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The Relationships between Gender, Social Expectation, and Decision-Making Processes of Engineering Students

Luis Miguel Dos Santos
Asst. Prof., Woosong Language Institute, Woosong University, South Korea, *luismigueldossantos@yahoo.com*

This study aims to explore the gender roles, social expectations, motivations, career decisions, and sense-making processes of a group of undergraduate female engineering students, particularly in the fields of naval, marine technology, and maritime studies, in the United Kingdom. Based on the Social Cognitive Career and Motivation Theory, two research questions were listed, why do undergraduate female students decide to study engineering, particularly in naval, marine technology, and maritime studies, as their career development? How do undergraduate female engineering students describe and make sense of their academic voyage and experiences as pre-service engineering professionals based on their gender, social expectation, and decision-making process? In line with the qualitative phenomenological approach, interview, focus group activity and member checking interview were employed to collect the stories from 20 female undergraduate engineering students in the United Kingdom. Three main themes were categorised, 1) interest in STEM learning, 2) determination about an engineering career, and 3) the surrounding environment: connection and relationship with the ocean. The results showed the potential managerial developments for gender diversity and constructive gender policies in engineering based on the voices of female engineering professionals. The outcomes of this study will fill the gaps in gender and gender issues in the engineering profession.

Keywords: decision-making process, engineering student, female student, gender diversity, self-efficacy, social expectation, university student

INTRODUCTION

For decades, the engineering profession has been known as the gender-based profession (i.e.male-dominated field) in which female engineers and staff are considered as the minority groups (Botella et al., 2019; Dos Santos, 2021b). Although no government regulations limit female engineers and staff's professional and career developments, many female individuals and groups decide not to join and even express their interests and personal hobbies in the engineering profession field due to gender biases and sociocultural pressures from society and communities. However, the desire (of female individuals and groups) to join the engineering profession does not stop and limit in

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response to discrimination and bias from different channels and directions—every year, many female secondary school graduates have applied for and enrolled in engineering programmes at the university level (Cadaret et al., 2017).

Purpose of the Study

This study aimed to explore the gender roles, social expectations, motivations, career decisions, and sense-making processes of a group of undergraduate female engineering students, particularly in the fields of naval, marine technology, and maritime studies, in the United Kingdom. Although there are no gender-based national statistics for the student populations, particularly in naval and marine technology and maritime studies, students enrolled in those academic programmes are likely male individuals and groups.

Reid et al. (2018) argued that individuals and groups' skills and professional practices should not be limited based on their gender and gender-related factors. However, in engineering, it is not common that gender biases and discriminations play an important role. Therefore, the results of this study should fill gaps in the current knowledge of human resource shortages and management issues in engineering education and the profession. In short, the study was guided by two research questions:

Why do undergraduate female students decide to study engineering, particularly in naval, marine technology, and maritime studies, as their career development?

How do undergraduate female engineering students describe and make sense of their academic voyage and experiences as pre-service engineering professionals based on their gender, social expectation, and decision-making process?

Significance of the Study

As many recent studies (Dos Santos, 2021b; McCullough, 2019) argued, the workforce problems of female engineering professionals were underestimated. In other words, female engineering professionals and students face challenges and difficulties due to their gender and gender-related issues. The results of this study will fill the gap in this area and provide effective recommendations for managerial developments and reforms in engineering and engineering education.

Literature Review

Theoretical Framework: The Social Cognitive Career and Motivation Theory

The Social Cognitive Career and Motivation Theory (Dos Santos, 2021a, 2021b; Kwee, 2021) was employed. The Social Cognitive Career and Motivation Theory was developed based on the Social Cognitive Career Theory (Lent et al., 1994) and Self-Efficacy Approach (Bandura, 1986), which advocated that individuals' career behaviours and motivations could be influenced by internal and external factors interactively. Social Cognitive Career Theory was useful for understanding students' decision-making process and career approach (Dos Santos, 2020; Dos Santos & Lo, 2018; Navarro et al., 2007). Based on the Social Cognitive Career Theory, a previous study (Dos Santos, 2021d) investigated the motivations and reasons why a group of

female mechanical engineering students decided to study this academic programme. Another study (Gibbons & Shoffner, 2004) also investigated first-generation college students' career developments and needs with an in-depth understanding. Decision-making processes and motivations tended to be impacted by one or multiple strategies and factors from the personal beliefs and/or social environment. In other words, psychologists argued that individuals' decision-making processes and behaviours would be impacted by various factors in the philosophical, psychological, and social levels. Without an in-depth understanding, researchers and scholars would not understand the factors behind it (Dos Santos, 2021a, 2021b; Kwee, 2021).

