

PERCEPTIONS OF ACADEMICS ON WOMEN IN ENGINEERING EDUCATION AND WORK PLACE

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Abstract

The under-representation of women in engineering has been observed at the faculty of engineering in a private university in Malaysia. The number of women academics in the faculty does not show any significant variation over the past thirteen years while the enrolment of female students has shown a decreasing trend. Currently, 35% of academics in the faculty are female and only 8% of the total students studying in engineering programs are female. The aim of this study is to explore the perceptions of academics on women in engineering education and engineering workplace. Based on the survey conducted at the faculty, all academics perceive that female students are as good as, if not better than, those of their male peers in academic preparation and study habits. About 70% of academics of both genders feel that female and male students are equally favourable in engineering programmes at the faculty. About half of academics believe that men receive more favour than women in the engineering workplace. However, female academics responded that there is no discrimination between male and female academics regarding salary, workload and career advancement at the faculty. A majority of academics feel that a special effort should be made to recruit female students in engineering programmes and about half of the respondents agree that the university should have special programmes to address female students' needs. The results from this study can be used in finding the ways to attract a larger number of women in engineering in the future.

Keywords - perceptions of academics, women in engineering education, engineering workplace.

Introduction

The under-representation of women in engineering has been observed not only at the faculty of engineering in a private university in Malaysia but also in other universities around the world. There are so few women engineers at the work force compared to other professions like medicine, law and business. Bureau of Labor Statistics, United States Department of Labor (2012) reported that female architects and engineers represent 13.6% of work force while female lawyers are 31.9% in 2011. It is important to find out the reasons why women do not choose engineering as a profession. Nguyen (2000) gave her opinion that capability and aptitudes are not important issues because women engineers have demonstrated that they are just as capable as their male counterparts. However, as the statistics confirm, engineering is predominantly a male occupation, and women, who are in the minority, will always have difficulties fitting into the male-dominated and oriented structure.

The enrolment of female engineering students in Canada is about 2.5% in 2008-2009 while there is about 10% in health professions (Research Council of Canada, 2010). Society of Women Engineers (SWE) (2006) reported that the enrolment of female engineering students in US is 20% in 2004. Since gender imbalance in engineering exists around the world, special efforts are being made by institutions, governments and professional organizations to promote women engineers, recruit and retain female engineering students. Societies such as Society of Women Engineers (SWE), IEEE Women in Engineering (WIE), Women in Science and Engineering (WISE) and the Institution of Engineer, Malaysia, Women Engineers (IEMWE) have been established to support women in engineering.

The American Association of University Women (AAUW) (2010) has identified three areas to look into: cultivating girls' achievements, interest, and persistence in science and engineering, creating college environments that support women in science and engineering, and counteracting bias.

The aim of this study is to explore the perceptions of academics on women in engineering education and engineering workplace. This study analyzes the trend in women participation (female academic staff and female students) at the faculty of engineering in a private university in Malaysia. This study also involves the perception of academics (both male and female) on women in engineering education and engineering workplace. Moreover, female academics are asked to express their experiences regarding relationship with male colleagues, faculty and the perception on salary and workload compared to their peer male colleagues in the faculty.

Methodology

This study consists of three parts: analysis of gender balance of academics and students in the faculty; perceptions of female and male academics regarding women in engineering education and engineering work place; and perception of female academics at their workplace over their male counterparts in the faculty. The statistics, academic qualification and positions of female academics in the faculty are collected for the period of December 1999 to January 2013 semester and the enrolment of female students in different engineering disciplines from the period of December 2004 to January 2013 are also taken for analysis.

In this study, two questionnaires are used as instruments. The first questionnaire is designed to analyze the perceptions of male and female academics on women in engineering education and engineering workplace. It consists of 5 questions and takes about 5-10 minutes to complete. The second questionnaire is designed for female academics only. It also consists of 5 questions. It is designed to explore the perception of female academics over their male counterparts in the faculty. Questions are extracted from the report written by Goodman et al. (2002) and Alvarez and Blazquez (2007) and modified appropriately for this study. Although 7-point scales are used to measure the perception of academics in the questionnaires, the analysis of the responses is carried out by taking percentage for agree (combining strongly agree, moderately agree and slightly agree), neither agree nor disagree and disagree (combining strongly disagree, moderately disagree and slightly disagree).

Results

Women academics in engineering

The involvement of women academics in the faculty is shown in Fig. 1. It does not show any significant variation over thirteen years. The percentage of women academics in the faculty is currently around 35% which is comparable to some universities in Malaysia. Azizan (2009) mentioned that the ratio of women to men faculty members at Universiti Teknologi Petronas is approximately 1:4.

