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Women's learning motivations: Qualitative inquiry of doctoral students in civil engineering

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Professional practice and engineering education are important developments in the field of engineering. Based on Social Cognitive Career and Motivation Theory, this study aims to understand the motivations, reasons, and career decisions of doctoral students of civil engineering. Specifically, the researcher aims to understand the motivations and reasons that may influence students' decision-making processes, particularly those of women, in regard to joining a doctoral degree programme in engineering. An interpretative phenomenological analysis was utilised in this study, with three interview sessions and one focus group activity employed for data collection. The findings indicate that achievements regarding education and career goals (becoming leading engineers and engineering educators), interests in career development (achieving advanced qualifications to obtain higher leadership positions), and the importance of surrounding environments and individuals (integral to One Belt One Road opportunities) are the main motivations and sense-making elements in regard to career decisions. Government leaders, human resources planners, department heads, university leaders, organisational managers, and other researchers may use this study as a blueprint to reform and improve their human resources management and engineering education schemes based on the recommendations and desires of scientists.

KEYWORDS

engineering education, engineering student, human resources management, One Belt One Road, social cognitive career and motivation theory, women in engineering, workforce management

Introduction

Background

From the late 1990s, the fast development of the engineering profession combined with social development has led to many young adults deciding to join the engineering profession with life-long development in mind. Engineering is a programme that suits

many industry-oriented and resource-rich countries, such as those within Southeast Asia. Every year, many traditional-age and returning students study in engineering schools to gain vocational knowledge to become registered engineers (Ballen et al., 2017; Falco and Summers, 2019). However, an undergraduate degree in engineering may only respond to the industrial needs of frontline engineers, engineering managers, and administrators. Henceforth, there is a demand for advanced degrees and training in engineering education for roles such as managing directors and internship supervisors. Although master's degree graduates in engineering may fill some positions in the aforementioned areas, the industry continues to demand doctoral degree holders in engineering for some higher level positions (Serrano and Groh, 2016; Maskey, 2018; Botella et al., 2019; McCullough, 2019).

The doctoral degree engineering programmes in Thailand follow the American curriculum, which may require students to complete both coursework and a thesis to graduate. When completing coursework, students can improve their vocational and professional skills, particularly in applications and skills that can be deployed after graduation (Dennehy and Dasgupta, 2017; White, 2018; McCullough, 2019). Although social stigma and biases mean that gender plays a significant role in who enters the engineering profession in Thailand, faculty at the university usually encourage minorities to join to close the gap and increase diversity in the industry (McGregor et al., 2017; Tao and McNeely, 2019).

Purpose of the study

This study aims to understand the motivations, reasons, and career decisions of doctoral students of civil engineering. Specifically, the researcher aims to understand the motivations and reasons that may influence their decision-making processes in regard to joining a doctoral degree programme in engineering. Two research questions guided this study:

1. Why and what are the motivations and reasons for joining and studying doctoral degree programmes in civil engineering studies at a Thai university?

2. How do doctoral students in civil engineering describe their experiences and sense-making processes, as they move from being experienced engineers to doctoral degree students?

Significance of the study

Although many studies in engineering focus on professional practice, technological development, and advanced skills, only a few studies concern the needs of engineering students, particularly those at doctoral level. Also, the social stigma attached to women entering the profession, which then creates a gender gap in the field, continues to impact the work of human resources management and workplace environments. Therefore, the results of this study will close the gap in this field and offer recommendations to government leaders, policymakers, university leaders, engineering professionals, and researchers to improve current policies that affect women in engineering, particularly for those studying for doctoral degrees.

Theoretical framework and literature

Social cognitive career and motivation theory

The current study was guided by the Social Cognitive Career and Motivation Theory (Dos Santos, 2021a). The Social Cognitive Career and Motivation Theory was originally developed based on Social Cognitive Career Theory (Lent and Brown, 1996) and Self-Efficacy Approach (Bandura, 1988). The Social Cognitive Career and Motivation Theory argued that individuals' motivations and career decisions might be influenced by psychological and internal factors with self-efficacy, such as (1) academic interests, (2) personal considerations, and (3) achievements of education and career goals, and social, and external factors, such as (1) interests in career development, (2) financial considerations, (3) surrounding environments and individuals. Individuals and groups may be impacted by one or more factors during their career-decision procedure and sense-making process. In this study, as giving up the original position and joining the doctoral degree programme as full-time students is not an easy step for many adults and non-traditional-age individuals, the theoretical framework may provide a holistic picture of the current background in engineering education. **Figure 1** outlines the social cognitive career and motivation theory.

