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FEMALE STUDENTS' PERCEPTION ON CHALLENGES AND OPPORTUNITIES FOR THEIR GENDER IN ENGINEERING TECHNOLOGY STUDIES AND THE PROFESSION

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Abstract

The field of engineering technology has been historically dominated by male students, resulting in a significant gender disparity in many countries. Female students pursuing engineering technology courses face unique challenges that can hinder their success and participation in the field. This research aims to explore the challenges faced by female students in engineering technology courses and present mitigating strategies to address the issues. A combination of basic quantitative survey was undertaken on a sampling of third year female students at a private engineering technology university. A qualitative interview was also conducted on a senior female academic staff who had extensive work experience in the field prior to become an academic. This served as a triangulation to the responses obtained from the surveyed respondents. Findings from the study shows that the challenges faced by the female students in engineering technology courses can be categorized into three main areas namely social and cultural barriers, academic obstacles, and lack of representation and support. As a whole, the female students have a positive perception on engineering technology as a tertiary study option and also as a career choice that they will continue to pursue. In addressing the challenges faced by female students in engineering technology courses, a multi-faceted approach is needed. The approach must also address social and cultural barriers and provide adequate academic support to empower female students to thrive in engineering technology and contribute to the nation.

Keywords: *Engineering Technology, Gender Disparity, Higher Education, Student Perception*

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INTRODUCTION

The People get into university education as a ticket for them to get a diploma or degree, so they are qualified to work in their chosen field. Higher education is frequently chosen by students who want to pursue interests in certain subjects or careers. Certain professions, including nursing, medicine, architecture, law, and pharmacy and engineering, require a specific occupational degree and certain language and communication skills to practice (Ahmad, et al, 2021). Students who pursue a degree will not only be able to learn a subject in-depth but will also be able to improve their teamwork abilities and acquire transferable skills like critical thinking, problem-solving, communication, and presentation (Ahmad, et al 2017). Half of the courses in the academia are dominated by certain genders such as female and male. For example, nursing and teaching courses are dominated by women, while engineering courses are dominated by men because there are many hands-on practical tasks. As such when it comes to the issue of gender in profession, women may lack confidence in their talents due to the historically male-dominated nature of engineering (Mohammadi, 2017). Gender stereotypes may have contributed to girls' early lack of interest in engineering as compared to boys. This is also due to the common belief that men are more mathematically competent and so more suitable for engineering positions, there is also plenty of proof of the survival of unconscious bias against female engineers (Longe & Ouhada, 2019).

Because of gender bias, women's decision to major in engineering in college is also strongly associated with their background and exposure to science and math classes in high school. Majority of women who do decide to pursue engineering believe that because they are more adept at these kinds of classes, they can succeed in an area that is dominated by men (Mahajan & Golahit, 2017). Engineering schools are often perceived by female students as stressful places where they feel alone and unaccepted by both male students and faculty colleagues. In many nations, women are employed in both traditional and non-traditional occupations. A non-traditional job is described as one in which more than 75% of the workforce is of the opposite gender, or, conversely, fewer than 25% of the workforce is your gender (Hansen, 2016). Occupations with a lower female employment rate are considered non-traditional for women. Non-traditional careers for women are those where men outnumber women in the workforce. Women typically pursue non-traditional employment in labor-intensive, scientific/technical, or managerial roles (Dudley, 2013). Malaysia for example, has made efforts to empower women in non-traditional careers by encouraging them to pursue training and education in science and technology, expanding vocational training opportunities, and recognizing their skills (KPWKM, 2016). Despite advancements in women's representation in higher education and employment, some occupations remain seen male dominated.