Two directions were categorised based on the Social Cognitive Career and Motivation Theory (Dos Santos, 2021a, 2021b; Kwee, 2021). First, individuals' behaviours may be influenced by their psychological and internal factors with self-efficacy, with 1) academic interests, 2) personal considerations, and 3) achievements of education and career goal. Second, social and external factors with 1) interests in career development, 2) financial considerations, and 3) surrounding environments and individuals also take an important role. In this study, with the application of the Social Cognitive Career and Motivation Theory, the scholar investigated the career decision and experiences of undergraduate female engineering students in the United Kingdom. As the Social Cognitive Career and Motivation Theory is one of the latest theories in motivations and decision-making processes, only a few studies have employed the study for this study. One of the related studies (Dos Santos, 2021e) investigated the motivations and reasons why international students decided to stay in Australia for career and job developments after their graduation. Based on the results, the results of the study outlined the relationships between different factors from the Social Cognitive Career and Motivation Theory for further managerial developments and contributions to the practice. Figure 1 indicates the social cognitive career and motivation theory.

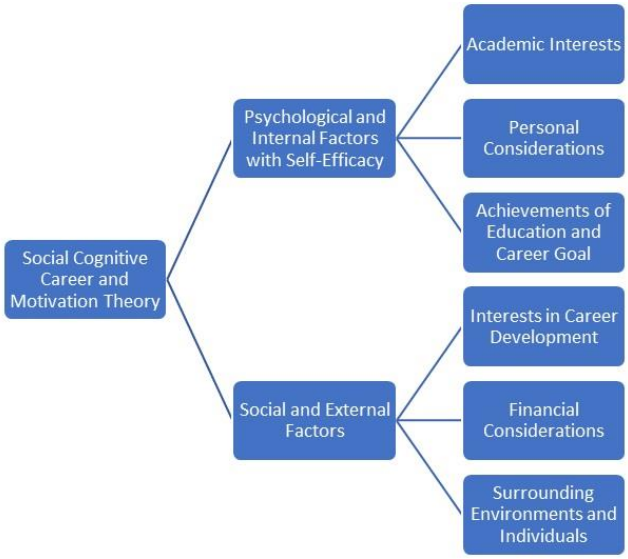

Figure 1
Social cognitive career and motivation theory

Female Professionals in Engineering and Engineering Students in the United Kingdom

Nevertheless, Dos Santos (2021a) argued that the population(s) of female engineers, engineering administrators, engineering students, engineering management, and even women in the related profession is relatively small compared with the number(s) of women in the other professions, such as the liberal arts, and the social sciences. Based on the report from one of the British professional societies (i.e. The Women's Engineering Society in the United Kingdom) (*Useful Statistics*, 2021) and a report from the nonprofit engineering organisation (i.e. Engineering UK) (Armitage et al., 2020), as of 2018, only less than 13% of the registered professional engineers were women, and slightly more than 20% of the country's engineering human resources, including administrative staff (e.g. managers and administrators), were female individuals and groups. Although secondary schools, school leaders, student counsellors, and government departments encourage students to achieve their educational goals based on their own personal hobbies, academic interests, and career perspectives, the study argued that after university graduation, only 25.4 % of female students and graduates (as opposed to 51.9% of male students) considered pursuing any job opportunities and long-term career developments in the field of engineering (or highly related professions).

Singh and Vinnicombe (2000) argued that gender and gender bias played important roles in the engineering profession, including engineering management for female engineering managers in Sweden and the United Kingdom. The scholars asserted that female professionals and engineers experienced difficulties, organisational disrespect(s), and confusion(s) about their commitment(s) because of the gender-oriented biases,

discriminations, roles, and professionalism (many believed female individuals cannot do and achieve the same results as male individuals). Although the study's participants were professionals with expertise and talent, they experienced challenges in engineering professions. Maskey (2018) argued that the workforce shortage and professional and registered engineers will not likely be solved and changed in the upcoming decades without effective plans and schemes in the United Kingdom and some similar regions and countries. A problem in the engineering profession is that of gender bias in favour of male professionals (Singh & Vinnicombe, 2000). Armitage et al. (2020) argued that the unbalanced issue in engineering is significant. In other words, the populations and numbers in engineering leadership, on faculties, and as frontline professionals are male.

