
AC 2011-610: INCREASING THE NUMBER OF WOMEN IN ENGINEERING AT UNIVERSITIES AND COLLEGES IN JAPAN

Emiko Hirose Horton, Shibaura Institute of Technology

Emiko Hirose Horton has been teaching English over 20 years in universities in America and Japan. She is currently teaching at a university of engineering. She is a member of the Dean's office and is working on various administrative issues as well as teaching general and technical English courses.

Kumiko Miki, Nihon University

Kumiko Miki has been teaching chemistry over 20 years at university of engineering in Japan. She is a member of JSEE and core member of group for women's engineer of that.

Increasing the number of women in engineering at universities and colleges in Japan

Abstract

This paper reports on the results of a survey into the number of female engineering students, professors, and professional workers in Japan. The survey reveals that the relative proportion of females in the engineering field is remarkably low. Recent efforts to improve the situation are reviewed, but such attempts appear to be dismayingly half-hearted, and it is as of yet impossible to judge if these solutions will actually have any significant effect on increasing the number of women in the engineering field in Japan.

Introduction

The Japanese Society for Engineering Education (JSEE) is an organization with a membership of 216 educational institutions (universities and colleges) and 98 leading corporations and has been contributing to the improvement of engineering education since 1952. In the period from April to June, 2010, a working group from the JSEE, comprised of a group of female teachers from member universities and colleges and female engineers from member corporations, conducted a survey on the present conditions of women in engineering in Japan. The questionnaire in both hardcopy and on web were sent to 216 member academic institutions and 98 corporations, and responses were received from 103 institutions (48%) and 14 corporations (14%). The questions were related to basic information such as the ratio of male and female students, faculty members, or workers. As for the academic institutions, 24 questions were asked including the questions regarding the plans to increase the number of female students and the support for female faculty members. On the other hand, 31 questions were asked of the member corporations related to their efforts to improve the working environment for female workers as well as some basic questions such as the ratio of female workers, and present conditions regarding maternity/nursing leave.

Ratio of female engineers

The number of responses (=14 of 98) received from the member corporations was small and not really an adequate number to investigate the present conditions of women in working places in Japan. However, among those corporations that answered the survey, the ratio of female engineers was only 1.3%.

Ratio of female students

The ratio of female students in engineering fields among the member institutions was 11.6% in universities and 16.5% in colleges of technology. According to the 2010 Basic

School Survey of MEXT (= Ministry of Education, Culture, Sports, Science & Technology), the ratio of female students in educational institutions as a whole is 41.1%, an increase of 0.4% from the previous year (Fig. 1). The number of female students has been increasing steadily. However, the ratio of female students in engineering is still very low. The average ratio of female students among JSEE member institutions is 14% (11.6% in universities and 16.5% in colleges of technology). Compared to the MEXT Basic School Survey in 2005, the female ratio has increased merely 0.9%.

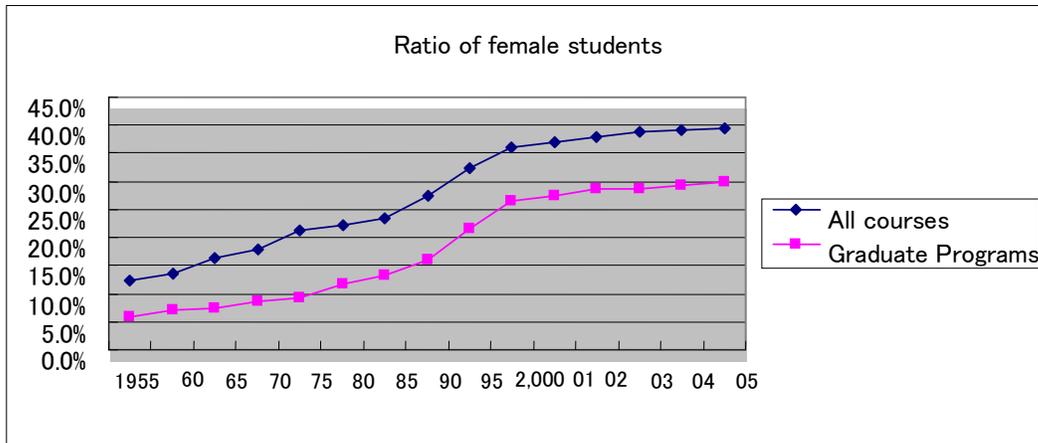


Fig. 1 Ratio of female students in educational institutions
(Based on the data from MEXT Basic School Survey)