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Many researches indicate an increase in the number of female engineers in both developed and developing countries particularly in soft engineering fields like design and computer science. However, women in engineering as a whole are still underrepresented compared to men. Despite the gender disparity, women have achieved success in this traditionally male-dominated field (Buse, Hill, & Benson, 2017). However, little is known about women engineers' feelings and experiences in male-dominated careers. Some women may not think that they are capable of succeeding in this male dominated field. Most studies concur that family commitment is the biggest obstacle that women engineers encounter (Mishkin et al., 2016) despite a lot of men and women now together managing the responsibilities of work and family life. In the engineering technology sector, job sites frequently change and this includes extended stays away from home or travel across significant distances. For the women, this might be challenging due to transportation issues and child-care responsibilities (Gutknecht, 2017). The undergraduate experience of engineering technology students is crucial because it establishes the students' readiness to become engineers (Ahmad et al., 2023). How well this experience turned out to be, could provide an explanation for the observed lower rate of female in engineering career. The quality of instruction, teamwork, classroom environment, role models, and student engagement all have an impact on the degree of satisfaction that female undergraduates in engineering programs feel about their learning experiences (Christie et al., 2017). The degree to which female undergraduates are satisfied with their educational experiences influences both their retention rate in engineering programs and their likelihood of continuing in the field. Moreover, according to Mishkin et al. (2016), few women choose STEM jobs, particularly in engineering, as they believe it is not a top option and felt that women engineers are underpaid in the engineering sector (Kadayifci & Gedik, 2016). Furthermore, studies done by McKay (2017) for instance, reported that in male-dominated occupations certain companies are found to pay much higher wages to male employees.

The objectives of this study being undertaken is to explore insights into the realities of female students studying in a male dominated tertiary course in terms of their level of suitability, comfort and ability to adapt and to overcome any arising challenges in the process. By doing this light could be shed on the female students' actual needs while undergoing the course and the possible ways that they address any study issues and mitigate any problems faced. The research questions for the study are as follows;

i. What is the level of comfortability and suitability for female students when studying in male dominated engineering technology courses at the university?
ii. What are the challenges faced by the female students while studying in the engineering and technology course at the university?
ii. How do the female students overcome any arising challenges of studying in the engineering and technology courses at the university?

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METHOD

This study employs a combination of quantitative and qualitative approaches via surveys and interviews. Data was collected by using quantitative survey on all third year female students studying at a male-dominated private engineering university called UniKL Malaysia France Institute (Unikl MFI) in Selangor, Malaysia. The survey items focus on the students' perception on engineering technology studies, the challenges faced and opportunities for women in the field. The Likert scale response options of Strongly disagree (1), Disagree (2), Neutral (3), Agree (4) and Strongly Agree (5) were used in the survey using 18 questionnaire items adapted from literature. Data collection process was done using Google form and distributed through WhatsApp and Telegram. 79 responses were obtained from the third year Bachelor in Engineering Technology programs female students, from a total of 130 third year female students. Based on minimum sampling calculation ratio by Krejcie & Morgan (1970), the minimum data figure was met, and data could be analysed using Microsoft Excel to generate descriptive statistics. Frequencies, percentages, mean, and standard deviation were analyzed using descriptive statistical techniques based on Fisher and Marshall (2009). A series of qualitative interviews were conducted on an experienced faculty member who was an alumnus and has previously studied engineering technology and has worked in the field prior to becoming an academician. This interview on this purposive sample was done and lasted 40 minutes where the session was recorded and transcribed verbatim for analysis. During the interview, written notes were taken into a template containing the questions.

RESULTS AND DISCUSSION

From table 1 below, the results show that the third-year female students come from five main courses. More than one third of them come from the Mechanical Engineering course (32.5%).