Dos Santos (2021b) found that the general public members believed female secondary school graduates lack the interest to join academic engineering programmes because female students do not believe they can find other female counterparts and peers in the schools. Chew et al. (2020) interviewed 19 female engineers about their experiences, practices, and workplace conditions in engineering organisations. The participants indicated that gender and related gender-oriented issues could be some urgent problems. However, if their career developments and long-term job opportunities met their expectations, followed fair human resource policies and perspectives, and had supportive management from the upper leadership and co-workers that informed positive social exchange, they were willing to continue to invest in a lifelong career pathway in the engineering profession (although the conditions are not favourable).

Working Conditions and Workforce Problems of Female Engineers and Engineering Students

From the perspective of social expectations, the general public members, social communities, parents, schools, teachers, and even counsellors further believed that occupations and university programmes might have some bias(es) toward certain gender groups and roles (Hand et al., 2017). A recent study (Dicke et al., 2019) investigated the traditional work/family related gender role beliefs in teenagers believe the gender issues and factors in educational and science-related career decisions and achievements in adulthood. Although some participants argued that their gender roles might not influence their personal achievements, the psychological and social expectations may impact some of their career achievements. Another recent study (El-Hout et al., 2021) also argued that social and cultural expectations, particularly cultural values and characteristics, played an important role in women's preferences and expectations in STEM fields and areas. As a result, it is important to understand the relationship between gender, social expectation, and the decision-making process of female STEM students at the university level, particularly female engineering undergraduate students (Nosek et al., 2009).

METHOD

This qualitative research study employed the phenomenological approach (Giorgi, 1985) with interpretivism (Burrell & Morgan, 1979) for undergraduate female engineering students. The qualitative design is appropriate because the scholar sought gender roles,

social expectations, motivations, career decisions, and sense-making processes of a group of undergraduate female engineering students, particularly in the fields of naval, marine technology, and maritime studies, in the United Kingdom. Unlike quantitative research tools with surveys and questionnaires focusing on numbers and statistics (Tang & Dos Santos, 2017), by employing the qualitative data collection tools, the scholar could understand the in-depth sharing, such as lived stories of their sense-making processes (Dos Santos, 2021b).

Participants and Recruitments

The purposive and snowball strategy (Merriam, 2009) were used. First, the scholar contacted two undergraduate female engineering students as the first group. With the verbal arrangement from these two participants, the scholar sent the consent form (ready-to-sign agreement), interview protocol (interview arrangement and questions), risk statement, and related materials to the participants. The participants were asked to further refer at least one undergraduate female engineering student(s) for this study. After several rounds of referral and discussion, 20 participants were willing to join the study. The participants should meet the following points in order to join the study,

Undergraduate student in the field of naval, marine technology, and maritime studies;

Female individuals;

Currently enrolled at one of the abovementioned academic programmes in the United Kingdom;

At least 18 years old.

Data Collection

In order to increase the validity of the study, the scholar employed three qualitative data collection tools, including multiple interview sessions, focus group activities, and member checking interview sessions. First, the scholar created three interview protocols for three lifespans, including 1) childhood and teenage experiences, 2) university experiences, and 3) career decisions during and potentially after university. Due to the location and the social distancing recommendation(s), the online-based interview sessions were conducted via Skype and Zoon-based applications. Each interview session lasted from 54 to 116 minutes.

Second, after completing all the interviews (i.e. a total of 60 interview sessions) with 20 participants, they were asked to join a focus group activity online. Again, due to the social distancing recommendation(s), the online-based focus group activities were formed. Two focus group activities were conducted (i.e. ten participants per group). The focus group activities lasted from 112 to 134 minutes with a 15-minute break.

Third, after completing the interview sessions and focus group activities, the scholar categorised the sharing based on each participant. Afterwards, the scholar sent the related sharing to each participant for confirmation. Therefore, the member checking interview sessions were hosted for each participant. During the member checking

interview sessions, each participant was asked to confirm their own sharing and lived stories. The member checking interview lasted from 34 to 45 minutes. All participants confirmed their data. Please note, the scholar used a digital recorder to record all sessions. However, no visual data could be categorised.