Engineering education

Engineering is an interdisciplinary field of study that involves the combination of multiple skills, theoretical knowledge, and practices (Chou and Chen, 2017). Unlike other subject matters, such as biology and mathematics, engineering students and professionals require an in-depth understanding of applied mathematics, statistics, and quantitative skills in one or more scientific subject matter(s), such as transportation, material science, and chemistry (Profillidis, 2016). Therefore, during academic training, such as in undergraduate degree in engineering programmes, students need to understand, learn, practice, and handle multiple skills and knowledge across their classroom environments and internship sites (Fletcher et al., 2021). Currently, an undergraduate degree in engineering is

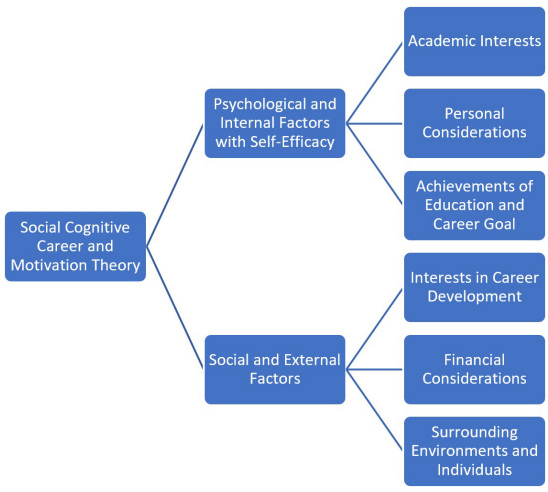

FIGURE 1
Social cognitive career and motivation theory.

designed for traditional-age secondary school graduates and returning students who want to gain practical knowledge as frontline staff and engineers at the industry level. If engineers want to gain in-depth and upper skills, such as theoretical knowledge, managerial skills, engineering education and teaching abilities, postgraduate education and training are essential (Kamphorst et al., 2015).

Postgraduate degree programmes, particularly academic programmes at the doctoral level (i.e., Doctor of Philosophy in Engineering), always require in-depth research and understanding in regard to particular knowledge and practice in the field. Thailand is a popular educational destination for science and technology education. Every year, a large number of domestic and international students decide to apply for doctoral degree programmes in engineering studies in Thailand (Kocijancic and Boonsongsrikul, 2013). In order to apply and potentially gain admission offers from doctoral degree programmes in engineering studies, applicants should have at least 6 years of professional working experience in the field, solid knowledge in their engineering profession, recommendation letters from their supervisors and potential thesis supervisors, publications in international-based journals and the form of book chapters, and/or registrations for their patents. Although these admission requirements are challenging, many applicants successfully gain offers and start their education (Bordia, 2001).

Challenges of women in engineering: The situations in the global industry

Women face challenges, discrimination, and social stigma in STEM, particularly engineering. A recent study (Botella et al., 2019) argued that women in engineering face challenges in engineering. Gender diversity plays a significant role in the STEM and Information Technology fields, and male counterparts and leaders dominate industries. Only a few women in upper management may encourage pre-service and junior-level women in engineer to join the industry, regardless of their specialisations and educational backgrounds. Another recent study (Fletcher et al., 2021) also argued that gender and skin colour played significant roles in engineering as many mid-level and upper management positions are occupied by White and male people. Although women in engineering and women of colour tried to climb to the upper management, the gaps could not be closed. Another study (Maskey, 2018) also argued that businesses and organisations should invest in funding and training for women in engineering. More than 60% of engineering companies and organisations in the United Kingdom need additional engineers for the workforce gaps. Although dozens of colleges and universities offer engineering training and degree programmes, the workforce gaps, particularly for women in engineering, are not filled. The workforce shortage is less likely to be filled as many women in engineering decided to leave the engineering industry after university graduation (Support Science Technology Engineering and Mathematics [STEM], 2020).

