (Kangwon University, Kunsan University, Pukyong University, Sungkyunkwan University, and Yonsei University) took part in this program and were awarded an annual grant of approximately 200 million Korean won.



Sources: Plan to support leading universities in engineering education for female students. Ministry of Education and Human Resources Development & Ministry of Commerce, Industry and Energy (2006).

[Figure Ⅲ-2] Implementation system for the plan to support leading universities in engineering education for female students

In order to select university participants to this program, the Ministry of Education and Human Resources Development held a briefing session for professors and students of engineering colleges and openly advertised for interested schools. As a result, 29 universities submitted their applications and an Evaluation Committee comprised of industry-academia-research experts selected five schools. In consideration of regional distribution, schools were selected in Seoul, Gyeonggi-Incheon, Chungcheong-Gangwon, Youngnam, and Honam.

〈Table Ⅲ-1〉 Selection criteria for the program to support leading universities in engineering education for female undergraduates

Evaluation field	Evaluation item	Evaluation details	Score
Educational conditions and performance	University infrastructure	Education facilities and equipment, faculty etc	15
	Performance of advancement into major-related fields	Performance of female graduates advancing into major-related fields	
Organization of program operator and determination of university	Organization & operation of program operator	Human resources and capacity, operational system of program operator	30
	Capacity of program operator	Capability and determination for implementation of head of program operator	
	Adequacy of program size	Adequacy of number of participating professors and female students	
	Preferential treatment etc	Advantages for participating program operators and participants	
	Corresponding investment amount	Proportion of corresponding investments from universities, local autonomies and industrial companies	
Faithfulness and validity to program plan	Necessity	Efforts to utilize results by the university, such as in plans to advance the university or specialize in certain fields	65
	Uniqueness of program	Program contents that can become a model for other universities in terms of a gender-inclusive perspective and originality in methodology	
	Adequacy and realizability of program plan	Adequacy in the composition of mandatory and selective programs	
		Adequacy and realizability of program contents	
		Programs that meed demands of female students and industry	
		Ways to operate the program through industry-academia cooperation	
	Connection with other programs	Create synergy effect by connecting with other programs	

Evaluation field	Evaluation item	Evaluation details	Score
	Adequacy of financial investment plan	Adequacy in computing program expenses	
	Performance index	Establishment of self-evaluation and management plans, such as performance index, adequacy of evaluation systems	

Sources: Plan to support leading universities in engineering education for female students. Ministry of Education and Human Resources Development & Ministry of Commerce, Industry and Energy (2006).

An examination of students and professors among selected engineering colleges demonstrated that Yonsei University had the highest ratio of women professors with 3.6%, whereas the other schools had less than 1%. Yonsei University had eight women professors in its engineering college alone, but the other four engineering colleges had only one or two professors who were women. In contrast, the proportion of female students was an average of 20.7%, higher than the ratio of women professors. Kunsan University had the lowest proportion of female students at 10%, whereas Kangwon University, Sungkyunkwan University, and Yonsei University stood at 20% and Pukyong University was the highest at 25%.

〈Table Ⅲ-2〉 Professor-student status of engineering colleges leading in engineering education for female students

Category		Male	Female	Total	Ratio of females (%)
Faculty of engineering colleges	Kangwon University	117	1	128	0.8
	Kunsan University	115	1	116	0.9
	Pukyong University	278	2	280	0.7
	Sungkyunkwan University	133	1	134	0.8
	Yonsei University	215	8	223	3.6

Category		Male	Female	Total	Ratio of females (%)
Total		868	13	881	1.5
Undergraduate students of engineering colleges	Kangwon University	2,500	660	3,160	2.9
	Kunsan University	2,328	259	2,587	10
	Pukyong University	6,598	2,208	8,806	25
	Sungkyunkwan University	2,407	305	3,012	20
	Yonsei University	3,008	670	3,678	1.2
Total		16,841	4,402	21,243	20.7

Sources: Choi Sunja et al., (2009)

For a majority of government-funded programs, the financial support lasted only for one year, but this program was exceptional and the support period lasted for five years. The performance of the program was, naturally, evaluated on an annual basis. However, government support was neither suspended nor provided on a discriminated basis as a result of the evaluation. The reason was due to the recognition that the task of transforming engineering colleges in their education for female students was an effort that required both time and preparation.