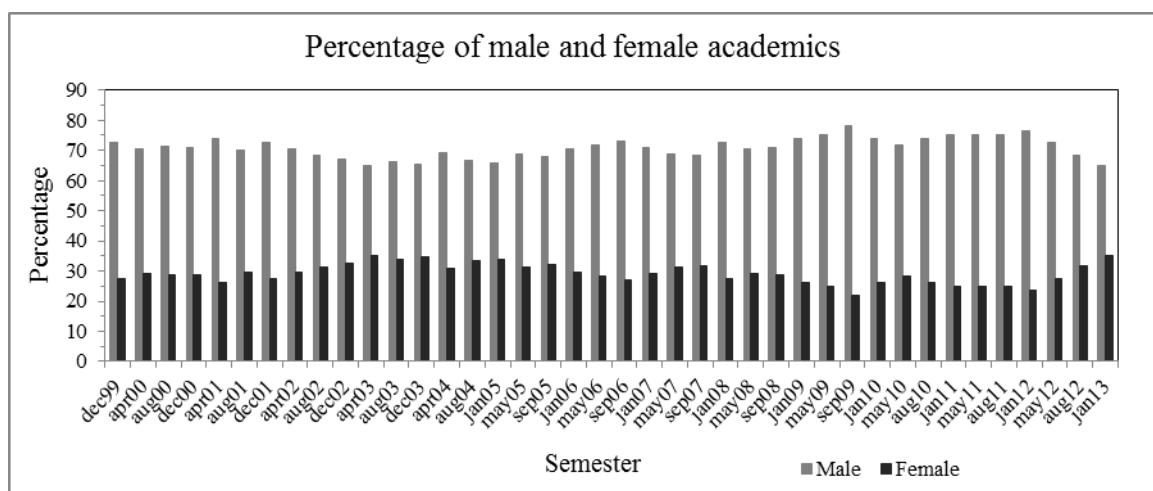


Figure 1. Percentage of male and female academics in engineering faculty

The significant variation of female academics in Civil (CE), Mechanical (ME) and Electrical and Electronics (EE) engineering disciplines can be seen in Figs. 2(a) and 2(b). From the figures shown, the involvement of female lecturers is the highest in EE in every semester. Gender balance is achieved in EE engineering discipline in January 2005 semester and then slowly declined to 38% at present. It is observed that the number of female academics in ME has been increased from 7% to 35% since 2012.

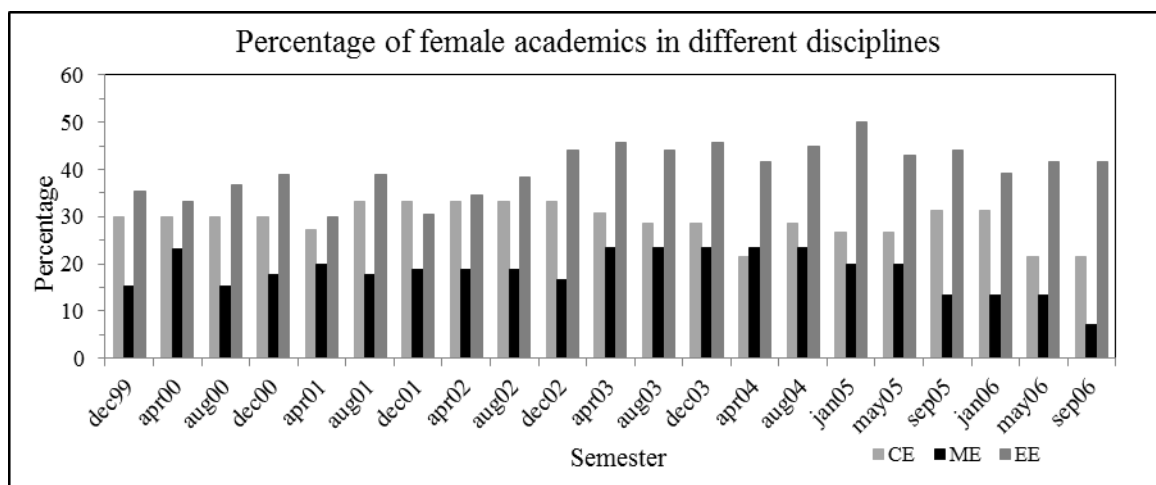


Figure 2(a). Percentage of female academics in different disciplines

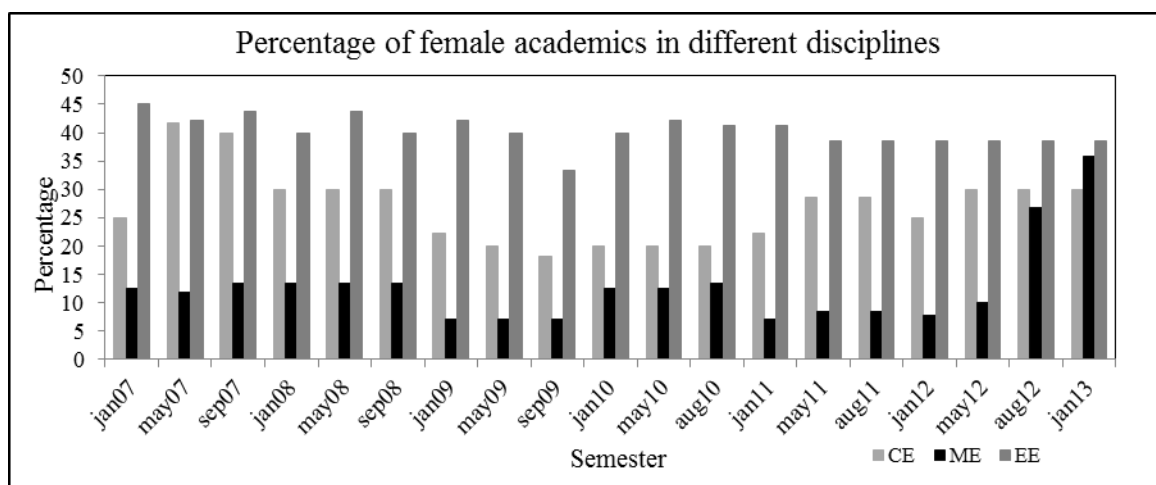


Figure 2(b). Percentage of female academics in different disciplines

Fig. 3 shows gender distribution across academic qualification and various levels of seniority from lecturer to full professor. The data in Fig. 3 shows that there are significant gender imbalances at all levels (except in associate professor level) especially in professor level. Kennedy (2005) pointed out that there is significant gender imbalance at all levels of the career ladder in Dublin City University. The gender imbalance worsens as progress is made along the career ladder to positions of greater power and decision-making.