Table 1: Third Year Female Students' Courses

Automotive Maintenance	Mechanical Manufacturing	Welding Quality	Mechanical	Industrial Automation	HVAC
12	14	13	25	11	4
(15.2%)	(17.7%)	(16.5%)	(31.6%)	(13.9%)	(5.1%)

As a whole, the data from the survey are skewed to the right indicating more positive responses of 'agree' and 'strongly agree' to the survey items. Only two items showed a slight skewness to the left namely item 9 and item 13 which asked on the female students' openness to prefer male members for group projects and on their opinion on the suitability of engineering technology courses for both genders. The rest of the survey items registered

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more than 55% positive responses namely 'ágree' and 'strongly agree' as opposed to the rest of the response choice namely 'neutral', 'disagree' and 'strongly disagree'

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Table 2: Third Year Female Students' Perception on Studies and Future Career

	Survey Item	SD	D	N	A	SA	Mean	Std Dev
1	There are usually a few female students in my classes	5 (6.3%)	2 (2.5%)	10 (12.7%)	24 (30.4%)	38 (48.1%)	4.113	1.132
2	Lecturers treat male & female students equally in class	0	4 (5.1%)	18 (22.8%)	31 (39.2%)	26 (32.9%)	4.000	0.877
3	I actively participate with male students in group project	0	14 (17.7%)	15 (19.0%)	26 (32.9%)	24 (30.4%)	3.759	1.076
4	I feel comfortable when asking questions to lecturers & classmates in class	3 (3.8%)	11 (13.9%)	19 (24.1%)	33 (41.7%)	13 (16.5%)	3.531	1.048
5	I feel comfortable in seeking assistance from lecturers after classes	0	9 (11.4%)	18 (22.8%)	30 (38%)	22 (27.8%)	3.822	0.970
6	I feel confident of my learning abilities in the course	4 (5.1%)	7 (8.9%)	19 (24.1%)	38 (48.1%)	11 (14.0%)	3.569	1.008
7	I feel a career in engineering & technology is appropriate for women	1 (1.3%)	6 (7.6%)	22 (27.8%)	31 (39.2%)	19 (24.1%)	3.772	0.946
8	I feel that I have to work harder in the course because of my gender	4 (5.1%)	11 (13.9%)	14 (17.7%)	30 (38%)	20 (25.3%)	3.645	1.155
9	I frequently choose to join male groups when doing group projects	7 (8.9%)	17 (21.5%)	21 (26.6%)	20 (25.3%)	14 (17.7%)	3.215	1.226
10	I aim to pursue career in engineering technology after graduating	1 (1.3%)	5 (6.3%)	18 (22.8%)	31 (39.2%)	24 (30.4%)	3.911	0.949
11	My family support my engineering technology choice of study	2 (2.5%)	2 (2.5%)	2 (2.5%)	33 (41.8%)	40 (50.6%)	4.354	0.862
12	My friends support my future career choice in engineering technology	2 (2.5%)	0	10 (12.7%)	34 (43.0%)	33 (41.8%)	4.215	0.857
13	The engineering technology curriculum suits both male & female students	1 (1.3%)	7 (8.9%)	26 (32.9%)	29 (36.7%)	16 (20.3%)	3.721	0.918
14	Sometimes female students are treated differently in the course	2 (2.5%)	8 (10.1%)	30 (38%)	28 (35.4%)	11 (13.9%)	3.481	0.945
15	The engineering technology course is suitable for students from both gender	2 (2.5%)	3 (3.8%)	15 (19.0%)	38 (48.1%)	21 (26.6%)	3.924	0.916
16	Female students can perform equally well as male students in the course	1 (1.3%)	6 (7.6%)	13 (16.5%)	31 (39.2%)	28 (35.4%)	4.000	0.974
17	Male and female students treat each other respectfully in the course	2 (2.5%)	3 (3.8%)	13 (16.5%)	41 (51.9%)	20 (25.3%)	3.936	0.896
18	Sometimes there are barriers that prevent females from pursuing study and career in engineering technology	2 (2.5%)	7 (8.9%)	17 (21.5%)	39 (49.4%)	14 (17.7%)	3.708	0.949

Survey item number 1 from the table above confirms that female students is a minority in engineering technology classes on campus as 78.5% of the respondent 'strongly agree' and 'agree' to the statement. Only 21.5% responded 'neutral', 'disagree' and 'strongly disagree'.

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This shows only in certain classes that there are balanced number of female students and male students.