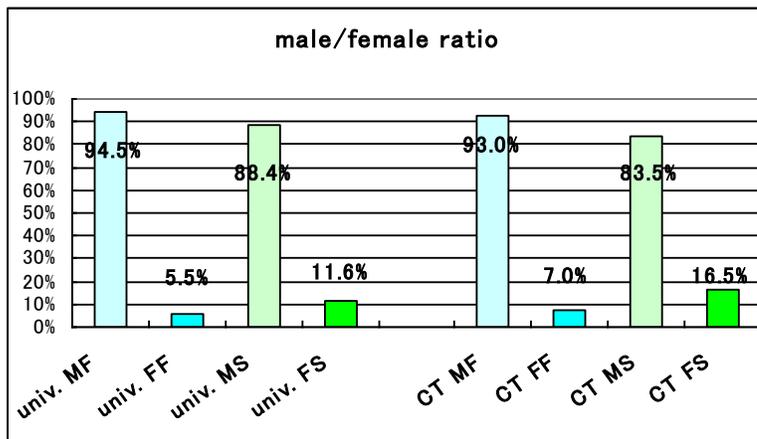


Fig. 2 Ratio of male/female faculty and students in engineering programs
(Data from 2010 JSEE survey)
Note: MF=male faculty, FF=female faculty, MS=male students, FS= female students, Univ.=universities, CT= colleges of technology

Since 2006, MEXT has been granting funds to institutions of higher education in science and technology (S&T) for their plans to promote the interests of science and technology (S&T) among female junior and senior high school students. MEXT states that the ratio of female researchers in Japan is very low compared to Western countries, and feels that

it is necessary to increase the number of female students in S&T. It is said that the information about the jobs in S&T fields are not well-provided, and it is difficult for youth to imagine future paths in the science and technology areas, particularly for females when choosing the higher education (MEXT 2008). 11 proposals (probably out of 11, although this is not stated in the data) were granted in 2006, 9 out of 27 in 2007, and 11 out of 29 in 2008.

Plans to increase the number of female students

93% of the responding universities and 95% of colleges of technology answered that increasing the number of female students is an important issue (Fig. 3). However, only a little over 50% of the universities are actually doing something about it while 73.2% of colleges of technology are implementing some strategies (Fig. 4). Despite the fact that most of the institutions said it was important to increase the number of female students, there seem to be gaps between the ideals and actual implementation. Kaminaga (2008) points out the institutions are still aiming their main recruiting efforts towards male students and not enough effort is being made towards female students. He says that this is the result of the business mind cutting off the “female” issue just like cutting off an unprofitable division in a corporation.

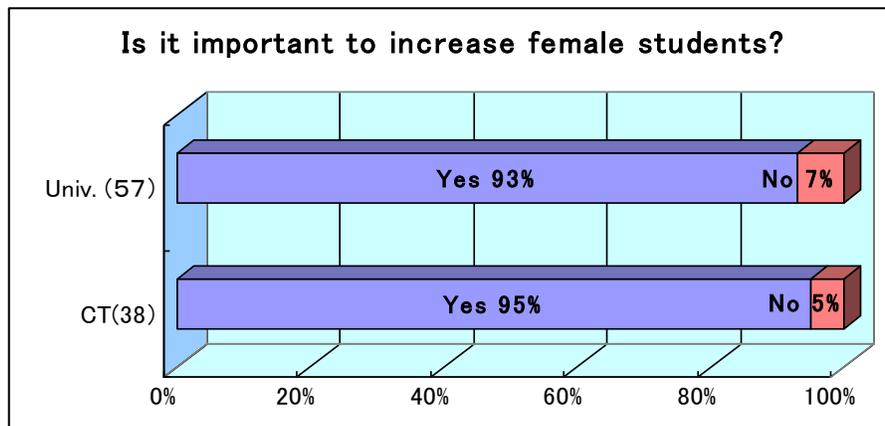


Fig. 3 Importance of increasing female students
(Data from 2010 JSEE survey)