Action programs, which were programs each university had to adopt to transform their engineering colleges, were not defined in advance. In other words, schools were obligated to 1) develop an engineering education system from a gender-sensitive perspective, 2) operate a program to enhance on-site adaptiveness, and 3) operate a program to promote industry-academia cooperation and employment, but details of the program were not provided. When the Ministry of Education and Human Resources Development and the Ministry of Commerce, Industry and Energy first adopted this program in 2006, their requirements for the program to the five universities were as shown in <Table Ⅲ-3>.

Universities had to develop the programs independently, among which the "development of an engineering education system from a gender-sensitive perspective" proved to be the most difficult. Not only were most of the engineering professors male, but the term "gender-sensitive perspective" was also quite new to them. The male engineering professors tried to understand the meaning of new terminologies such as "gender-sensitive", "gender-mainstreaming", "gender equality", "gender roles" and "gender stereotypes", for which they held seminars and small-group discussions. In addition to the above, each school was permitted to autonomously select programs, such as a program on career education and employment support (mentoring, etc), a program to cultivate basic vocational skills, a program to support employment in specialized professions (qualifications, etc) and a program to guide major-related clubs for female students.

〈Table Ⅲ-3〉 Description of program to support leading universities in engineering education for female undergraduate students

<Mandatory Programs>
① Restructuring to build a gender-sensitive engineering education system Restructuring the education system and operation by taking into account the cognitive characteristics and experience of female students in all sectors, including curriculum, instruction-learning method evaluation, and onsite practical training. ② Program to enhance on-site adaptiveness Operation of a program to enhance basic capabilities required by industrial companies in order to restore self-confidence in female students in their major ③ Program to promote industry-academia cooperation and employment Operation of an industry-academia collaboration program, on-site experience, career development (internship, corporate training, vocational experience etc) in cooperation with industrial companies to facilitate students' advancement into major-related fields
※ Conduct a survey of demands of students and related industrial companies for the entire course and program, reflect the results and include methods to cooperate with businesses ※ Improve experiment-practical training environment and increase related equipment to improve educational conditions ※ Programs for mixed gender and exclusively for female students may be operated in parallel

<Selective Programs>
Career education and employment support program (mentoring etc) Development and operation of a curriculum to enhance basic knowledge and vocational skills needed to undertake a job (legal, finance, leadership, problem-solving skills, creativity etc) Program to support specialized, professional employment (practical employment skills, such as qualifications) Guidance to major-related clubs for girl students Other - universities may develop programs autonomously

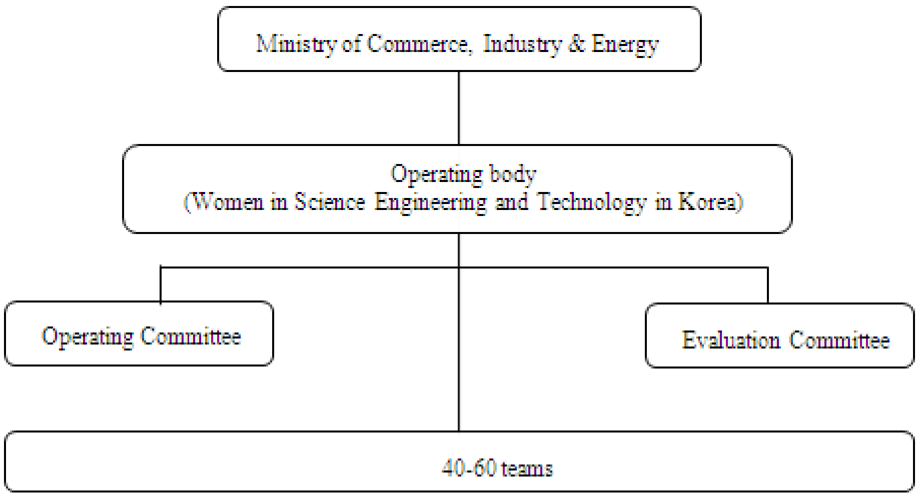
Sources: Plan to support leading universities in engineering education for female students. Ministry of Education and Human Resources Development & Ministry of Commerce, Industry and Energy (2006).