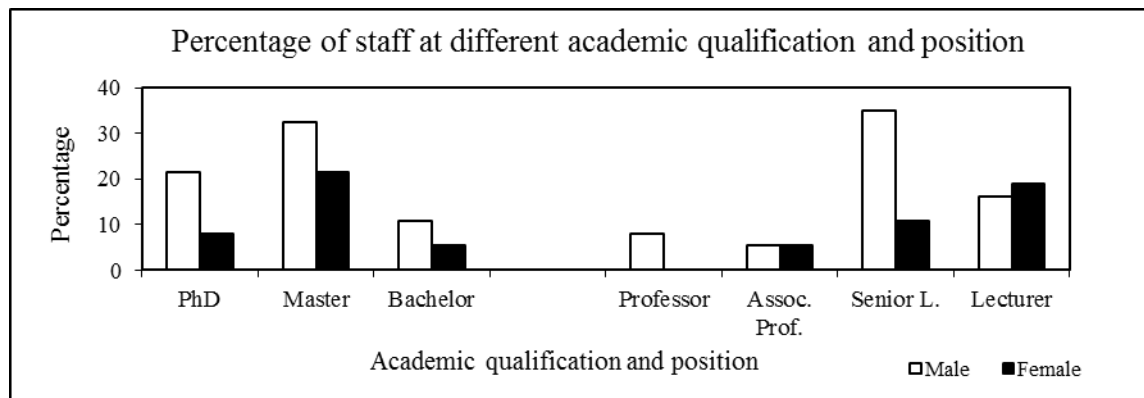


Figure 3. Percentage of staff at different academic qualification and position in the faculty

Enrolment of female students in engineering

Enrolment of female students in degree and diploma in engineering programmes offered in the faculty is shown in Fig. 4. It can be seen that the enrolment of female students in degree programme is higher than that in diploma programmes. However, the percentage of female students declined from 15% to 9% in degree programmes and from 12% to 6% in diploma programmes. Currently the overall enrolment of female students in the faculty is about 8%. This shows the declined trend of female enrolment in the faculty since 2009.

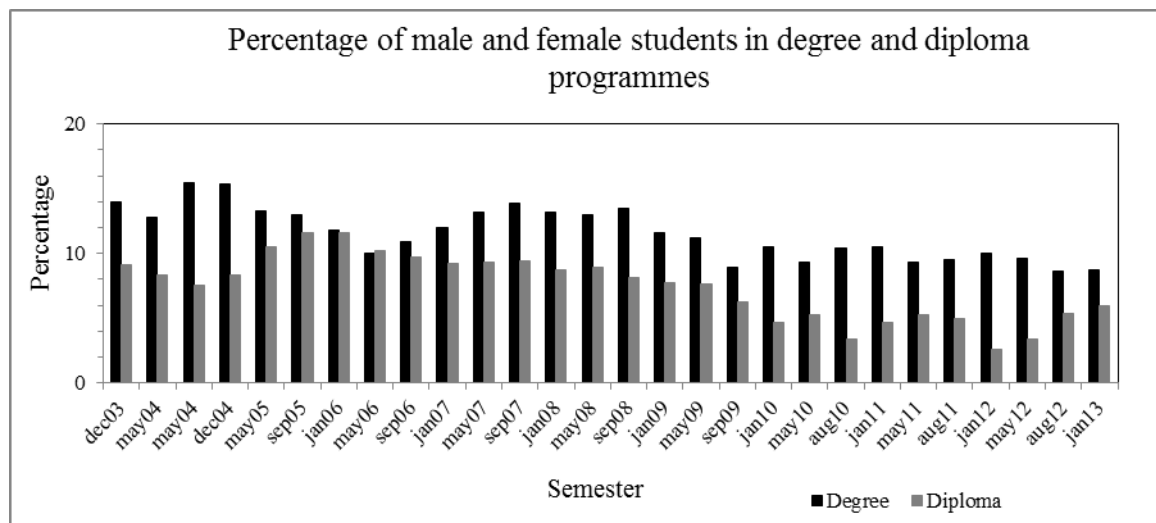


Figure 4. Percentage of male and female students in engineering faculty

The faculty offers three disciplines: civil, electrical and electronic and mechanical engineering. From Figs. 5(a) and 5(b), it is observed that the percentage of female students in civil engineering has increased slowly since August 2010 while female students in electrical and electronic engineering has declined significantly from 15% to 4% since September 2008 semester. The percentage of female students in mechanical engineering is about 4% and it seems there is no significant variation over recent years.

