Academic Performance and Perceptions of Female Students in Civil Engineering

Ni Lar Win and Khin Maung Win

Abstract The gender imbalance in engineering education and engineering workplace has been received worldwide attention. Various efforts are made to find solutions to the inadequate number of women in engineering professions. The underrepresentation of female students is observed in the engineering faculty at a private university in Malaysia. The aims of this study are (1) to observe the involvement of female students in civil engineering degree programme offered in the faculty, (2) to examine the academic performance of female students compared to their male counterparts and (3) to explore the perceptions of female students toward their education. The student progress rate (SPR) is used to measure academic performance of students in the civil engineering degree programme. Student progress rate is defined as the ratio of subjects passed to subjects attempted throughout their studies. The SPR for any student lies between 0 and 100 %. Means of SPR are analysed for the performance of female and male students. This study extends to find out the performance of female students by comparing the percentage of female and male students receiving academic awards given by the university and graduate students' classification. Questionnaire is used for perceptions of female students regarding the role of women in engineering. The study shows that women are good for engineering since female students in civil engineering programme do as well as or better than their counterparts. Female students have positive attitudes toward their education. The result from this study can be used to attract more female students to study in engineering programmes.

Keywords Academic performance • Civil engineering • Female students • Perceptions

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1 Introduction

The gender imbalance in engineering education and engineering workplace has been received worldwide attention. Various efforts are made to find solutions to the inadequate number of women in engineering professions. However, the underrepresentation of female students in engineering in Western countries such as the USA, Canada, the UK and Australia is still observed. According to Engineers Canada (2012), 17.7 % of the total enrolment was female students studying engineering in accredited Canadian programmes in 2011, and the enrolment of female students in civil engineering was 21.8 %. Yoder (2011) reported that the enrolment of female students in undergraduate engineering programmes in 348 US and 11 Canadian engineering colleges was 18.2 % in 2011. Kaspura (2012) stated that the percentage of female engineering students in Australia was steady over the decade, and it was about 16.0 % of the total engineering students.

Studies on gender differences in academic performance in the field of science and engineering have been carried out by many researchers. Orabi (2007) indicated that academic performance is affected by many factors such as motivation, student ability and the quality of secondary education received. He analysed student academic performance by comparing course work scores between the two genders using assignments, projects, exams and class participation. The results showed that there were no significant differences between mean scores in the academic performance of the genders in an introductory engineering course offered in the University of New Haven.

Felder et al. (1995) examined the gender differences in the students' academic performance, persistence in chemical engineering and attitudes toward their education and themselves. They concluded that the women in the study on average entered chemical engineering with credentials equal to or better than those of the men, but exhibited erosion relative to the men in both academic performance and confidence as they progressed through the curriculum.

Chen et al. (2012) carried out the academic performance of female students in mechanical engineering in North Carolina Agricultural and Technical State University. They analysed academic performance by comparing the mean, median and 10th and 90th percentiles of the final marks (combination of course work and final examination marks) of male and female students. They have found that the female students in their study performed better or equally well than the males by all measures.

Arsad et al. (2011) investigated the female academic performance of electrical degree students at the Faculty of Electrical Engineering of Universiti Teknologi MARA, Malaysia, based on the student's entry levels. They concluded that female students performed better than male students due to the strong ability in fundamental engineering foundation and self-efficacy of the female students which greatly influenced the overall academic performance.

Olsen et al. (2006) used student progress rate (SPR) as a key performance indicator to measure academic performance in the Australian universities, while the cumulative grade point average is used to measure the academic performance of students by He and Banham (2009), Oladeji and Sangotayo (2011) and others.

The aims of this study are (1) to observe the involvement of female students in civil engineering degree programme offered in the faculty, (2) to examine the academic performance of female students compared to their male counterparts and (3) to explore the perceptions of female students toward their education.

2 Methodology

This study consists of three parts: analysis of gender balance in civil engineering degree programme, academic performance of female students and perceptions of female students regarding women in engineering. The enrolment of female students in civil engineering degree programme offered from the period of September 2008 to January 2014 (17 semesters) by the faculty is taken for analysis.

The student progress rate (SPR) is used to measure academic performance of students in the civil engineering degree programme. Student progress rate is defined as the ratio of subjects passed to subjects attempted (Olsen et al. 2006). Therefore, the SPR for a student is between 0 and 100 %. In this study, means of SPR are calculated for the comparison of academic performance of male and female students. The university celebrates the ceremony of Academic Award Presentation twice a year for students who excelled in their academic pursuit. The percentage of female students receiving academic awards in the programme is analysed, and performance of graduate students by classification is also observed.