Most of the students (72.1%) for instance responded 'agree' and 'strongly agree' to the statement that their lecturers treated them equally despite their gender (Survey Item 2). However, there are also a small number of students (27.9%) responding to 'neutral', 'disagree' and 'agree', which means there might also be instances where lecturers might not treat the students equally in the classroom.

For survey item 3, 32.9% and 30.4 % voted 'strongly agree' and 'agree' to the statement which describe that they participate equally in group projects with male team-mates. Meanwhile, a group of them voted 'neutral', 'agree' and 'disagree'. This shows that there are also female students who are comfortable with only female in their groups. Some of the women surveyed might be apprehensive towards some male students in their classes who seem more knowledgeable and confident in their abilities.

As for survey item 4, majority of the female students chose 'strongly agree' and 'agree' when it comes to asking questions during the lecture session. The responses to the questions indicate that the students have many similar concerns. Meanwhile 13.9 % and 3.8% responded that they disagree towards statement above which means there are few of them feelings nervous when it comes to asking questions in the class.

For item 5 on seeking assistance from lecturers, out of 79 respondents, 30 and 18 of them (65.8%) responded to 'agree' and 'quite agree' that they go to their lecturers for assistance after their class. It is clear from the comments received that many female students feel at ease and even comfortable to meet their lecturers outside of class. However, there are 11.4% that disagreed with the statement of meeting their lecturer after class.

As for survey item 6, 49 (62.1%) out of 79 respondents chose 'strongly agree' and 'agree' when asked on their level of confidence of their learning abilities in engineering and technology courses. It should be noted that the female students, though a minority in the university, did react positively. They see their small numbers as a challenge to succeed. The percentage for 'neutral', 'disagree' and 'strongly disagree' is also quite a lot which is 38.1%. Evidence from the above table clearly shows that some of the female students do not have high confidence in being in the field. This proves what (Longe & Ouhada, 2019) said that the lack of self-confidence in maths and science ability deprive many women from participating in science, technology, engineering and mathematics.

For survey item 7, 50 respondents responded 'strongly agree' and 'agree' that engineering career is an appropriate choice for women. Meanwhile, it could be seen that there are 29 students who responded 'neutral', 'disagree' and 'strongly disagree' on engineering becoming an appropriate career choice. Based on these 3 categories of answer, some of them might feel that the engineering technology field is quite hard and challenging for a career choice. Moreover, traditionally, men are known to be more dominant in the engineering technology career.

For survey item 8, 39.2% and 25.1% of respondents stated 'agree' and' strongly agree' with the statement that they must work harder in engineering and technology studies because of their gender. Meanwhile 29 (36.7%) of the respondents voted 'neutral', 'disagree'

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and 'strongly disagree' with the statement because they might feel that they could cope well the engineering technology courses and there is no gender challenge.

Meanwhile, majority of the respondents (26.6) for survey item 9 stated 'neutral', with statement that they do choose male students as group member for doing assignments or projects in engineering technology classes. In this case, some of the female students (30.5%) indicated that do not like to have male student their group for doing assignment or project because in fact they can do better than man in doing any report or assignment. As for the 43% respondents who agreed to choose male students in their group, this is due to the fact that in the engineering and technology courses they will have to do some practical or workshop classes that will be useful with male assistance in some of the physical and heavy tasks.

Based on the data for item 10 of the survey, majority of the female students agree to continue pursing career in engineering after graduation. 69.6% respondents do have intention to work in the field when they stated 'strongly agree' and 'agree' to the survey statement. This also reflects the female students' strong level of confidence and positive belief of their ability and talent for work in the engineering technology field. Only 7.6% of the respondents claimed that they have no intention of pursuing a career in this field. It could be strongly assumed that more than 90% of the female students are comfortable with engineering technology as their study course and they wish to extend it into developing a career in this field.

For survey item 11, 92.4% of the respondents indicated that they receive family support for studying in the engineering technology courses at the university. Only 6 female students responded that they did not obtain support from family members on their choice of tertiary study. Based on the data, it could be inferred that this support has become the source of the female students' confidence and strong belief of their abilities in studying in engineering technology courses.