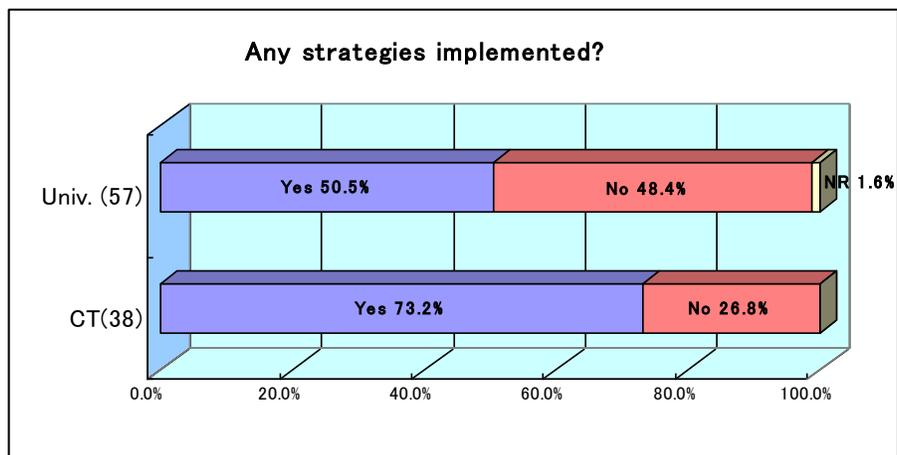


Fig. 4 Any implemented strategies to increase female?
(Data from 2010 JSEE survey)

Among the institutions which are making some efforts to attract female students, the most common strategy is some sort of publicity such as distributing school brochures or booklets targeting female high school students (32 institutions). The next common activity is holding of lectures or experiment sessions particularly trying to appeal to female high school students (20 institutions), followed by improvement of facilities for female students (18 institutions). Many universities and colleges are making as many different efforts as they can think of. Some of the examples are as follow.

Examples of strategies implemented:

- Some sort of publicity
 - School pamphlets / web site targeting female students
 - Explanatory meeting for female students exclusively
 - Girls corner at Open campus
 - Tour of labs of female faculty
 - TV / newspaper commercials
- Seminar / Lecture
 - Science lab at girls school
 - Science summer camp for girls
 - Lecture by female researchers/graduate students
- New system
 - Special admission by recommendation
 - Setting up of new more appealing departments (e.g. “Design ···”)
 - Special scholarships
 - Change of department name
 - Career designing project for female students

- Facility improvement
 - Renovation of cafeteria / dormitory / toilet
 - Building girls' dormitory
 - Girls' parlor/lounge
- Others
 - Hiring of female faculty (e.g. "At-least-one-female-faculty per department")

Most institutions in our survey have started to implement some strategies to increase female students in the last few years, but there were no answers indicating how much of an increase. One of the universities has been implementing multiple strategies since 5 years ago: leaflets with female engineer role models, delivery of lectures at high schools, explanatory meetings about the university, and so on, and the increase of females is said to be up 0.6% in 3 years (10.9% in 2007 to 11.5% in 2010).

What is the percentage of female students are these institutions aiming for? Only 13 member universities and 14 colleges responded to the question, and the average answer was 23%. It seems likely that most institutions have only vague ideas about a target ratio of female students. In a world survey, the average ratio of female students was 23%. According to a UNESCO report, in 1994 the number of female students in engineering, the ratios of female students were 14% in US (1990), 15% in UK (1991), 20% in France (1991), and 9% in Germany (1989). Although the data is a little dated, the number of female students in engineering in Japan is not yet reaching the figures of two decades ago in Western countries. Considering the fact that the number of female students in engineering fields has increased by 1.6% in the last five years (10.7% in 2005 MEXT Basic School Survey and 11.6% in 2010 JSEE survey), the goal of 23% will not be reached easily without making greater effort at recruiting females.