Data Analysis

The scholar employed the data analysis tools based on the recommendations of the grounded theory approach (Strauss & Corbin, 1990) and general inductive approach (Thomas, 2006). The scholar employed two techniques, including the open-coding technique and the axial-coding technique (Strauss & Corbin, 1990; Thomas, 2006), to categorise the massive sharing from the participants.

First, the open-coding technique (Strauss & Corbin, 1990; Thomas, 2006) was used to categorise meaningful sharing and stories into different themes as the first-level groups. During this stage, 12 themes and 13 sub-themes were categorised, such as family influence during early childhood. However, Merrian (2009) argued that further developments should be taken for an effective qualitative report. Therefore, in order to conduct further data analysis, the axial-coding technique (Strauss & Corbin, 1990; Thomas, 2006) was employed for the second-level groups. As a result, three themes and two sub-themes were yielded.

Human Subject Protection

Privacy of all parties is the most important element in this study. As a result, the signed consent forms, sharing, stories, contact information, university information, computer, and related information were all locked in a password-protected cabinet. Only the scholar could read the information. Once the study was completed, the scholar deleted and destroyed all materials to protect privacy. The study received support from the Woosong University Academic Research Funding 2022.

FINDINGS

From 60 semi-structured interview sessions and focus group activities from 20 participants, the scholar collected a series of meaningful themes based on the participating students' lived stories and experiences. Although not all participants had gone to the same secondary schools and universities, many of their perspectives and ideas were similar. The scholar ultimately categorised three themes and two sub-themes from the data. Findings are presented in Table 1.

Table 1
Themes and subthemes

Themes for the study	
3.1.	Interest in STEM Learning: Studying Based on the Participants' Interests
3.1.1	Determination: Engineering as Educational Pathways and Long-Term Development
3.2.	Determination about an Engineering Career: Overcoming Gender and Social Biases
3.2.1	Knowledge and Professional Skills Played Strong Roles than Gender
3.3.	The Surrounding Environment: Connection and Relationship with the Ocean
3.3.1.	

Interest in STEM Learning: Studying Based on the Participants' Interests

All 20 participants shared their academic and personal interests in the STEM courses and their practical lab experiments. First, STEM courses, particularly engineering courses, involved multiple knowledge, skills, and subject matters. In other words, STEM subject matters are not standalone courses. Students and professionals should understand multiple knowledge from the STEM fields in order to handle their professional responsibilities and occupation(s) during and after the university education and voyage. Several stories were captured,

> *I want to combine my knowledge and experiences for my studies…I enjoyed the lab and experiments with my hands…see the changes and the procedures…from point one to point four with different steps…in the lab…in the experimental labs and in the real and practical classrooms…I can use the microscope…the learning procedures are great…I want to continue this at university…*(Participant #3, Focus Group, First Year)

> *…if I love traditional classroom learning without any lab experiments…I should join the history of physics…or the philosophy of the ocean…but I want to understand the field and the real experience from the ocean…I join this engineering programme…I know it is very hard for women in engineering…but I could overcome the discrimination with my excellent skills…*(Participant #13, Focus Group, Second Year)

Besides the delivery options (i.e. the differences between the traditional classroom learning and learning with lab and field experiences), other comments concerned the students' interest in the subjects and the rationale of the learning (i.e., the knowledge and materials of the STEM subjects). Many reported that although the STEM subjects were hard and required long hours of study, they wanted to continue because of their interests. Two commented:

> *…I am interested in biology, animal sciences, oceanology, and environmental sciences…one of the possible options is the studies about naval engineering…although many of my secondary school peers, counsellors, and peers…urged me to select general biology instead…I am sure what I am*

> *doing…my interests…in the oceans and sea animals…*(Participant #1, Interview, First Year)
>
> *…I love the ocean…I know I want to contribute my energy and life to this beautiful ocean…my secondary school was 15 minutes walk from the coast…I grew up next to the sea…I know the studies in engineering are very hard…but I am sure my interests in this beautiful ocean will help me to overcome the challenges…*(Participant #3, Interview, First Year)

Determination: Engineering as Educational Pathways and Long-Term Development

From the perspective of the long-term education development, the scholar captured two interesting stories,