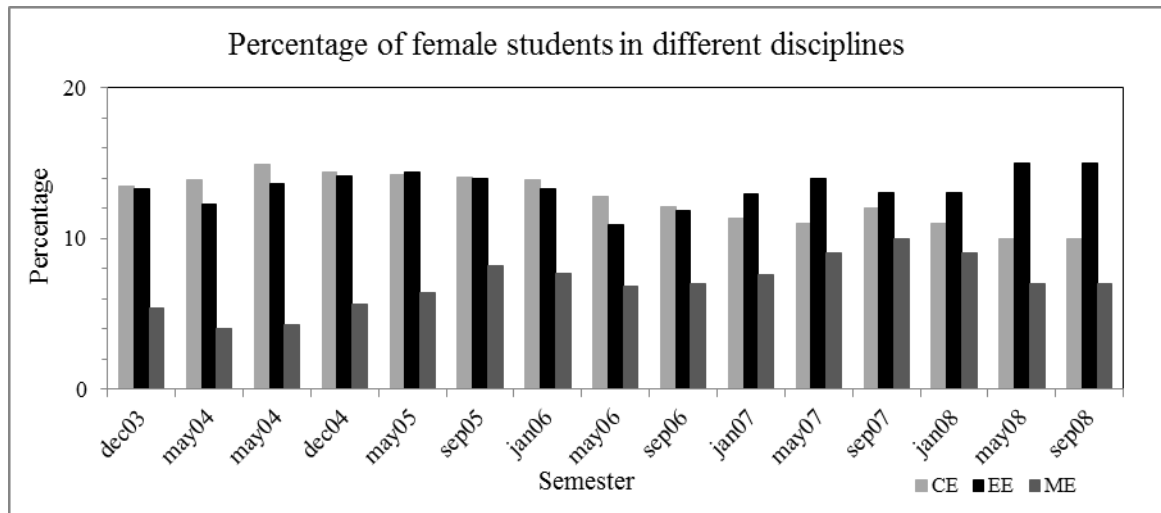


Figure 5(a). Percentage of female students in different disciplines

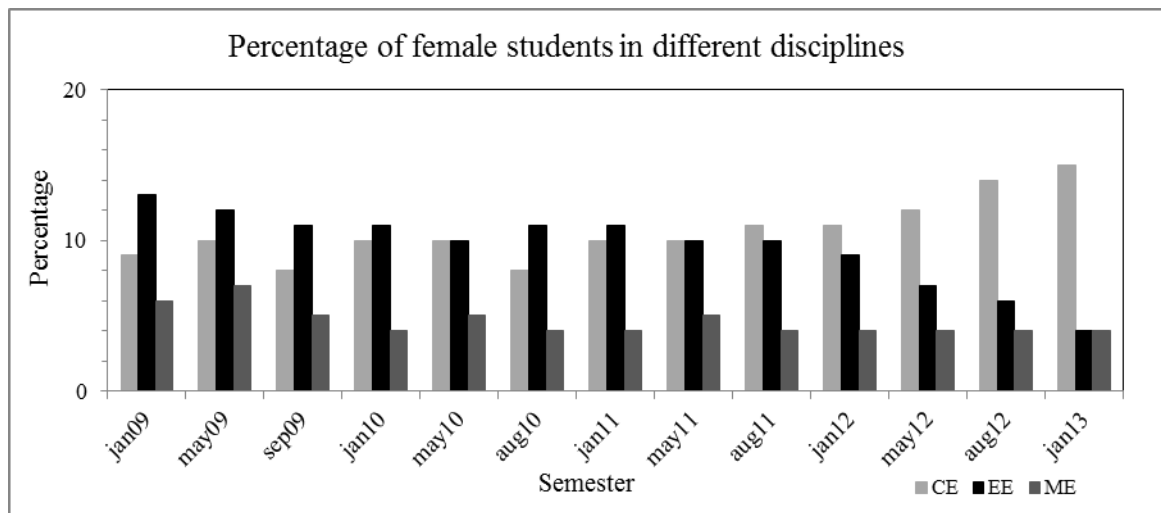


Figure 5(b). Percentage of female students in different disciplines

Perceptions of academics on women in engineering

The questionnaires are given to female and male academics in the faculty to explore the perceptions of academics on women in engineering education and engineering workplace. A total of 42 academics (28 male and 14 female academics) from civil, electrical and electronic and mechanical engineering disciplines responded to the survey. The majority of respondents are Malaysians (86%). Sixty percent of male and 43% of female respondents hold the position of senior lecturers (inclusive of full and associate professors). About 17% of the respondents have worked more than 15 years with the university while 38% have 10 – 15 years and 26% have 3 to 5 years. Based on the findings obtained from the questionnaires, the study reveals the following:

Perceptions of academics on women in engineering education

Academics are asked to compare the academic preparation, study habits, laboratory skills, engineering abilities and mathematical abilities of female engineering students to those of male students. Fig. 6 shows the comparisons of academic skills of female and male students. Academics of both genders responded that female students are as good as, if not better than, those of their male peers in academic preparation, study habits and mathematical abilities. Ni Lar Win and Khin Maung Win (2007) reported in the previous study that female engineering students in the faculty do as good as or better than their counterparts. However, female academics have better opinion of female students on laboratory skill and engineering skill than male academics have.