In our survey, colleges of technology (= 73.2%) displayed more enthusiasm toward increasing the number of female students compared to the universities (= 50.5%) (Fig. 4), while only 12% of colleges of technology indicated having designated section for female support / gender equality (Fig. 5). Colleges of technology are organized and managed under the Institute of National College of Technology, Japan, and are probably more influenced by the policies made by the organization. The Institute of National Colleges of Technology released a year plan including the issuing of school brochures targeting female junior high school students about female graduates who are front runners in industries, and are hiring female teachers more aggressively (the Institute of National College of Technology, 2010), and this pressure seems to be working in most colleges of technology. On the other hand, there are big differences among universities; some universities have been making great effort by implementing various strategies to increase the number of female students, while very little

or no effort is being made by many others.

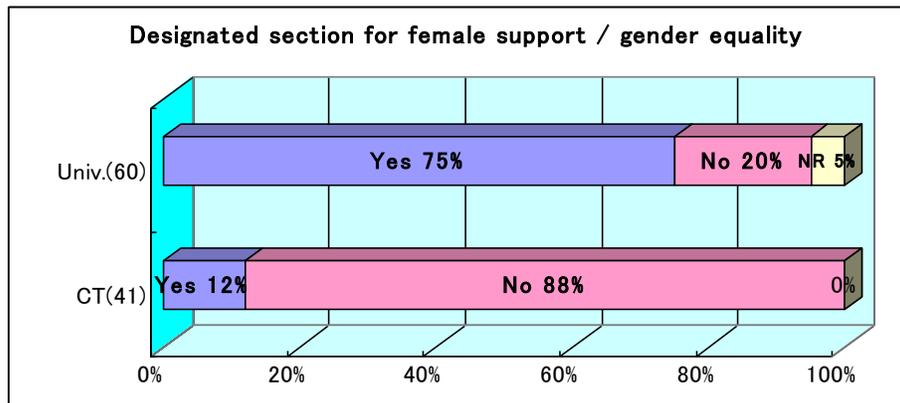


Fig. 5: Designated section for female support / gender equality
(Data from 2010 JSEE survey)

Female teachers and the working conditions

In our survey, 86% of the member institutions (82.2% of universities, 92.7% of colleges of technology) answered “yes” to the question of whether they think it is important to increase the number of female teachers in order to increase the number of female students. As for the question about the achieving a target percentage of female teachers, only 11 universities and 9 colleges of technology indicated 13% and 15% of the total faculty, respectively. However, the present figures for female faculty members are only 5.5% and 7%, respectively (Fig. 6).

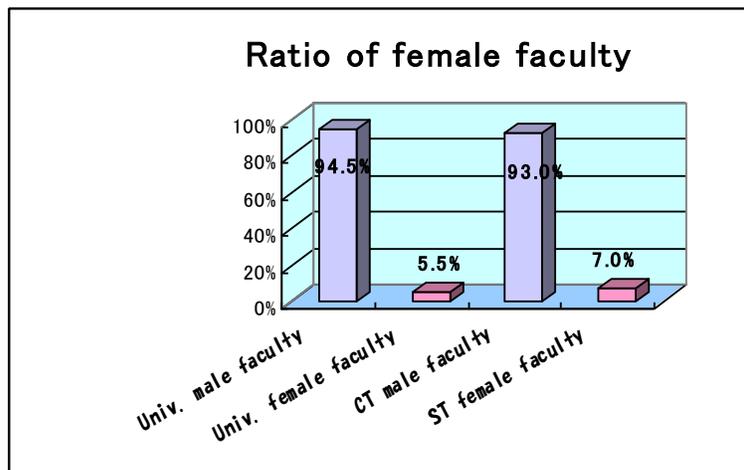


Fig. 6: Ratio of female faculty
(Date from 2010 JSEE survey)

The number of female teachers shows a drastic difference depending on the educational level. Nearly 2 out of 3 elementary school teachers are female (65.1%), while only 1 out of 10 are female professors at universities (9.7%) in all department taken as a whole, and only 1 out of

50 (university) and 3 or 4 out of 50 (in colleges of technology) at the JSEE member institutions.

Bearing and caring for children and caring for the elderly are the common obstacles for women to continue their careers. 71.4% of the member institutes have the institutionalized rules to support women in these situations, 21.4% leave decisions to the section the woman works at, and 7.1% have no special policies or rules. As for the question about whether there is any plan to help women take maternity leave easily, 40% of the institutions answered “none.” Even the institutions with some policy, only mentioned “providing information about the rules,” “providing substitutes while on leave,” or some related cases. The academic institutions seem way behind the corporations in terms of the consciousness for the support of female workers.