> *…my sister told me that I need to have at least a Master of Research degree for a reasonable job or position in the science profession…but I have my interests, and I can continue with it…I have my confidence and I can do it…as long as I love science and engineering…I will study…in engineering…and I received my offer from many universities…*(Participant #17, Interview, Third Year)
>
> *…I am planning to study the Professional Doctorate in Engineering studies after my undergraduate degree…I don't want to study a PhD because I am not interested in research…I want to do the applied sciences and studies, which can help me to improve the problems in the ocean…*(Participant #18, Interview, Third Year)

Determination about an Engineering Career: Overcoming Gender and Social Biases

Besides the personal interests, which may help the students overcome the university's challenges (i.e. as the upper theme explained), the strong self-efficacy and support from university lecturers will help them overcome the problems (Bandura, 1986). The first group's comments were concerned about the situation in the university,

> *…only less than 15% students are women in my department…but it is not an issue…in the United Kingdom, the management and opportunities are all fair…and my lecturers gave us the same energy and assignment…our brains and our learning skills are the same…engineering students, employers, and all others…women can do engineering too…I will receive my degree with first honour…*(Participant #11, Interview)

Second, all expressed concerns, thinking, and ideas about the gender-based problems, workplace conditions, social pressure, and discriminations in the engineering professional environments, organisations, and even university environments, particularly women in the STEM and academic programmes. All participants expressed their strong confidence in and determination about telling people that female professionals would eventually become one of the best leaders and engineering professionals. Two illustrative voices were captured,

> *…people don't want to hire a female engineer for marine engineering and technology…I am here to use my professional skills, ideas, and practical skills to tell people they are wrong…female engineers work perfectly in ocean engineering and marine issues…the ocean and sea will not limit all female engineeing professionals and staff…female would establish ships and boats and professional marine knowledge…the United Kingdom is a coastal nation with marine resources…both men and women can become the best-talented people and engineers…gender is not a consideration…*(Participant #7, Focus Group, First Year)

> *…the fields need marine engineers and experts of the marine sciences in England and Scotland…is gender an issue…totally not…many women experts and professionals are working in oil engineering in Aberdeen…these women are managers, engineers, and blue-collar staff…why should we use gender to categorise people's skills?…some people don't believe female professionals…but I must employ my skills and ideas and…knowledge to change this bias…the number and population…mean nothing in any aspects…women can work…perfectly in…the field of STEM and…engineering…*(Participant #5, Interview, First Year)

Knowledge and Professional Skills Played Strong Roles than Gender

From the perspective between professional skills, learning behaviours, and gender roles, the scholar captured two stories from the participants,

> *…gender, females, women are not the excuses…for people to decide their own studies and job in the future…the former Prime Minister May was a woman…our Queen is a woman…many political leaders are women…I am not seeking the top management and role(s)…I want to achieve my future in engineering…I have to show people that my gender does nothing…but just the discrimination and bias from others…*(Participants #20, Interview, Third Year)

> *…gender is just an excuse from male management…in history, women could only work as housewives…but women could work perfectly…therefore, some male directors are afraid of the women's workforce…I am here to tell people that women can do the same job with the same level of professional skills…women should not be looked down…*(Participant #9, Interview, Second Year)

Also, many argued that the general public expected that women should study liberal arts academic programmes to match and fit social expectations. However, many do not agree with such social expectations, as said,

> *…I know many people believe girls should study liberal arts, such as history, education, primary school education, Latin, accounting, nurse or so…I believe my gender does nothing…girls can determine their future…girls can do their job and create their future…I am here to study engineering and create my future in engineering…*(Participant #2, Interview, First Year)

The Surrounding Environment: Connection and Relationship with the Ocean

In addition, the participants wanted to continue the connection and apply the marine knowledge and relationships to their lifelong career developments. Detailing this direction(s), from the perspective of surrounding individuals' influence, the scholar capture a story, which was about how nature protects the participant's family,

> *…people…countries, regions, cities, and even governments…took away… the natural resources…food…energies…animals from the ocean and seas…we have to think about some ways to save the long-term developments…we have to protect the ocean and environment…my family loves fishing…but once we caught enough fish from the ocean…we need to think about how to save the offspring from the fish colonies…we somehow need to stop and say thank you to our nature…the ocean protected…and contribute their resources to our family…as a human…it is time for us to protect our nature…*(Participant #4, Interview, First Year)

Some participants reported that their father and mother worked in a science organisation for marine science, and the family members conducted many conversations at home about the ocean and coastal environments. Because those participants had acquired an interest in marine science during their childhood, the influence from their family members played important roles in the motivations, career decisions, and sense-making processes. Two said,