C. Implementation of the program to support female undergraduate-graduate student team-based research

At the initiation of the program, the Ministry of Commerce, Industry, and Energy set a goal to increase the proportion of women engineers participating in industrial technology development projects to 5% by 2008. In a bid to achieve this goal, the Ministry increased the ratio of women evaluation commissioners in the Evaluation Committee for Industrial Technology Development Projects, and, according to the nature of a task, granted additional points to tasks where women were in charge. In addition, it allocated 15% of the Project to Foster Regional Innovative Talents (30 billion Korean won) and Support for Workers at New Technology Small-and-Medium sized Enterprises (10 billion Korean won) to women project leaders. Together with such measures, it pursued the WATCH21 Program through the Women in Science Engineering and Technology in Korea in order to increase the number of female students advancing into majors and jobs in industrial technology fields.

The Women in Science Engineering and Technology in Korea was founded in 2004 with the purpose of facilitating the training and utilization of skills of women engineers, developing their careers and fostering leaders. In addition to

WATCH21 after 2004, the organization operated the Woman Engineer's Award, an internship academy for female college students, issued a book on successful women engineers at work titled *Women Engineers Who Change the World*, and a program for engineers to contribute specialized knowledge. Before the implementation system was integrated in 2011, the Women in Science Engineering and Technology in Korea provided support to 40-60 women student research teams every year. It also had an Operation Committee and Evaluation Committee related to this project.



[Figure Ⅲ-3] Implementation system for WATCH21

2. Post-integration Implementation

The above three programs to increase the number of female students advancing into science and technology fields were individually adopted in 2001, 2004 and 2006, respectively. Not only did the government ministry that supported each program vary (Ministry of Education and Human Resources Development, Ministry of Education and Human Resources Development-Ministry of Commerce, Industry and Energy, and Ministry of Commerce, Industry and Energy), but also the implementation system differed by program. At the time of inception, such different implementation systems seemed reasonable, but problems began to arise and accumulate with the development of various implementation systems targeting identical or similar groups. Above all, the mutual cooperation and role sharing of parties related to the operation of the program increased, but achieving sufficient cooperation was difficult since they each had to operate their programs according to their own implementation schedule.

〈Table Ⅲ-4〉 A comparison of the three major programs in the policy to increase the number of female students advancing into science and technology fields

Comparison criteria	WISE	WIE	WATCH21
Year of inception	2001	2006	2004
Supporting ministry	Ministry of Education and Human Resources Development	Ministry of Education and Human Resources Development - Ministry of Commerce, Industry and Energy	Ministry of Commerce, Industry and Energy
Operating body	Formerly known as Korean Research Foundation, and now known as National Research Foundation of Korea[9]	Formerly known as Korean Research Foundation, and now known as National Research Foundation of Korea	Women in Science Engineering and Technology in Korea
Target	14 WISE Centers	5 Universities	40-60 research teams
Beneficiaries	Primary-middle-high school girls[10] Female university students in science and engineering	Undergraduate female students in engineering colleges	Graduate female students in science and engineering, Undergraduate female students in science and engineering high school girl students

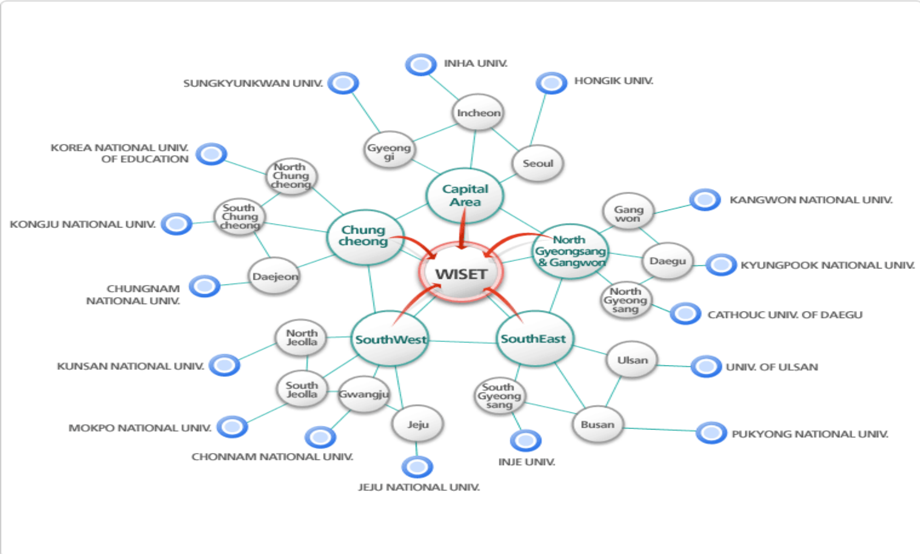
Size of budget provided	100-200 million KRW per center	200 million KRW per university	Approx. 5 million KRW per team

Note) The size of the budget provided differed slightly by year. The figures in the above table demonstrate only approximate sizes.