While most academic institutions responding to the survey answered that there is no difference in the possibilities for the promotions (94.3% universities, 97.6% colleges of technology), the higher the position, the lower the ratio of females is (Fig. 7). There were some institutions which acknowledged the difficulties for women to be promoted in engineering education. Although the answers are vague, they include “difficulties building up research achievement in some engineering areas,” “While the recruitment is done fairly, there are simply too few female candidates in the engineering fields,” and women’s “lack of experience and engineering knowledge.”

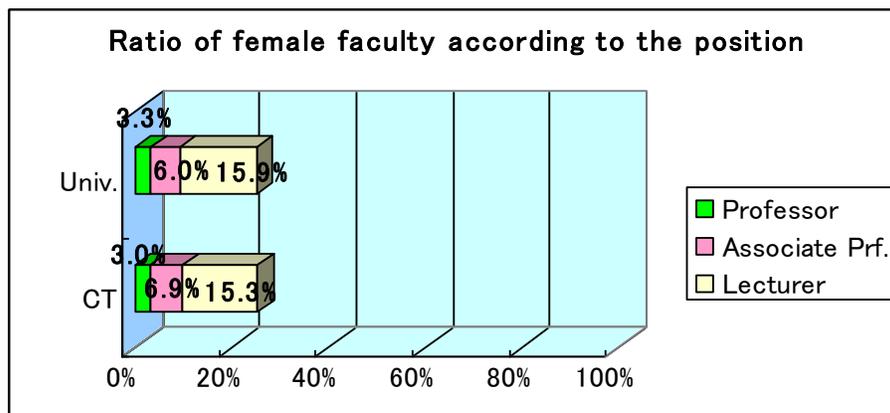


Fig. 7: Ratio of female faculty according to the position (Data from 2010 JSEE survey)

The figures are similar at corporations. At private enterprises in 2008 only 3% are female at the general manager level, 4.6% at the section manager level, and 7.7% at the assistant manager level (Ministry of Health, Labour, and Welfare, 2008). While more women are pursuing their careers in Japan, the structure seems to remain male dominated at

working places.

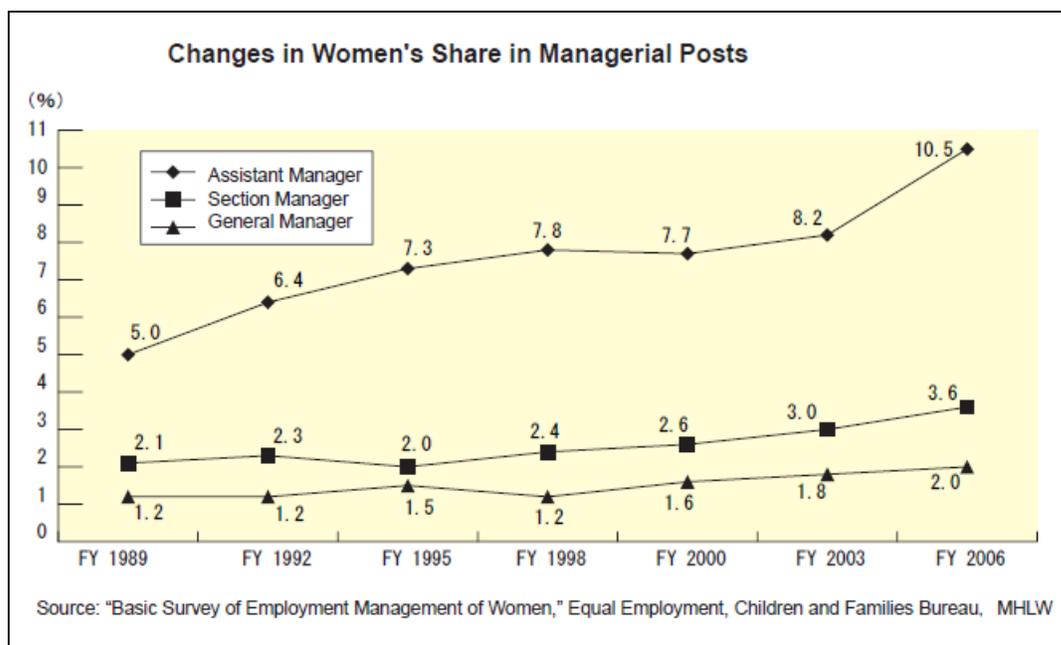


Fig. 7: Female ratio in managerial posts
(Data from "Survey on Wage Structure," Ministry of Health, Labour and Welfare)