> *…I grew up in a marine science family…we shared and watched news and TV about this issue…I am interested in this area and want to build up my expertise and knowledge in this area too…I am happy that my parents can share some good knowledge and lab experiments with my classmates and friends…beyond the classroom environment…we can see the labs in the summer…with my lecturers and classmates…I will continue with this programme with the PhD degree…*(Participant #15, Interview, Third Year)

> *…my father is a lab scientist for oceanology…we chatted…the environmental policies from the government…but chatted the tourism problems…how the visitors harm the environment…we also talked about global climate change and how can we do something to protect the environment…the influences from my family members…made me to work on my engineering degree…I know women are very hard in this profession…but I can do it because I love our Earth…*(Participant #8, Interview, Second Year)

Many indicated that the government departments always encouraged green energy, green fishing, and environmental protection policies to conduct the country's sustainability and global communities. Many have absorbed the knowledge from primary and secondary school environments. As a result, many want to continue with the environmental policies as their long-term developments, said,

> *…from the ideas of sustainabilities…we have to protect our environment…only one Earth…and only one global village…people and scientists need to think*

> *plans…many people do not believe in women…but I am here to work as a professional female engineer…I have to argue and practice the environmental-care policies and management for our ocean…*(Participant #16, Focus Group, Third Year)
>
> *…the Scottish government established many environmental policies in Aberdeen…one of the biggest energy hubs in Europe…at the same time, we have to protect the fishing industry…and think about the pollution policies for people who are living next to the waterbody…perhaps I care about the future of our children…we need to merge with some ideas from females and mothers…we have to balance between the financial consideration and family…*(Participant #14, Interview, Third Year)

DISCUSSIONS

From the perspective of the relationship between the traditional classroom and experimental learning in the university, many STEM subjects and courses required hands-on experiences in the lab environments, such as biology lab, computer lab, and field research experience (Simon et al., 2017). All 20 participants indicated their desires for field experiences (rather than traditional classroom learning). The participants expressed that the hands-on and non-traditional-classroom environments greatly increased their learning interests (Sholahuddin et al., 2021). Besides the personal interests with positive childhood experiences, many believed that their previous experiences, suggestions from peers and family members, and interests of long-term career development also strongly influenced the motivations, career decisions, and sense-making processes. According to some recent studies (Botella et al., 2019; Dicke et al., 2019; El-Hout et al., 2021), gender roles and social expectations of occupation will impact the decision-making processes, the determination(s) of the participants in this study was strong enough to overcome the challenges. In summary, the participants' personal voices followed and echoed the finding from the finding of a project (Falco & Summers, 2019), advocating that the significant childhood experiences and having the self-efficacy in individuals interests and academic courses can significantly influence and increase the likelihood of enrolling an academic programme and career pathway after their academic voyage (Setyaningsih & Sunaryo, 2021). In line with the Social Cognitive Career and Motivation Theory (Dos Santos, 2021a, 2021b; Kwee, 2021), the results found that when individuals' academic and school interests in the STEM courses were based on former childhood experiences and suggestions from third parties, that could influence their motivations, career decisions, and sense-making processes.

From the perspective of human resources management, workforce shortages, and gender roles in the engineering fields, reports and statistics have long argued that the numbers of professionals and registrations of female engineering professionals are relatively low, regardless of the concentrations and specialisations (e.g. the field of engineering practices), and all of the study's participants (based on the literature) understood and acknowledged that issue before they applied to the university (Botella et al., 2019; Maskey, 2018). In line with some recent studies (Dos Santos, 2019, 2021a, 2021c), when the scholar asked the participants about their motivations, career decisions, and

sense-making processes as female engineering professionals, particularly about joining the academic programmes in engineering studies and becoming engineers after their graduation, the participants strongly advocated that they will overcome the gender discriminations, biases from the general public members, and voices from some social pressures.