Academics are asked to give their opinion on conditions for male and female engineering students in the faculty. Both female (F) and male (M) academics gave similar responses to the question; 20% of female academics and 32% of male academics believed that conditions favour men and about 80% of female academics and 68% of male academics believed that conditions are equal for male and female students in the faculty. Besides, academics are also asked whether they have heard students' complaints about female students being treated unfairly by lab assistants or faculty members or their peer male students.

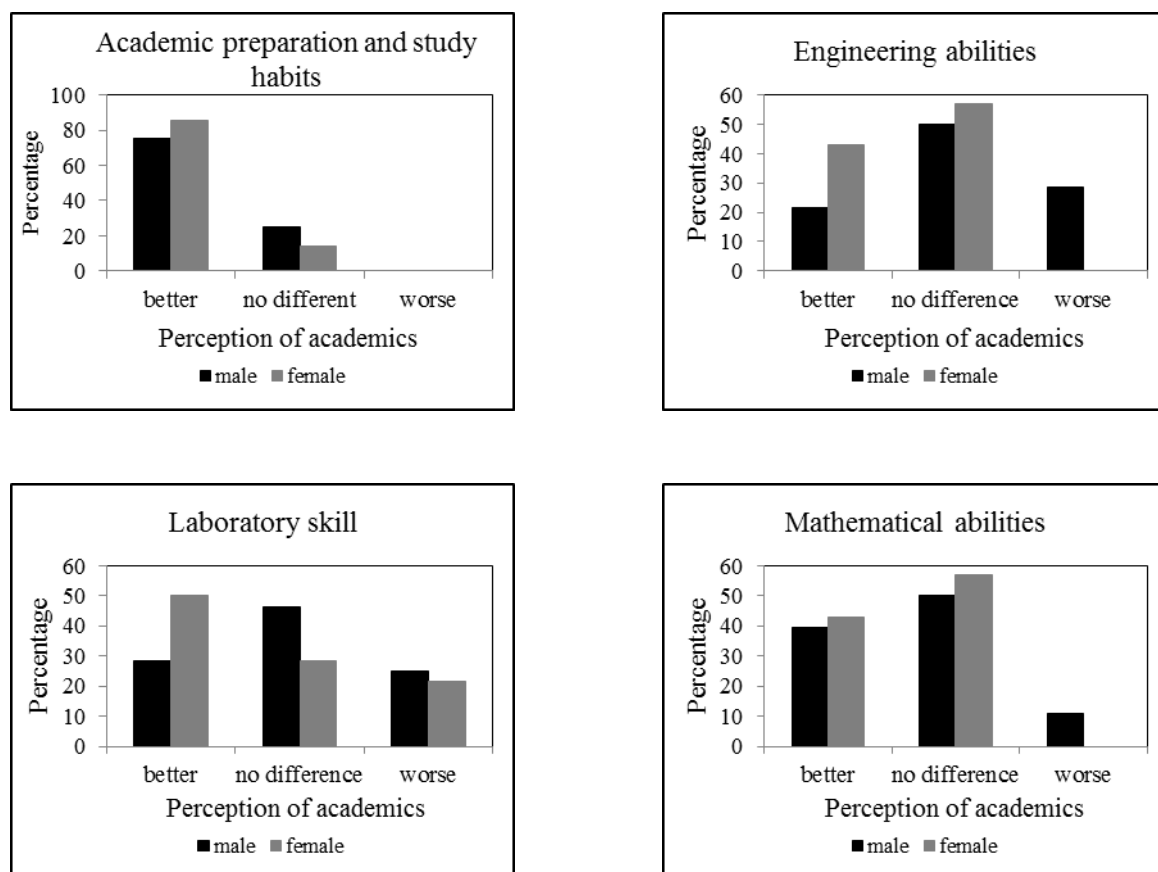


Figure 6. Perception of academics on academic preparation and skills of male and female students

Almost all academics responded that they have never heard of such complaints about unfair treatment to female students.

Perceptions of academics on student–faculty interaction

Academics are asked to express the degree of their agreement regarding the support for female students in their faculty. It can be seen from Table 1 that 60% of academics agreed that the faculty is supportive of female students and 55% believed that the faculty is genuinely committed to helping female students to complete their engineering degree. However the responses of males and female academics on engineering climate are different. About 64% of female academics disagreed that the engineering climate at the faculty favours male students.

Table 1. Perceptions for support for female students

	Agree		Neither		Disagree	
	F	M	F	M	F	M
My faculty is supportive of female students.	50%	68%	29%	32%	21%	0%
The engineering climate at my university favours male students.	7%	25%	29%	50%	64%	25%
I believe my faculty is genuinely committed to helping female students complete their engineering degree.	50%	57%	36%	43%	14%	0%

Perceptions on support programmes for female students

Academics are asked to give their opinion on having support programmes for female students. The analysis is focused on the sample as a whole since the differences between the responses of male and female academics are not significant. It can be seen from Fig. 7 that a majority of academics (62%) felt that university should have a special effort to recruit female students in engineering programmes.