Accordingly, the varying implementation systems were integrated in 2011. In addition to the above programs, there was the Center to Support Women Scientists and Engineers, which supported women graduate students in science and technology and women scientists and engineers who completed their studies, but its implementation system was also integrated. Under the Park Geun-hye administration, all policies to increase the number of female students advancing into science and technology fields was placed under the authority of the Ministry of Science, ICT and Future Planning (MSIP). MSIP currently pursues three programs in this field through the Center for Women in Science, Engineering and Technology (WISET). WISET is entrusted with the regional program evaluation, which was originally under the Korea Research Foundation in the previous system. The program operators for WISE, WIE and WATCH21 in each university were transferred to the regional agencies under WISET. In the process, some changes were made to beneficiary universities. There were a total of 16 regional agencies in each of the metropolitan local autonomies, which were hosted by the universities located in each region.

9) Korea Research Foundation, which originally operated WISE and WIE programs, along with other two related institutes under the Ministry of Science and Technology was integrated into the National Research Foundation of Korea established in 2009.

10) Programs for primary school girls were operated during the early stages, but declined gradually. Currently there are no programs for primary school students.



Sources: WISET website (www.wiset.re.kr)

[Figure Ⅲ-4] Network for the policy to increase the number of female students advancing into science and technology fields

3. Establishment of Related Laws and Systems

The legal basis for the policy to increase the number of female students advancing into science and technology fields is the Act on Fostering and Supporting Women Scientists and Technicians enacted on December 18, 2002. The main outline related to the above policy is as follows:

First, the Government shall set forth the goals and directions for mid- and long-term policies to foster and support women in science and technology, and establish and promote five-year master plans for fostering and supporting women in science and technology according thereto (Article 4 of the above Act). The master plan must be incorporated with not only the policy to foster women scientists and engineers pursued by the Ministry of Science, ICT and Future Planning (MSIP), but also plans and policies set up the other cental administrative agencies and heads of metropolitan local autonomies.

Second, the heads of related central administrative agencies and Mayors/Do Governors shall establish and promote implementation plans by fiscal year in accordance with master plans (Article 5 of the above Act).

Third, the Minister of MSIP shall conduct an investigation of actual status each year, for the purpose of ascertaining the current status of practical use of the talents of women in science and technology and other results following the enforcement of this Act, publicize the outcomes therefrom, and file a report thereon with the National Science and Technology Council (Article 6 of the above Act).

Fourth, the State and local governments may induce schoolgirls in elementary or secondary schools and female students attending universities or colleges to enter the science and technology universities, and may develop and operate programs necessary to motivate them to enter the science and technology field, or support the institutions or organizations that operate the said programs (Article 7 of the above Act).

Fifth, in case the ratio of female students among those attending science and technology universities is very low, the State and local governments may encourage the science and technology universities to maintain the adequate ratio of female students who enter each year. The State and local governments shall devise and promote preferential policies in their assistance of research expenses for science and technology universities that maintain an adequate ratio of female students (Article 8 of the above Act).

Sixth, the State and local governments may select excellent students from female students attending science and technology universities and provide them with scholarships or research subsidies, or have them participate in the research and development projects implemented by the State or local governments (Article 9 of the above Act).

Seventh, the State and local governments may establish institutes for supporting women in science and technology in order to efficiently foster and support women in science and technology (Article 14 of the above Act).

The policy to increase female students entering science and technology fields is particularly based on Articles 7, 8 and 9 among the above provisions. In order to implement this policy, the State and local governments must establish five-year plans, and devise and implement annual implementation plans. Accordingly, the First Five-year Master Plan (2004-2008) and the Second Five-year Master Plan (2009-2013) were pursued, and currently, the Third Five-year Master Plan is in the process of being set up.