In this study, a questionnaire as an instrument is designed to find out the female student perceptions regarding the role of women in engineering. It includes their backgrounds (demographic information and precollege experiences) and the perceptions: engineering classroom environment (how encouraged or discouraged they were by academic grades, time required for course work), contentment in the engineering major (interest in engineering and happiness with choice of engineering major) and change in self-confidence. It consists of 17 questions and takes about 15–25 min to complete. Some of the questions are extracted from the report written by Goodman et al. (2002) and modified appropriately for this study. Six-point scales (strongly agree, moderately agree, slightly agree, strongly disagree, moderately disagree and slightly disagree) are used in the questionnaires to measure the perception of female students.

3 Results

3.1 Involvement of Female Students

The percentage of male and female students enrolled in civil engineering degree programme from September 2008 to January 2014 session is shown in Fig. 1. It is observed that the percentage of female students ranges from 11 to 22 %. It is currently about 14 % in January 2014 session.

Almost half of the female students are international students. They came from China, Indonesia, Maldives, Mauritius, Sudan and Uganda. The distribution of female students by country is shown in Fig. 2. The highest number of female students came from Mauritius followed by Indonesia.

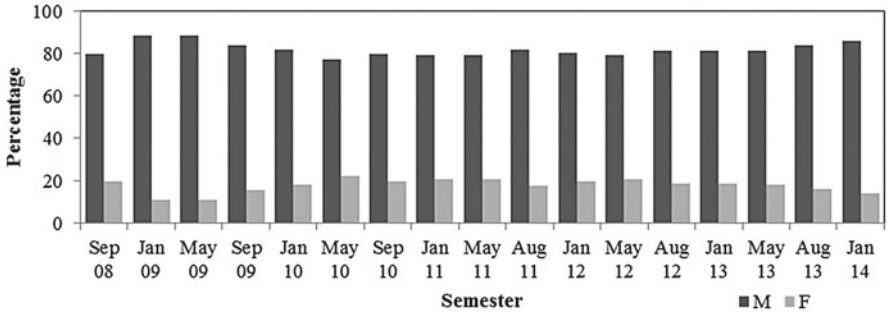

Fig. 1 Percentage of enrolment of male and female students

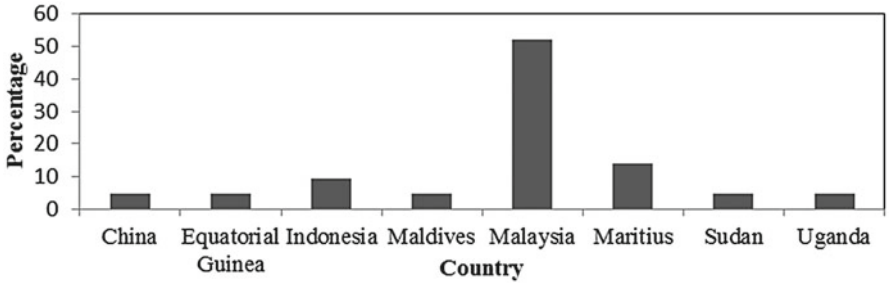

Fig. 2 Distribution of female students by country

3.2 Academic Performance of Female Students

Mean SPR of both male and female students who enrolled in January 2014 session is analysed and is about 86 %. It means that on average, students passed 86 % of the total subjects that they have enrolled in the programme. Mean SPR of male and female students by year and all students (year 1 to year 4) in the programme is shown in Fig. 3. It is observed that the mean SPR of female students in year 3 is 99 %. It means that female students in year 3 passed almost all the subjects that they have attempted. It is observed from Fig. 3 that female students outperformed male students in year 3 and are slightly better in year 4. In overall, female students performed as good as male students since mean SPR for females is 83 % and males is 86 %.

The percentage of male and female students receiving academic award in the degree programme is shown in Fig. 4. Female students performed as well as or better than their counterparts since the percentage of female students receiving academic awards is higher than that of male except in May 2012 session.