For survey item 12, 84.8% of the respondents indicated that they get their friends support for studying in engineering technology courses as their future career choices. In other hands, only 2.5% of the female respondents did not get the support from their peers on their decision to take up engineering technology. From this data, it could be inferred that this is also a source of strength for the female students to persevere in the male dominated engineering technology courses.

In the table showing data for survey item 13, 16, 57% of the respondents agree that curriculum for engineering and technology courses favor both male and female genders equally, while 32.9% voted that they are neutral about it, while only 8 respondents the gave negative responses to this statement. It could be noted that there are isolated cases where a few female students do face challenges in adapting to a male dominated field of study. Thus a system must be put in place to assist such students to adapt better to this new study environment with gender disparity.

Based on data for survey item 14 above, 49.3% of the respondents agree that sometimes female students are treated differently than male studies in engineering technology education due to their gender. From a negative perspective, this might indicate

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presence of gender discrimination however, it could be also inferred that they receive better class treatment from course lecturers as compared to female students due to their being a minority gender in class. This could be seen from the 38.5% respondents who responded 'neutral' to the statement on differences in treatment. Moreover, 12.6% of the respondents gave positive response that they disagree and strongly disagree to the fact that they receive any different treatment.

The data for survey item 15 shows that 74.7% of the respondents agree that engineering and technology courses are suitable for both male and female students. Meanwhile 19.5% responded that they are neutral to the statement. Only 6.3% responded negatively to the statement because they might feel that engineering and technology courses are tough and might not be suitable for female students.

Data for survey item 16 reflected the positive and strong belief of the female students that both genders can do well in engineering technology courses. Majority (74.6%) positively responded 'strongly agree' and 'agree' to the statement that the female gender can perform equally well in the course of study. Only 25.4% responded 'neutral', 'disagree' and 'strongly disagree'.

For survey item 17, 77.2% of the respondents are agree that male and female students in the engineering technology courses treat each other respectfully in classes. On the other hand, only 6.3% responded negatively with 'disagree' and 'strongly disagree' while the rest gave 'neutral' responses. This shows that a high majority of the female students have positive interactions with their male peers during their studies in the engineering technology courses.

In item 18 of the survey, 67.1% of the respondents agreed that sometimes there are barriers that keep females from studying or pursuing in engineering technology. Meanwhile 23.4% are not sure and 12.5% disagree. As the female students are the minority in such courses, there will be inevitable challenges and gaps relating to adaptability, suitability of tasks, compatibility and so. Continual improvement is taking place as more female students and staff are making inroads by contributing their talents in the engineering technology studies and the workplace.

All the findings from the survey and interview are able to answer all the three research questions and shed lights on the realities of female gender challenges in tertiary studies and workplace career where were traditionally dominated by the male gender. This study highlights socio-cultural factors influencing the female students' participation in engineering technology like gender stereotypes and social role theory and the study has shown that the female students stand firm against all the negative factors to persevere in their studies. All the responses from the 18 survey items were well supported and triangulated by interview responses from the interviewed female senior lecturer who was an alumnus of the engineering technology program about two decades ago. A lot of the interview responses supported and echo the findings from the survey.

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CONCLUSION

The study was able to provide useful insights into the experiences and challenges faced by female students in engineering and technology courses. The study also shows that the female engineering technology students indicate an overall positive perception about engineering technology as suitable field of tertiary study and as an appropriate career choice for women. The findings from this study could raise the awareness on the need for gender-sensitive policies, adequate opportunities and support systems to address the barriers faced by women in engineering and technology field of study and career options. The study proves to be significant in continuing to promote gender diversity in the engineering technology fields for the benefit of the nation.

AUTHOR CONTRIBUTION

Author 1: Conceptualization and writing **Author 2**.: Writing and data collection **Author 3**: Data collection and analysis **Author 4**: Writing, analysis and reviewing **Author 5**: Reviewing and editing

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