The number of candidates trying to enter science and engineering fields has been decreasing since 1992 (Fig. 8). In 1992 there were 620,000 applicants for entrance to universities in engineering, this number had decreased about 60% to 270,000 applicants in 2007. It is said that the digital technology industry in Japan is already short almost half a million engineers (The New York Times, 2008). The reason for such decline are complex: young people in Japan are too contented and have little interests in hard work, the life-time income for engineers is lower than that of other fields such as business, the job market in engineering fields is not good, along with other negative factors for engineers. However, Katsunosuke Maeda, the honorary president of Toray, says that the crisis of S&T education is due to the lack of emphasis on basic science at schools. He says that it is necessary to increase the hours of S&T courses in primary and secondary schools.

According to the MEXT Gender Equality White Paper, the interests in both science and math among the 5th graders and the 8th graders decreases greatly regardless of sex (Fig. 8 and 9). This change suggests that something has to be done to keep the students interested in science and math. At the same time, good role models should be publicized more in those fields, particularly for female students from early ages.

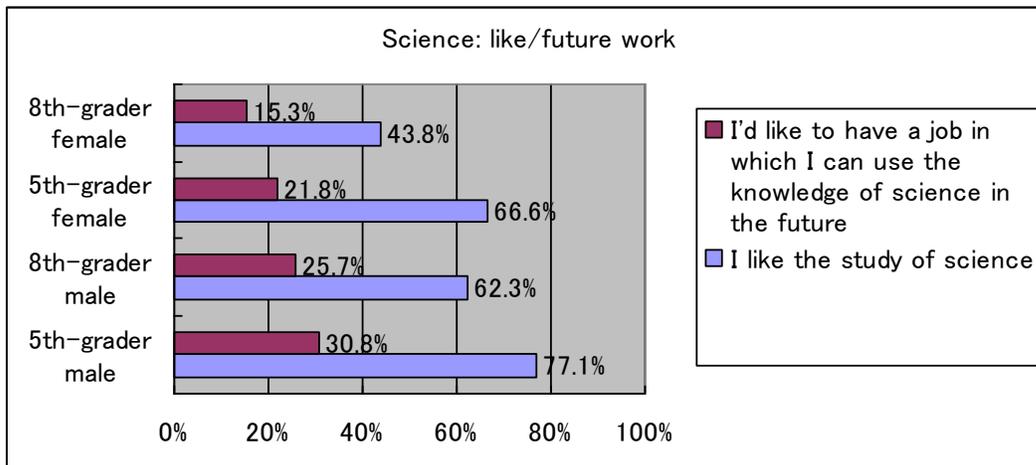


Fig. 8 (Data from MEXT Gender Equality White Paper, 2005, “Survey on ideas towards science and math among elementary and junior high school students”)

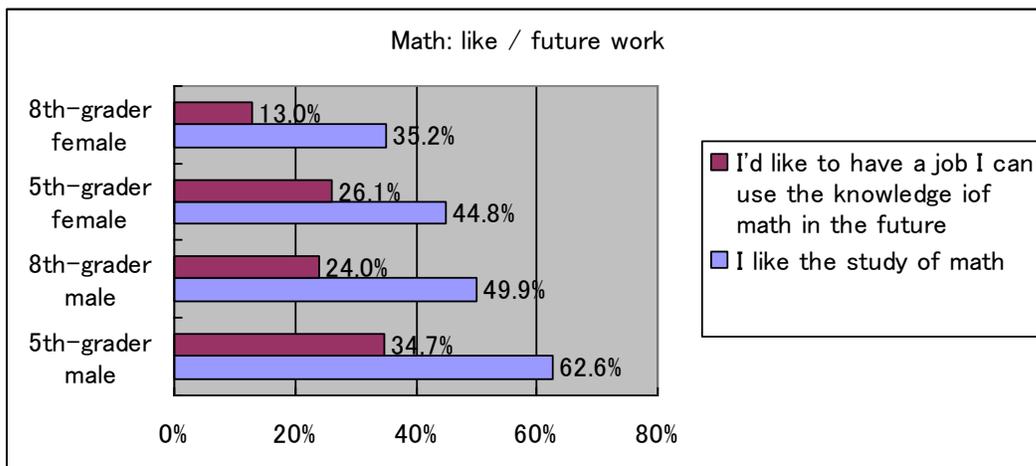


Fig. 9 (Data from MEXT Gender Equality White Paper, 2005, “Survey on ideas towards science and math among elementary and junior high school students”)