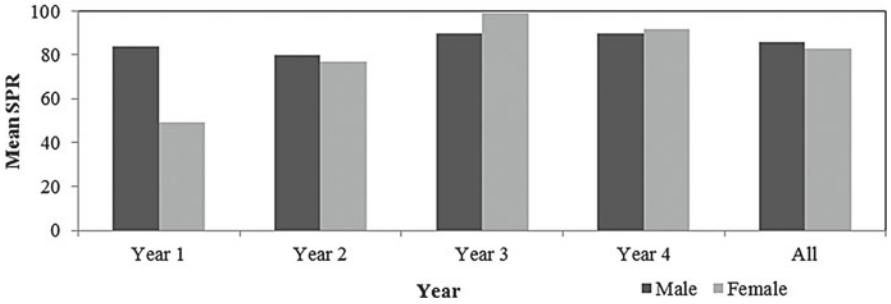

Fig. 3 Mean SPR of male and female students

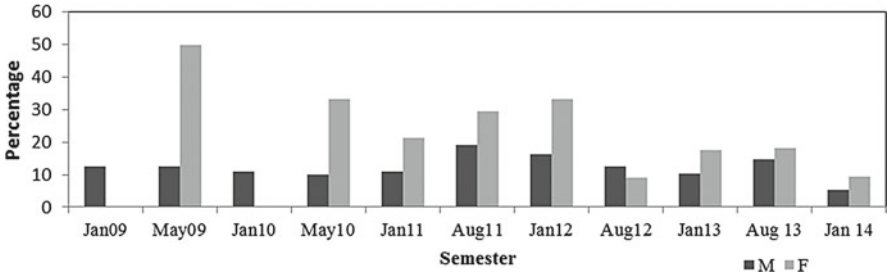

Fig. 4 Percentage of students receiving academic award

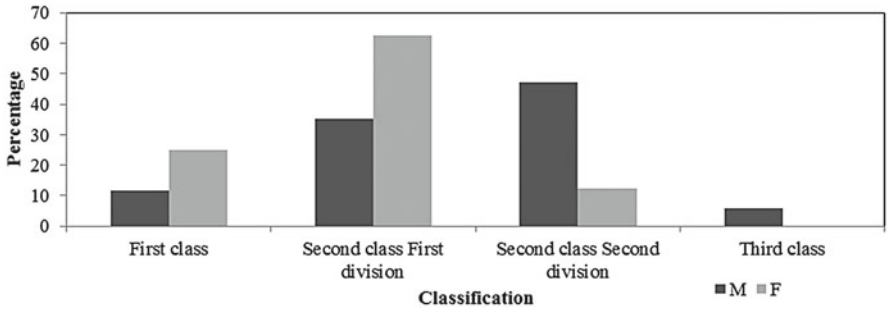

Fig. 5 Performance of graduate students

The performance of graduate students by classification (First Class Honours, Second Class Honours First Division, Second Class Honours Second Division and Third Class honours) is shown in Fig. 5. It is observed that female students outperformed males in First Class Honours and Second Class First Division Honours.

Based on the results shown in Figs. 3, 4 and 5, it is concluded that female students in civil engineering degree programme do well or better than their counterparts. This finding agrees with Win and Win (2013) where mean, median and percentiles of marks are used to measure academic performance. However, the result obtained in this study does not agree with the finding obtained by Felder et al. (1995) and Oladeji and Sangotayo (2011).

3.3 Perceptions of Female Students

Perceptions of female students are analysed from the questionnaire given to the female students in civil engineering. A majority of female respondents were Malaysian (70 %). About 60 % of the respondents were between the ages of 22 and 23, where 25 % were older and 15 % were younger. Before entering engineering degree programme, 60 % of them completed the University Foundation Programme where they took advanced calculus, physics and chemistry. Ninety percent of them have a high level of interest in engineering.

Students are asked to give the reasons why they want to become a civil engineer. The reasons given are the employment opportunities, salary potential, interest in the subject matter in civil engineering and ability to work in the challenging environment. One student answered that one could bring changes and make a difference toward the environment.

All of them were happy with their choice of engineering, and they are confident that engineering is the right major for them. Sixty percent of them would either *definitely* or *probably* encourage other women to major in civil engineering. Forty percent said they *would be neutral so that they would not* encourage or discourage others.