In regards to the establishment of the master plan, the MSIP first devises the draft plan after conducting basic research after which various opinions are gathered through a hearing. Additionally, by gathering opinions after reviewing the master plan from related government ministries and local governments, the role distribution and cooperation between central ministries and between central ministries and local governments are reviewed. The draft of the master plan is corrected through this opinion-gathering process and finalized after the deliberation by the National Science and Technology Council.

Ⅳ

Evaluation

1. Progress to Date

A. Proportion of female students in science and engineering universities

The policy to increase female students entering science and technology fields recommends the proportion of female students for each major in the science and engineering university to be over 30%, and in case of engineering majors with lower ratios, the goal is to reach 25% by 2013.

An examination of the proportion of female students in science and engineering universities showed that in case of natural sciences, the proportion of female students in bachelor, masters and doctoral degrees were over 30%, whereas the proportion of female students in engineering was less than 20% for all three degree-levels. The ratio of female students in the engineering sector increased mainly among masters and doctoral degree students, compared to those in bachelor programs. Therefore, the policy goal to raise the proportion of female students in engineering to 25% has yet to be achieved.

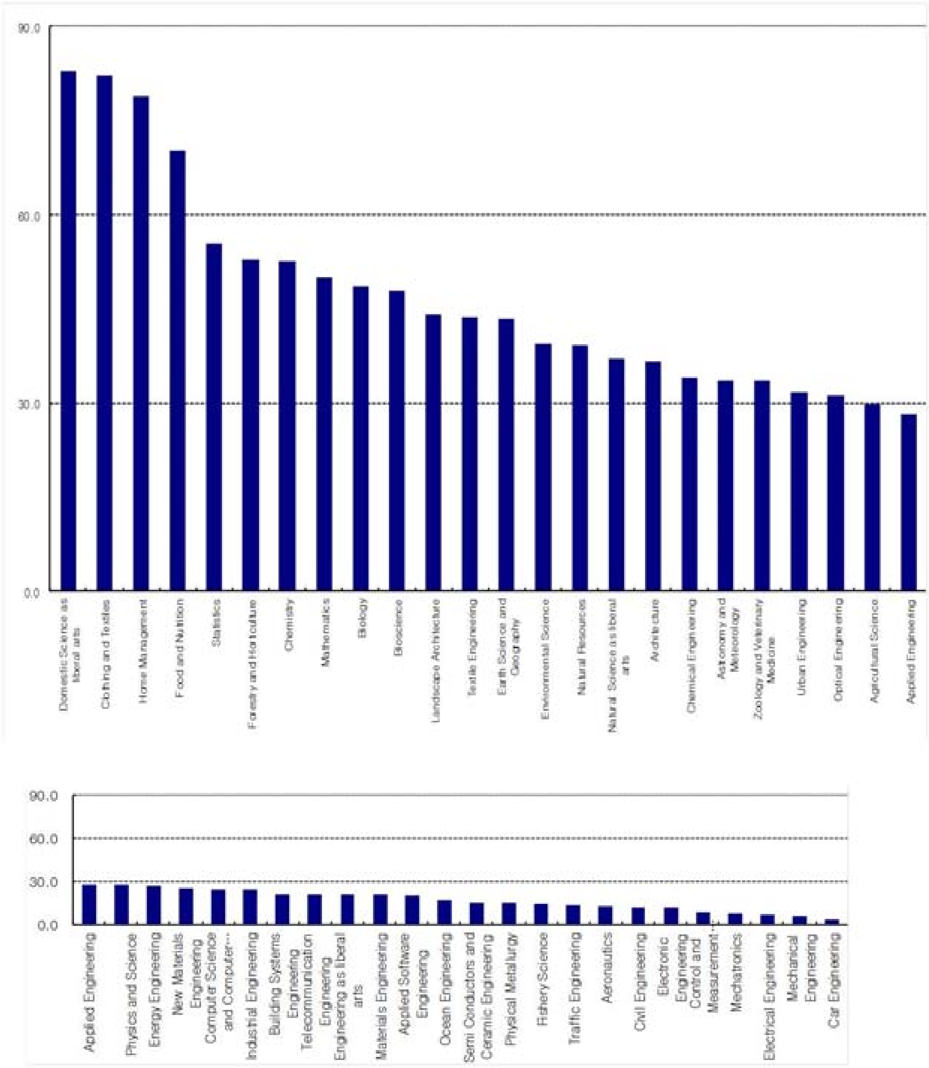
〈Table Ⅳ-1〉 Number and proportion of female students in bachelor, masters and doctoral degree programs in science and engineering