Challenges of women engineering students: The situations in academia

Women engineering students, learners, and educators face challenges and social stigma in education. A recent study (McCullough, 2019) argued that although the gender gaps and gender-oriented discrimination in STEM are being closed, the upper management and senior positions are occupied by male leaders. Although they are well-prepared, women in engineering and STEM workers usually take the frontline and mid-level positions. Another recent study (Carnemolla and Galea, 2021) also argued that lack of awareness and self-alignment, gender gaps, esteem, and influences from other people played significant roles in the career decisions and decision-making processes of women in high school students in engineering. A study (Balakrishnan and Low, 2016) also indicated that the sociocultural factors and views of the general public members also influenced and impacted the decision-making processes of women and groups in the engineering field, particularly women and students who have an interest in engineering. Although many women and students want to join the engineering industry, the voices and comments from others could limit their career decisions (Vidal et al., 2020).

Doctoral learners' motivation for learning

In general, doctoral learners and curriculum developers recognise that doctoral learners and graduates must have different understandings, achievements, learning expectations, and outcomes (from master's and undergraduate students). Many elements influence students' motivations and career decisions (e.g., achieving their academic qualifications and goals). According to a recent study (Mosyjowski et al., 2017), doctoral degree students and graduates want to understand how to improve their current workplace environments, practical skills, managerial styles, and theoretical knowledge in their profession. Unlike their frontline co-workers with undergraduate training, individuals with doctoral training may lead and create new management and knowledge in their professional practice. Another study (Wiegerová, 2016) indicated that doctoral students are motivated by two factors: external factors involving the fulfilment of ideas from others, modelling, and financial considerations; and internal factors, which concern ideas about becoming researchers, entering their desired field, teaching at the university level, and enjoying the excellence of education. Another study (Guerin et al., 2015) collected surveys from 405 participants about their motivations and reasons for pursuing doctoral education. The findings indicated that family and friends, internal motivations, influences from previous faculty members, positive research experiences, and career considerations were the key ideas underlying their doctoral education. Therefore, although different individuals may have various motivations and reasons for studying, many may be influenced by external and internal factors from their lived experiences.

Methodology

Research design

The researcher employed the interpretative phenomenological analysis (IPA) (Smith et al., 2009) as the means for the qualitative investigation. The interpretative phenomenological analysis is the appropriate design in this study as the researcher tended to collect in-depth and rich data from a small group of individuals who are working on their doctoral degree programme in civil engineering at one of the Thai universities. Based on the guideline of the interpretative phenomenological analyses (Smith et al., 2009), the results of this study are rich and engaging with lived stories and a personal understanding of their sense-making process. Some personal understanding and lived stories are hard to be explained from statistics and numbers. Therefore, the qualitative research design met the expectation of this study.

Recruitment, participants, and data collection

Women doctoral degree students in engineering in the Thai university environment are underrepresented. The snowball sampling strategy (Merriam, 2009) was employed to recruit eight participants for this study. The reason for employing the snowball sampling strategy was to recruit enough participants with similar backgrounds. The researcher started with participants based on personal networks, which was followed by snowball sampling to recruit a sufficient number of participants for the qualitative study.

For the first step, the researcher connected one doctoral degree student in engineering studies at one of the Thai universities. The participants needed to meet all of the following points in order to be recruited, (1) a currently enrolled doctoral degree student in the field of civil engineering in Thailand, (2) a plan to continue to work in the field related to civil engineering after graduation, (3) Thai citizens. **Table 1** outlines the demography of the participants.

Once the participant orally agreed with the study, the researcher sent the research protocol, consent form, interview questions, focus group activity questions, and referral agreement to the participant. The participant signed and emailed the consent form to the researcher. Then, the researcher arranged the individual and semi-structured interview session *via* the distance-based application for the virtual interview. According to some qualitative researchers (Morgan, 1998; Creswell, 2012), in order to gain in-depth interview data and lived stories from the participants, the researcher needs to conduct multiple interview sessions. Therefore, in this case, three interview sessions per participant were conducted. After the first interview session, the participant should try his/her best to refer at least one doctoral degree programme student in civil engineering studies at one of the Thai universities. A total of eight

TABLE 1 Demography of the participants.