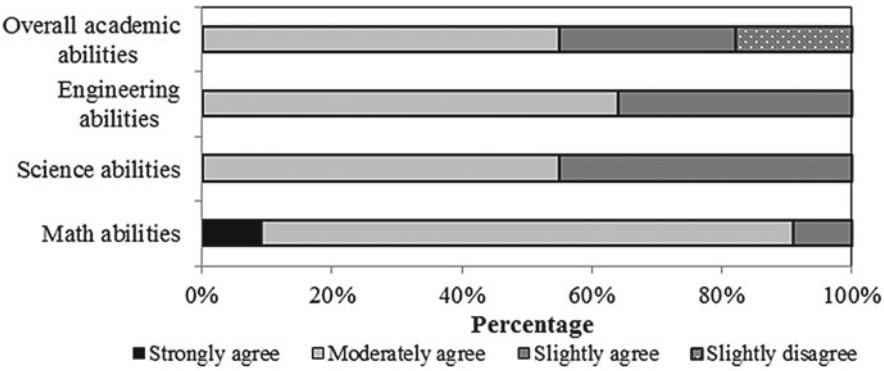

Fig. 6 Change in self-confidence

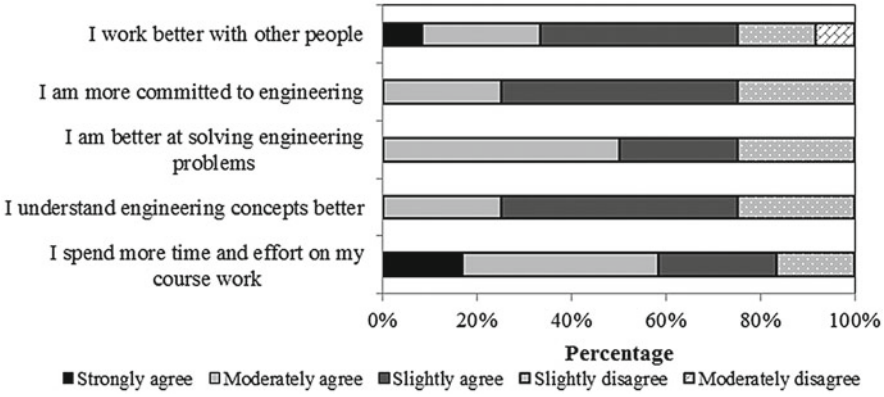

Fig. 7 Perception of female students compared to males in engineering courses

Students were asked whether they agree or disagree that their self-confidence has changed since they entered the engineering programme. It can be seen from Fig. 6 that students agreed that their self-confidence has changed in math, science and engineering abilities (100 %). However, 20 % of the students slightly disagreed in self-confidence changed in overall academic abilities. Eighty percent of them felt that they have more confidence in engineering abilities during their study in engineering. About 70 % of respondents have been elected at least once as a class representative for the specific subject.

In the questionnaire, female students were asked to compare themselves to the male students regarding on engineering courses (see Fig. 7). More than 80 % of students spend more time and effort on their course work. It is observed that they have more confidence in engineering abilities compared to their counterparts.

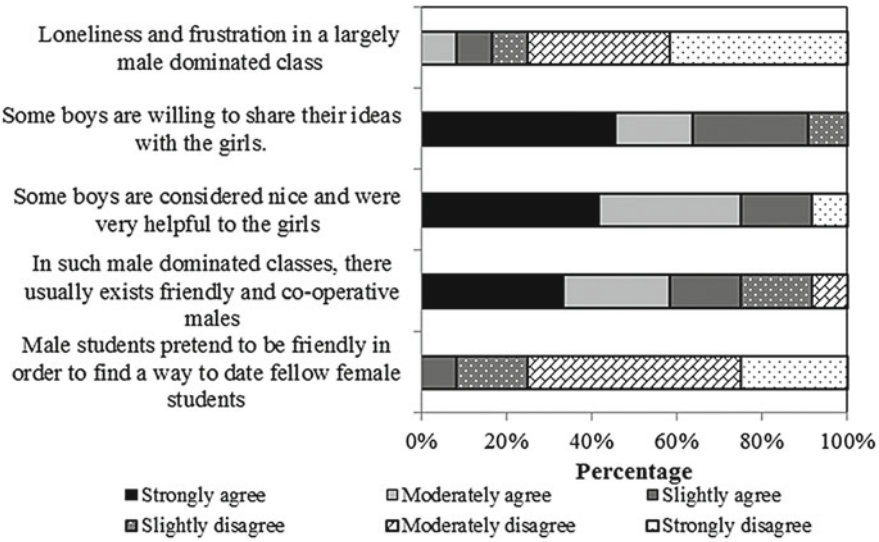

Fig. 8 Experiences with male engineering students

The female students were asked to express whether they have any unpleasant experiences with male engineering students (see Fig. 8). Almost all female students have positive attitudes toward their male counterparts since they considered the males as nice, helpful, friendly, co-operative and willing to share their ideas. Most of the respondents felt that they did not have loneliness and frustration in largely male-dominated classes.

About half of the respondents felt that engineering faculty was supportive of female students. However, about 60 % believed that faculty should have special programmes to address women's needs. Ninety percent of them have positive attitude toward their lecturers.

4 Conclusions

This study has attempted to examine the academic performance and explore the perception of female students in civil engineering degree programme. The conclusions are as follows:

1. Underrepresentation of female students is observed in the faculty since female students make up of 14 % of total students in civil engineering.
2. Female students outperform their male counterparts by all measures.

3. Female students have positive attitude toward their choice for their education and change in self-confidence.
4. Overall perception of female students is encouraging toward the interaction between students and faculty.
5. The result from this study can be used to attract more female students to study in engineering programmes.

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