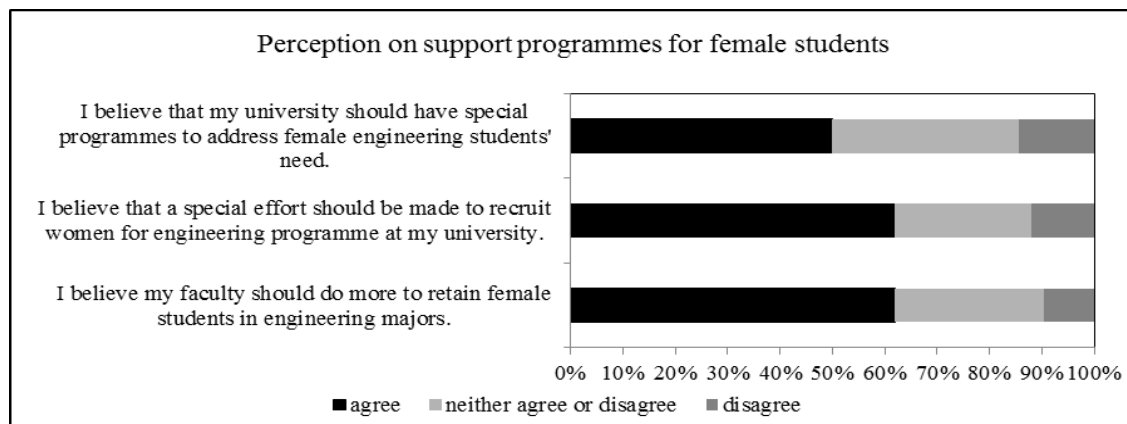


Figure 7. Perception on support programmes for female students

About half of the respondents agreed that the university should have special programmes to address female engineering students' need. About one-third is neutral and 15% of academics did not believe to have such programmes to address female students' needs.

Perceptions of academics on women in the engineering workplace

Academics are asked to respond to the statement given in Table 2 regarding women in the engineering workplace. About 60% of both female and male academics gave similar responses to the question that it is more difficult for a woman to balance between a career and a family in engineering than in other fields. Female academics are more likely to disagree that young women engineers are generally offered higher paying jobs at the beginning of their careers. Male academics tended to agree that some fields of engineering are easier for women.

Table 2. Perceptions on women in engineering workplace

	Agree		Neither		Disagree	
	F	M	F	M	F	M
It is more difficult for a woman to balance a career and family in engineering than in most other fields.	64%	54%	7%	21%	29%	25%
I believe women who are beginning their engineering careers are generally offered higher paying jobs than are men.	15%	25%	15%	25%	70%	50%
I believe it is easier for women to go into some fields of engineering than other engineering fields.	50%	79%	21%	7%	29%	14%

Academics are asked to give their opinion on conditions for male and female engineers in the engineering workplace. About half of both female and male academics believed that conditions favour men and the other half was neutral (see Fig. 8).

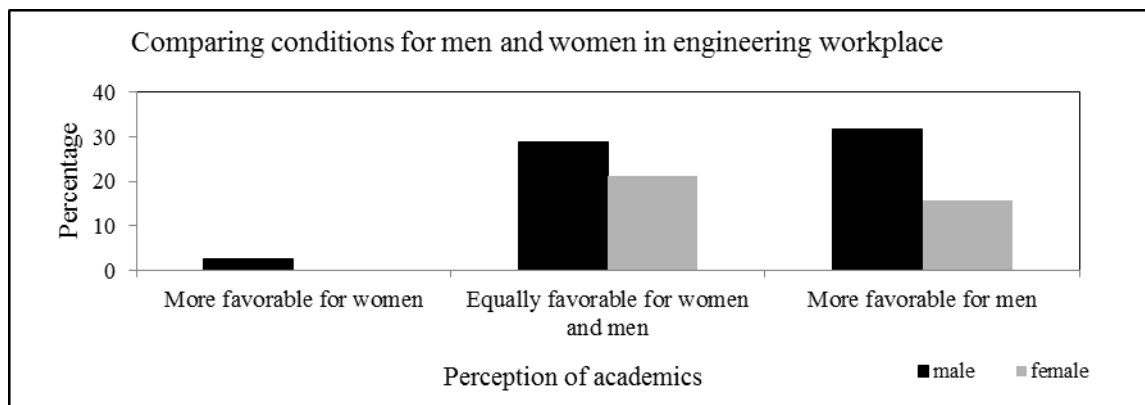


Figure 8. Comparing conditions for men and women in the engineering workplace

Experience of female academics with their male colleagues

Only female academics are asked to respond to the statements given in Fig. 9 regarding relationship with their male counterparts. Majority of female academics have positive experiences with their male colleagues since they disagreed to all the statements that senior colleagues prefer working with men, male colleagues perceive women not as productive, work environment with male colleagues is affected for being a woman and male colleagues exclude me from important activities. Minority of the respondents were neutral.