From the perspective between professional skills, learning behaviours, and gender roles, all participants argued that gender would not influence their knowledge, skills, and professional management in engineering education and their potential engineering career after university (Simon et al., 2017). In line with a recent study (Dos Santos, 2019), although the general society and public members have the bias(es) due to the gender differences, such as women have lesser STEM skills and management, all used their experiences and professional skills as examples to show the evidence. To summarise, according to some recent studies (Botella et al., 2019; McGregor et al., 2017), scholars have argued that gender-based biases and social discriminations in gender issues, particularly in the human resources workforce and salary differences, continue to impact female professionals' career developments, motivations, and decision-making processes. In this case, the female professionals also argued such challenges based on their gender roles. But they argued that they would try to overcome the challenges with their professional skills and practices. In line with the Social Cognitive Career and Motivation Theory (Dos Santos, 2021a, 2021b; Kwee, 2021) and their dedication and determination towards their career development, the contributions of these participants would influence gender diversity and gender equality in the United Kingdom and other international regions.

In line with two previous studies (Kwee, 2020; Rinke, 2009), the influences of the surrounding environments and individuals played an important role(s) in individuals' motivations, career decisions, and sense-making processes. Almost all participants were raised in some coastal cities (cities near the ocean) before enrolling in their engineering programme at one of the British universities. Many had experienced marine environments and connections with the ocean during their childhood and teenage. Also, their family members worked in companies and organisations in ocean-related aspects. Therefore, due to the impacts from their families and the surrounding environments, they had established solid connections and relationships with the ocean. Besides the perspectives and influences from the surrounding individuals, the environmental factors also significantly influenced the motivations, career decisions, and sense-making processes (Dos Santos, 2021b). In summary, many scholars (Kwee, 2020; Rinke, 2009) have argued that people's social and external environments play an important role(s) in individuals' motivations, career decisions, and sense-making processes. Although gender role(s) may play roles in the decision-making process, many believe that their gender (i.e. female) and their gender roles will bring new voices and ideas to the current environmental policies and situations in engineering. The findings of this study confirmed these points, with support from the participants' voices. One participant argued that "*I am a human for our ocean…we need to protect our mother Earth…before it is too late for the long-term protection…*" (Participant #1, Focus Group, First Year). Again in line with the Social Cognitive Career and Motivation Theory (Dos Santos,

2021a, 2021b; Kwee, 2021), these participants' sharings and lived stories strongly outline their professional determination and its basis in their surrounding environment—their families, towns, and the ocean itself.

LIMITATIONS

The scholar categorised three limitations and future research developments for this study. First, the current study only recruited 20 undergraduate female engineering students in naval, marine technology, and maritime studies. Although the results of this study solved the problems in the area, other academic programmes, such as electronic engineering, biomedical engineering etc., also face a similar challenge. Therefore, future research studies may further investigate the problems in other STEM subject matters.

Second, only undergraduate female engineering students could be recruited due to the limited resources. However, postgraduate (i.e. both taught and research-oriented) programmes also face the same challenges, such as gender roles. Therefore, future research studies may further investigate the problems with postgraduate students.

Third, although many British colleges and universities serve many domestic and international students, the results may only reflect the situation, social problem, gender role, motivation, career decision, and decision-making process for participants in the United Kingdom. Therefore, future research studies may take this study as the blueprint to investigate the problems in their own countries and regions.

CONCLUSION

This study contributed to three parties. First, university department heads, university lecturers, administrators, and enrolment managers may take this study as the opportunity to reform and polish the current policies, curriculum design, recruitment strategies, and even gender policies in the university environment. Many STEM departments and faculties may face an unbalanced ratio between male and female students. The results of this study (i.e. from the students) released the voices and comments for the appropriate personnel to improve the diversity. For example, based on the voices of the participants, departments may provide additional help and secondary school admission fairs for female and minorities students who may face challenges in the STEM subjects and programmes.

Second, secondary school counsellors and teachers may also take this study as the opportunity to upgrade the university admission counselling sessions. Many participants indicated that the general public members' social expectations, gender roles, and voices played important roles in their decision-making process. Secondary school personnel should establish counselling sessions and plans for students to overcome challenges and select the appropriate academic programmes. For example, secondary school personnel may encourage female and minorities students to join some internships and field trips during their teenage in order to increase their understanding and experiences in the fields before university.

Third, government leaders, policymakers, and scholars may take this study as the opportunity to upgrade the current plans and schemes for gender roles and social justice

for minorities. Although there are no policies for discriminations and biases (i.e. toward minorities students in university selection), the social expectations and biases from the general public continue to harm secondary school students' self-efficacy and decision-making process. Therefore, based on the comments from this study, appropriate personnel should establish plans and ideas for social justice and gender diversity.

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