Name	Positions before the doctoral degree enrolment	Years of experiences	Continue doctoral degree after master's
Participant #1	Engineer	8	Yes
Participant #2	Engineer	8	Yes
Participant #3	Engineer	9	Yes
Participant #4	Senior engineer	10	Yes
Participant #5	Senior engineer	10	Yes
Participant #6	Engineering manager	11	Yes
Participant #7	Engineering manager	11	Yes
Participant #8	Senior engineering manager	11	No

participants joined. Three interview sessions and one focus group activity were employed. The themes of these three interview sessions were about (1) experiences during your undergraduate degree in the engineering programme, (2) your working experiences, and (3) leaving your position and your current doctoral learning experiences. Each interview session lasted from 67 to 83 min. After the interview sessions, the researcher invited all eight participants to the distance-based focus group activity (Morgan, 1998). Due to the location, the focus group activity was hosted virtually. The focus group activity lasted 113 min.

Language uses

As English is the language of this study, the researcher sent the English materials to the appropriate personnel. During the data collection procedure, the participants were allowed to use English, Chinese, or Thai for their sharing. If the participants need to conduct the sessions in Thai, the researcher could request an interpreter for an oral translation. Also, a translator may be required if the participants need to share any written information in Thai. The researcher covered the costs of the interpreters and translators.

Data analysis

The researcher re-read the transcripts multiple times for the potential connection. Then, the researcher employed the open-coding technique for the first-level themes. The researcher categorised 22 themes. However, further coding was required. Therefore, the researcher employed the axial-coding technique for further development (Merriam, 2009). As a result, three themes and two subthemes were merged for this study.

Human subject protection

Privacy of this study was the most important consideration due to the career and educational opportunities in this narrow profession. Therefore, all the signed consent forms, personal connections, voiced messages, written transcripts, computers, and related materials were locked in a password-protected cabinet. Only the researcher has the right to read the materials. After the researcher completed the study, the researcher immediately deleted and destroyed the materials. The study was supported by Woosong University Academic Research Funding 2022.

Results and discussions

The researcher collected more than 600 pages of written transcripts through the data collection and data analysis procedure. Although the participants are currently enrolled in and studying under different doctoral degree programmes in engineering studies in Thailand, many shared similar ideas and lived stories. In particular, after the focus group activity, many shared and exchanged ideas. Many have established personal and academic connections and networks as a result of this study. For the details of the relationship between the research questions, theoretical framework, data collection tools, and finding themes, please refer to **Figure 2**. Please note that the researcher combined the results chapter and the discussion chapter as a comprehensive chapter for immediate comparison. Readers may compare the current findings and previous literature for readership. **Table 2** outlines the themes and subthemes.

Achievements of education and career goal: My gender role

All eight participants received their undergraduate degrees in engineering studies. Although the participants indicated that the social stigma and negative comments from the general public members influenced their career decisions and decision-making processes due to their gender (Botella et al., 2019; McCullough, 2019), all of them joined the engineering profession after graduating from university. After all of the participants had gained 8–11 years of professional working experience in the industry, they went back to university for master's degree programmes. Seven continued their doctoral degree education straight after completing their master's degrees, whilst one decided to join the doctoral programme after several years. Based on their achievements in undergraduate and master's degree programmes, they want to apply their engineering knowledge and practice from the classroom to the working environment. The researcher captured two stories,

> *. . .we learnt a lot of mathematic knowledge. . .but many of these mathematic skills are pure maths but not applied maths. . .we have to work with a lot of blue-collar workers who do not understand any scientific terms and knowledge. . .we have to use different ways and explanations. . .to describe the knowledge to them. . .but I enjoyed this way as I can transfer my textbook materials to workplace. . .*(Participant #1, Interview).

> *. . .I want to use my engineering knowledge and apply to our Thai communities. . .many regional areas. . .still need a lot of foundational developments, such as buildings and trains. . .I am happy that my knowledge and skills can help to build up my country. . .*(Participant #8, Focus Group).

All participants argued that they face challenges and social stigma due to their gender roles in the industry and academia.