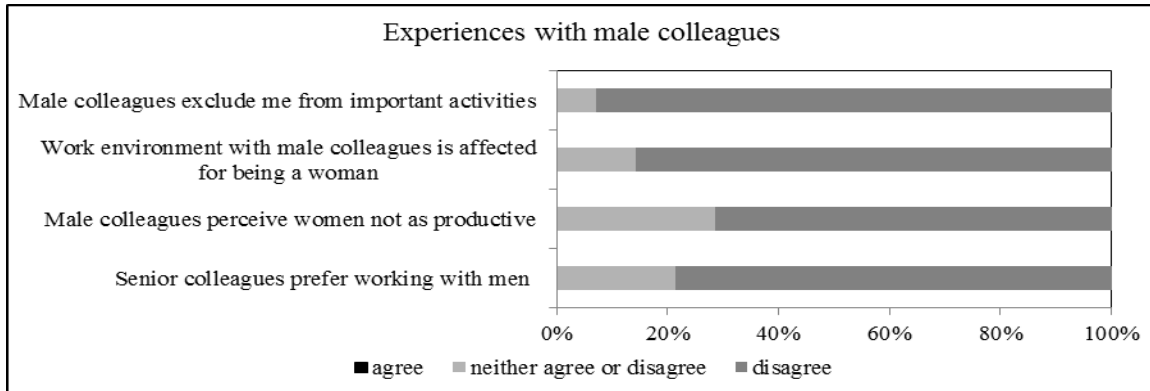


Figure 9. Experiences with male colleagues

Experiences of female academics with the faculty

Female academics are asked to respond to five statements about conditions with the faculty as given in Fig. 10. About one-third of respondents agreed that women academics are involved in decision making. Majority of respondents agreed that they are encouraged to participate and publish in scientific journals. Most female academics also acknowledged that they are given credit for their achievement. About half of the respondents disagreed that there are salary differences between men and women within the faculty while 30% are neutral. Almost all disagreed that women have less space and resources within the faculty.

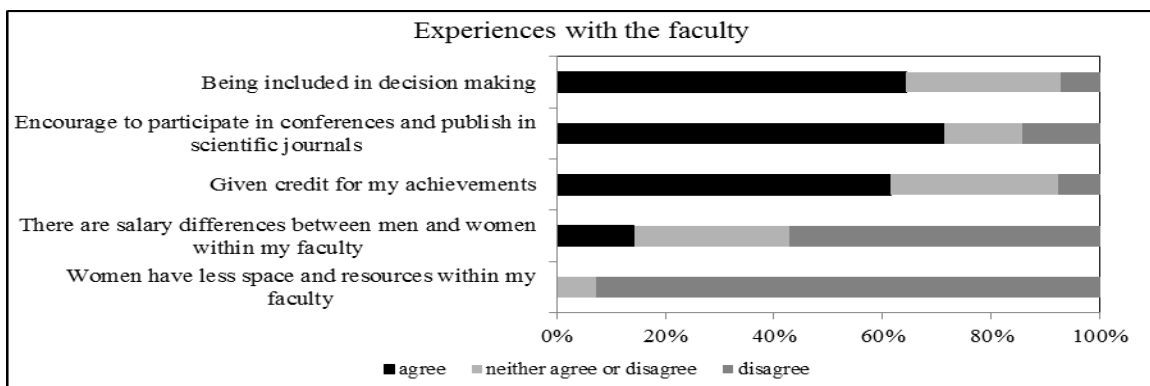


Figure 10. Experiences with the faculty

Perceptions on academic workload

Based on the responses to the statements given in Fig. 11, female academics perceived that academic workload is fair, consistent and appropriate compared with male colleagues.

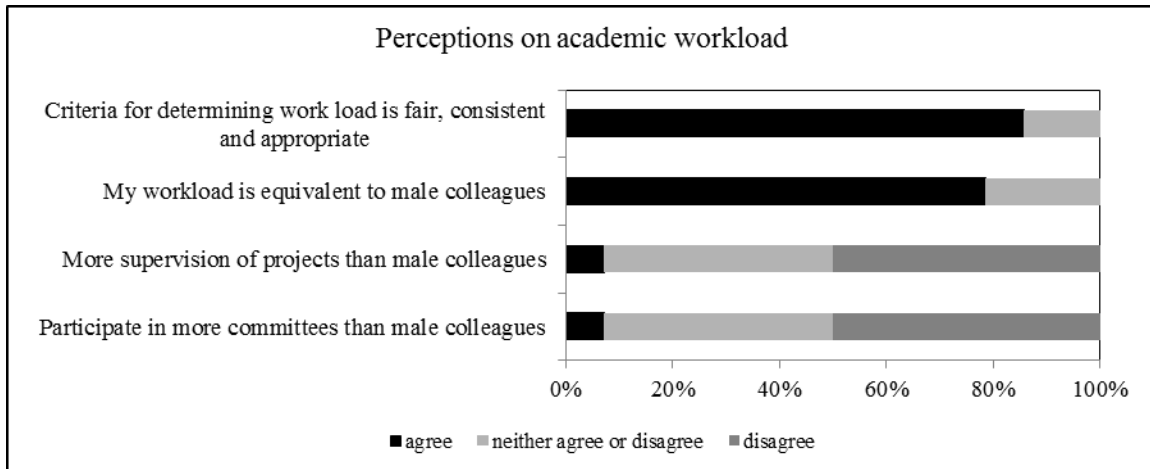


Figure 11. Perceptions on academic workload

Perceptions on academic career advancement

Majority of female academics responded that there are equal opportunity for advancement and the criteria for advancement are fair and consistent (see Fig. 12). However, respondents have different perceptions on the statement that female academics need more work and time to attain high academic ranks than male colleagues. About three quarter of the respondents disagreed with the statement that male colleagues believe that women do not possess skills to become leaders.