Unit: No. of persons, %

Year Fields/Gender		2000	2005	2010	2011	2012
Natural sciences	Total	183,303	177,177	180,489	183,718	188,092
	Female students	96,221	94,171	94,873	96,598	97,870
	Ratio of female students	52.5	53.2	52.6	52.6	52.0
Engineering	Total	353,444	362,411	362,357	372,478	378,454
	Female students	62,414	64,447	68,298	72,121	73,612
	Ratio of female students	17.7	17.7	18.8	19.4	19.5
Overall Science and Technology	Total	536,747	539,588	542,846	556,196	565,546
	Female students	158,634	158,618	163,171	168,719	171,482
	Ratio of female students	29.6	29.4	30.1	30.3	30.3

Sources: Korean Educational Development Institute Education Statistics Services DB.

The proportion of female students in 47 major sub-fields shows that about half of the fields have a female ratio of under 30%, most of which are in engineering sub-fields.



Sources: Research and Development Activities Report 2011 (KISTEP, 2011)

[Figure Ⅳ-1] Proportion of female students by major for bachelor programs in natural sciences and engineering fields in 2012

B. Proportion of female doctoral graduates

In devising the Second Master Plan on Training and Supporting Women Scientists and Engineers, the government set the goal of increasing the number of annual female doctoral graduates from 700 in 2007 to 1,000 in 2013. The number of graduates from domestic science and engineering universities who acquired a doctoral degree reached a total of 5,292 in 2012, among which women accounted for 1,127 graduates, exceeding the policy goal (1,000 persons). This is almost triple the number of women doctoral graduates (431 persons) in 2000.

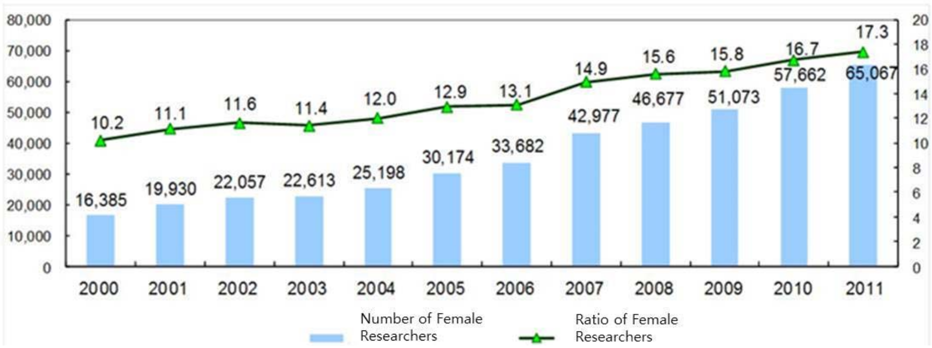
〈Table Ⅳ-2〉 Number and proportion of females with doctoral degrees in science and engineering from domestic universities

Unit: No. of persons, %

Year Fields/Gender		2000	2005	2010	2011	2012
Natural sciences	Total	1,157	1,531	1,830	2,157	2,242
	Female students	359	525	670	803	813
	Ratio of female students	31	34.3	36.6	37.2	36.3
Engineering	Total	1,531	2,138	2,308	2,935	3,050
	Female students	72	149	223	266	314
	Ratio of female students	4.7	7	9.7	9.1	10.3
Overall Science and Technology	Total	2,688	3,669	4,138	5,092	5,292
	Female students	431	674	893	1,069	1,127
	Ratio of female students	16	18.4	21.6	21	21.3

Sources: Korean Educational Development Institute Education Statistics Services DB.

For reference, the number of women researchers working in Korean universities and research institutes (including private company research institutes) stood at 65,067 persons as of 2011, representing 17.3% of the total number of researchers (310,109 persons). Given the higher proportion of women doctors compared to the proportion of women researchers, the latter is expected to rise at a steady pace.



[Figure Ⅳ-2] Number and proportion of women researchers working in research and development activities (2000-2011)

2. Implications

As a result of the policy to promote women to enter science and technology fields pursued by the Korean government for over the past decade or so, the legal and institutional bases and policy implementation system to foster and utilize the skills of women scientists and engineers have been established. It has also produced significant results by increasing the proportion of women researchers working in R&D activities from 10.2% to 17.3%.