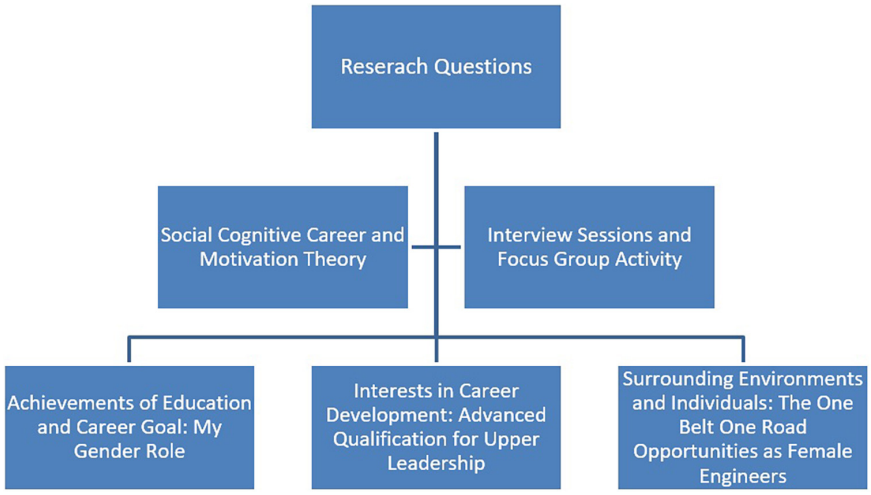

FIGURE 2
Relationship between the research questions, theoretical framework, data collection tools, and finding themes.

However, many decided to ignore the negative comments and viewpoints from others. Many believe that achievements of education and career goal is their first priority, particularly as women in engineering said:

> *. . .my co-workers in the engineering organisation told me that. . .I should not study my doctoral degree because there are no rooms for female engineers and senior positions. . .but I want to tell people that female engineers can be useful and powerful in this field. . .my gender should not be my limitations. . .*(Participant #4, Focus Group).

Becoming the leading women in engineering and engineering educators

When the researcher asked about their goals and ideas after their doctoral degree graduation, all eight participants indicated a desire to become leaders or faculty members in the engineering profession after graduating from their doctoral degrees. Based on the reflection of a previous study (Lent et al., 2008), all strongly indicated that the doctoral degree qualification and background always increase their motivation, self-efficacy, and determination for leadership (Zemelka, 2017; Tao, 2018; Frehill, 2020). Several participants said that they wanted to become leading engineers because of the curriculum and training in their undergraduate degree in engineering studies during their undergraduate education (i.e., some positive previous experiences influence their career decisions and motivations), particularly as women in engineering and contributors to the engineering fields. Two participants commented:

> *. . .I learnt engineering management and organisational leadership from my undergraduate and master's degrees. . .I sought interests in management. . .in the engineering company. . .or from the construction site. . .I want to become a female leader. . .or a female manager. . .because of my degree. . .so I studied my master's degree. . .but a master's degree is not enough. . .therefore, a doctoral degree is needed. . .also, I believe the degree will help me to overcome gender discrimination. . .*(Participant #3, Interview).

> *. . .I think effective primary, secondary, and university education take a very important role in people's motivations and career goals, particularly for female people. . .if I met a good teacher in history, I might join the history department. . .but my teachers. . .were good in maths and sciences. . .and use many computer systems for the maths courses. . .I joined engineering. . .as a woman. . .*(Participant #7, Interview).

According to a previous study (Thanomsilp, 2018), interdisciplinary and effective teaching and learning strategies

TABLE 2 Themes and subthemes.

Themes and subthemes
4.1 Achievements of education and career goal: My gender role
4.1.1 Becoming the leading women in engineering and engineering educators
4.2 Interests in career development: Advanced qualification for upper leadership
4.2.1 Use the qualification for career promotion based on their previous experiences as women in engineering and engineering educators
4.3 Surrounding environments and individuals: The one belt one road opportunities as women in engineering

could increase the interests and learning outcomes, which eventually change the motivations and career decisions of the students. Besides a desire for women in leadership positions, another group of participants indicated that, due to their supervision experiences (i.e., working as site-internship supervisors), and professional experiences and knowledge, they intended to work in the field of engineering education. Two participants commented:

> *. . .supervising junior workers or university interned students are fun. . .I want to guide and teach the newcomers in our field. . .we need to provide practices and ideas to the new blood. . .but I think my knowledge is not good enough. . .so I need to study a doctoral degree. . .*(Participant #2, Interview).