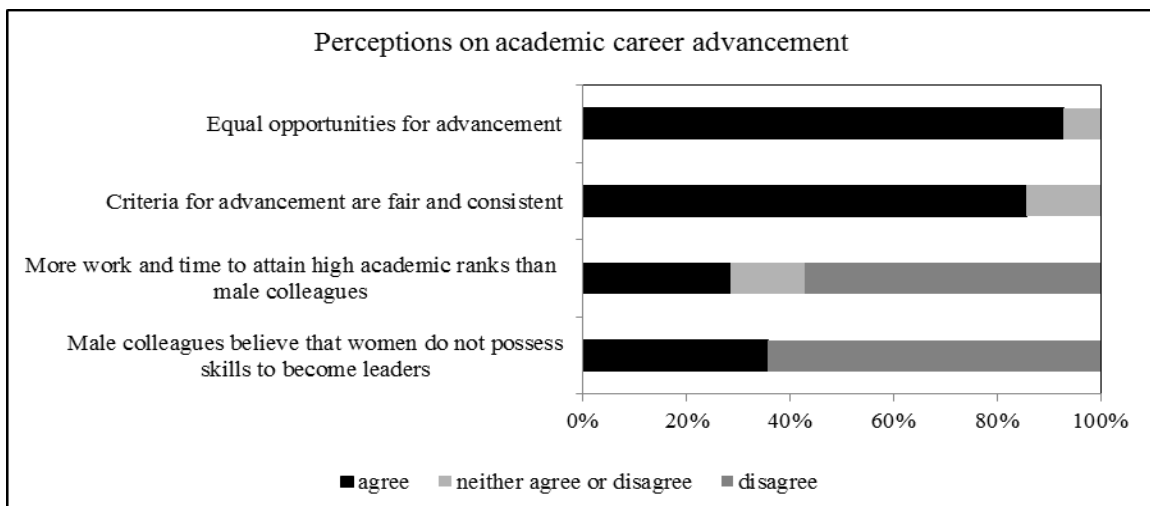


Figure 12. Perceptions on academic career advancement

Private life and career

As shown in Fig. 13, almost all respondents receive support from their family for their career as academics. Only 30% responded that they have more dedication to their family than their career. Female academics are more likely to say they disagreed that the faculty provides flexibility for family needs and advancement in their career.

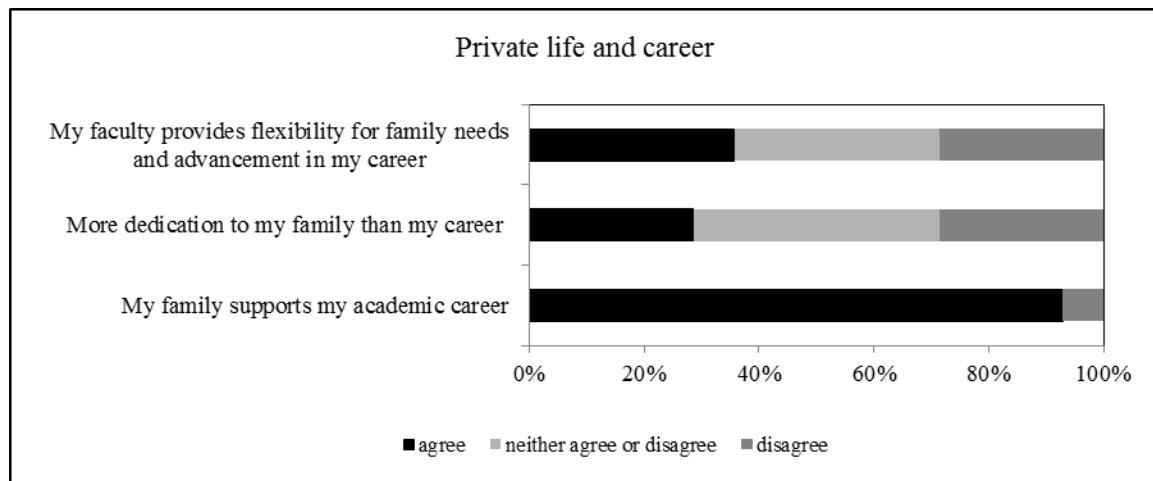


Figure 13. Private life and career

Conclusion

This study has attempted to reveal the involvement of women in engineering and perceptions of academics on women in engineering education and engineering workplace as follows:

Academics of both genders responded that female students are as good as, if not better than, those of their male peers in academic preparation, study habits and mathematical abilities. However, female academics have a better opinion of female students on laboratory skill and engineering skill than male academics have. Male academics are more likely than female academics to say that conditions favour men in engineering education. Almost all academics responded that they have never heard of complaints about unfair treatment to female students in the faculty.

A majority of academics feel that a special effort should be made to recruit female students in engineering programmes and the university should have special programmes to address female students' needs.

About half of both male and female academics generally perceived that conditions in the engineering workplace favour men and the other half is neutral. Female academics are more likely to disagree that young women engineers are generally offered higher paying jobs at the beginning of their careers.

Majority of female academics have positive experiences with their male colleagues and with the faculty. Female academics felt that there is no discrimination on salary, academic workload, academic career advancement compared to male academics in the faculty.

The results from this study can be used in finding ways to attract a larger number of women in engineering in the future.

Acknowledgement

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