However, the results of this policy cannot be deemed to have reached a satisfactory level. The proportion of general high school girl students selecting natural sciences was 33.5% in 2000, but fell to 25.8% in 2012, and although the proportion of female students in science and engineering colleges has increased in masters and doctoral programs, the low percentage of women actually entering engineering fields has not improved significantly.

Remaining problems signify that efforts to set detailed policy goals and efficiently pursue programs to achieve such goals were insufficient. For instance, there are certain science and technology fields where the number of women is particularly lacking (mainly engineering), whereas in some fields, women already dominate a greater majority (mainly natural sciences). This is the reason why policy objectives and targets must be diversified according to different science and technology fields. For example, for engineering fields where there is a lack of women, greater efforts are required to try and induce more talented girls to enter this field from middle-high school levels. On the other hand, for natural science fields where women already represent a majority, policies to support such female university students to enter society successfully are needed rather than a policy to increase the number of more girls entering the field.

The weight of the current policy, however, is placed on the contrary to this. In other words, most of the programs provided to middle and high school girls only aim to stimulate interest in overall science and technology fields, but policies to inspire interest in engineering, in particular, or attract talented girl students to engineering fields are direly needed. On the other hand, the support provided on a university level focuses on women engineering undergraduates, who are few, but little support is provided to natural sciences fields where there is a large number of female students. As a consequence, universities that are placed in charge of implementing the program often discover that there are only a small number of female students in engineering colleges to whom they can actually provide services, whereas they cannot provide services actively to female students in natural sciences colleges where there is a high demand.

In order to prevent such problems, an accurate investigation of the current status and analysis of problems should be undertaken and an adequate strategy to achieve policy goals must be established at time of policy adoption. The policy to promote women to enter science and technology fields in Korea began with the WISE program in 2001, but according to an analysis on the adoption process of this policy (Central Officials Training Institute, 2006, p. 71), investigations on the current status and problems of women scientists and engineers that should have been conducted prior to establishing the WISE policy were actually carried out four years after the introduction of the WISE program.

Reference

Ministry of Education (2001), *Master Plan for National Human Resources Development: People, Knowledge and Advancement*

Ministry of Education (2004), *First Master Plan on Training and Supporting Women Scientists and Engineers*

Ministry of Education & Ministry of Commerce, Industry and Energy (2006), *Plan to Support Leading Universities in Engineering Education for Female Students*, Korea Development Institute (KDI)

Ministry of Education (2008), *Second Master Plan on Training and Supporting Women Scientists and Engineers*

Korea Institute of Science & Technology Evaluation and Planning (KISTEP) (2011), *Research and Development Activities Report 2011*, Ministry of Education

Kim Young-ok (1996), *Ways to Foster and Utilize Skills of Women Scientists and Engineers in a Knowledge-based Economy*, Korean Women's Development Institute

Kim Jeong-ja et al. (1998), *Policy Tasks for the Development of Women Scientists and Engineers: Based on the Educational Experience of Female University Students of Science and Engineering Colleges*, Korea Science and Engineering Foundation

Roh Junghye et al. (2000), *A Study on Designing New Programs to Invigorate Utilization of Women Scientists' Human Resource*, Korea Science and Engineering Foundation

Jung Kwanghwa et al. (2003), *Establishing Strategies to Strengthen Substantiality of Systems for Nurturing and Utilization of Women Scientific Technicians*, Korea Science and Engineering Foundation

Central Officials Training Institute (2006), *Policy Cases for the Fostering and Supporting of Women Scientists and Engineers: With a Focus on the WISE Program*, Department on the Development of Policy Cases, Central Officials Training Institute

Choi Soonja et al (2009), *A Study on Performance Analysis and Ways for Expansion of Programs to Support Engineering Education in Female Students*, Korea Research Foundation

Center for Women in Science, Engineering and Technology (WISET) Regional Agency of DGG (2012), *Teaching Plan for the Outreach Laboratory Program* (middle school)

Center for Women in Science, Engineering and Technology (WISET) Regional Agency of Chungbuk (2012), *2012 Business Report*

Center for Women in Science, Engineering and Technology (WISET) Regional Agency for Dongnam (2013), *Gender-sensitive Instruction and Learning Techniques*