> *. . .the doctoral degree training is not only a leadership development. . .it also helps us to build up the training skills for our junior-level engineers and co-workers. . .it really enjoyed my time as a supervisor. . .the experience made me join the doctoral degree in engineering too. . .*(Participant #4, Interview).

In line with the Social Cognitive Career and Motivation Theory (Dos Santos, 2021a), achievements regarding education and career goals in the participants' previous undergraduate degrees in engineering studies and working experiences played important roles in their sense-making processes. First of all, although the participants argued that their gender roles and gender status (Dennehy and Dasgupta, 2017; Botella et al., 2019; Dos Santos, 2021b) played significant roles in their decision-making processes, the participants argued that their achievements and interests would overcome the challenges in the gender gaps in engineering. This finding echoes previous studies (Falco and Summers, 2019; Frehill, 2020) in regard to how positive experiences in education and the workplace may influence career decisions and career developments. Although many expressed social stigma and challenges due to their gender roles, the challenges have become the encouragements and motivations.

Interests in career development: Advanced qualification for upper leadership

Some scholars (Roach, 2017) indicated that doctoral degree graduates might join the industry as upper-level scientists, managers, trainers, or teachers. After years of experience, many individuals aim to gain managerial positions for the sake of their career development and promotions, particularly as women in engineering. With the reflection of the previous study (Tao, 2018), in this study, all participants expressed their interest in upper managerial or university teaching opportunities based on their advanced qualifications (i.e., doctoral degrees). Specifically, all expressed an interest in either full-time or part-time university lecturing opportunities after completing their doctoral degree programmes, particularly as women in engineering, engineering educators and experts. Two participants commented:

> *. . .if I can teach and combine my professional practices and theoretical knowledge to my students. . .it is very practical. . .many faculty members in the universities. . .tend to be theoretical teachers. . .but in the sites, we need to combine knowledge, practice, and management. . .not just knowledge. . .I can deliver these unique vocational ideas to our students. . .*(Participant #6, Interview).

> *. . .many Thai universities do not have enough teachers and lecturers in engineering, particularly female educators. . .I think I have to use my human resource to fill up the gap. . .the workforce shortage. . .we need to have more engineers. . .so if our universities have more teachers and lecturers, we can host more engineering programs and courses. . .*(Participant #5, Interview).

In line with some previous studies (Dennehy and Dasgupta, 2017; McGregor et al., 2017; Botella et al., 2019; Vidal et al., 2020), the population of women in engineering and engineering educators is low, regardless of the geographic locations. In this case, the participants wanted to use their knowledge, practice skill, managerial style, and gender role as the means to influence and reform the current engineering industry, particularly the gender gaps and diversity in Thailand. Although the reform for women in engineering is not established yet, many participants believed their contributions would change the current gender diversity.

Use the qualification for career promotion based on their previous experiences as women in engineering and engineering educators

More than half of the participants are currently teaching at one of the junior colleges or universities as teaching assistants or junior lecturers due to their excellent working experience and training from their doctoral degree programmes. All believed that their doctoral degree programmes and practical knowledge would help them seek career promotion at the university level. Two stories were captured:

> *. . .I received a scholarship for my doctoral degree programme. . .so I am working as a teaching assistant at my university. . .my supervisors and school dean told me that once I have my doctoral degree finished. . .they will*

> *recommend me to the board for a lecturer's position. . .I am looking forward. . .I want to use my degree and contribute to my career. . .*(Participant #3, Focus Group).

Once Participant #3 shared her experiences, many echoed their situations with a similar idea, saying:

> *. . .many opportunities are available in Thai universities. . .as long as we are expert in engineering. . .I want to teach and lecture at junior colleges because of my previous experiences. . .I also enjoy my current visiting teaching in one of the junior colleges. . .rewarding. . .*(Participant #1, Focus Group).