Conclusion

Increasing the number of female students in engineering fields is a difficult problem in Japan as well as in the US and other countries. Japan will face a serious labor shortage within 25 years due to the decline in the birth rate and the massive retirement of the baby-boomer generation. The overall number of women working in Japan has been rising, but the number of women in engineering is not increasing at the same pace. The number of female engineering students has also been increasing in Japan, but it is still a minuscule amount and insufficient to increase in the number of female engineers.

The fact that the population of female students in engineering fields remains so low involves various issues such as problems in math and science in the early stages of education,

negative influence or lack of influence by parents, no clear career images of woman engineers, a lack of a career-oriented mentality among young women, and lack of support in work places. Other major factors which limit the number of female students, faculty and workers are child-bearing and caring for the elderly, as mentioned above. There are no quick answers to solve these problems. Specific efforts to improve the situation, such as those of the Gender Equality Bureau Cabinet Office web site, have only been made in the last few years, and it is too early to determine whether these efforts will have real effects.

Bibliography

1. Fackler, M.(2008), High-Tech Japan Running Out of Engineers. *The New York Times, World Business*, May 17, 2008. Available at:
<http://www.nytimes.com/2008/05/17/business/worldbusiness/17engineers.html> (last accessed December 2010).
2. Gender Equality Bureau Cabinet Office. Challenge Campaign.
<http://www.gender.go.jp/c-challenge/index.html> (last accessed March 2011).
3. Ichikawa, S.(2002). *Gakuryoku-teika ronso*, Dispute on decreasing scholarship (The English title is translated by the author of this paper), Tokyo: Chikuma Shobo.
4. The Institute of Colleges of Technology. Dokuritsuhojin Kokutritsu Kotosenmongakko-kiko no Nendokeikaku Heisei 22-nendo, An independent administrative institution, 2010 Annual Plan of The Institute of Colleges of Technology, [The English title is translated by the author of this paper]. Available at:
http://www.ibaraki-ct.ac.jp/upload/files/dokuho_pdf/re_nendokeikaku22.pdf (last accessed December 2010).
5. Kaminaga, M. (2008). *Gakuryoku-teika wa sakkaku de aru* , An illusion of the decline in academic performance, [The English title is translated by the author of this paper]. Tokyo: Morikita-shuppan.
6. Maeda, K.(2008). *Kougakubu wo kaitai seyo – saraba kougakubu*, Demolish Engineering Department – Farewell Engineering, [The English title is translated by the author of this paper]. Nikkei Business Report, 8/18/2008. Available at:
<http://business.nikkeibp.co.jp/article/manage/20080811/167777/> (last accessed December

- 2010).
7. Ministry of Education, Culture, Sports, Science and Technology (MEXT), 2005, I-2-4 Percentage Distribution of University Students by Major Field of Study. Available at <http://www.mext.go.jp/english/statist/07070310/005.pdf>. (last accessed Jan. 2011).
 8. Ministry of Education, Culture, Sports, Science and Technology (MEXT) statistics. 2006. College of technology. Available at: <http://www.mext.go.jp/english/statist/06060808/pdf/072.pdf> (last accessed December 2010).
 9. Ministry of Education, Culture, Sports, Science and Technology (MEXT) , 2008 Selected projects for promoting female junior and senior high school students for S&T (The English title is translated by the author of this paper), Available at: http://www.mext.go.jp/b_menu/houdou/20/05/08052617.htm (last accessed January 2011).
 10. UNESCO Institute for Statistics. 2010. Women in Science. Available at: http://www.uis.unesco.org/template/pdf/S&T/FactSheet_2010_ST_No6_EN.pdf (last accessed December 2010).