Besides the encouragement from their supervisors and leaders in the university, many also indicated that they wanted to become the first group of female engineering faculty members in the Thai university environment, saying:

> *. . .we need to have gender diversity and gender balance. . .I could not see many female engineering faculty members and teachers in Thai colleges and universities. . .perhaps many women fear. . .the gender gaps. . .so they did not go to engineering schools and complete their doctoral degrees. . .but I don't feel afraid. . .I want to become the first few faculty members. . .*(Participant #4, Focus Group).

The Social Cognitive Career and Motivation Theory (Dos Santos, 2021a) predicts this commitment to transferring practical skills and theoretical knowledge to the next generation. Previous studies (Ballen et al., 2017; Roach, 2017; Alaçam and Olgan, 2019; Dos Santos, 2021b,c) show that mid- and senior-level professionals desire knowledge transfer. In this case, all participants expressed and shared the same desire as well. More importantly, in line with a previous study (Dennehy and Dasgupta, 2017), the participants wanted to use their gender role, as women in engineering and engineering educators, as encouragement for women in engineering, students and potential engineers in Thailand. Although the gender gap is still large, the participants believed their contributions would eventually fill the gaps in the area.

Surrounding environments and individuals: The One Belt One Road opportunities as women in engineering

During the past decade, the Chinese government established the One Belt One Road initiative and made international scientific developments, particularly in Latin America, Africa, the Middle East, and Southeast Asia. In Thailand, one of the member states of the One Belt One Road initiative, scientists and professionals may join the developments and opportunities with the Chinese developments and government agencies (Das, 2017; Punyaratabandhu and Swaspitchayaskun, 2018). Therefore, experienced engineers may have unique opportunities in terms of their career development after graduating from their doctoral degree programmes, regardless of nationality and gender. All participants expressed the desire to take career promotions and opportunities in a One Belt One Road country or region, particularly Thai and women in engineering. Comments regarding this finding were captured:

> *. . .one of my former undergraduate degree in engineering faculty members is currently working in China. . .as a full-time researcher. . .I want to gain some international working and teaching experiences too. . .The doctoral degree will bring me to the next step. . .frontline experiences in the Southeast Asian region. . .is good but not good enough for such international promotions. . .I will become one of them. . .because of the One Belt One Road opportunity. . .many promotions are waiting. . .*(Participant #8, Focus Group).

> *. . .my supervisor transferred to Guangzhou 3 years ago because of the One Belt One Road opportunity. . .he is the leader of the Chinese-Thailand project in the southern Thai region. . .he has a PhD degree at a top-tier Chinese university too. . .the One Belt One Road initiative provides us a lot of opportunities. . .I have to take one of them. . .*(Participant #6, Focus Group).

The One Belt One Road Initiative and the related opportunities greatly influenced the motivations and career decisions of the group of doctoral degree students, particularly for women in engineering. Although foundation development is greatly needed in Thailand, skilled workers, engineering professionals, and qualified supervisors are unavailable. Therefore, the opportunities of the One Belt One Road Initiative (Pongpech, 2005; Das, 2017; Dos Santos, 2018; Punyaratabandhu and Swaspitchayaskun, 2018) may fill up the gaps in human resources, skills, materials, and financial resources shortages. As one said:

> *. . .I want to see my hometown. . .in the southern region near Malaysia. . .can be connected with high-speed trains. . .I do not like the missing trains and unpaved freeways. . .if I can use my skills to help my country. . .I want to take this opportunity. . .*(Participant #2, Focus Group).

When asked about the gender role and women's issues between the One Belt One Road initiative and women in engineering, the participants argued that their gender role might become the representative and image for many developing countries and regions, particularly women in engineering. In fact, many participants argued that gender gaps and social stigma are significant in many developing countries and regions.

If they can become professional engineers and engineering educators, the One Belt One Road initiative will help them to bring a positive image to other countries and regions, said:

> *. . .I want to give a lecture to many African engineers and engineering students as females and woman in engineering. . .many people do not believe in women in engineering. . .but I am going to use my image. . .for the positive encouragement and promotions. . .for women in engineering. . .*(Participant #5, Focus Group).

Echoing the Social Cognitive Career and Motivation Theory (Dos Santos, 2021a), surrounding environments and individuals in terms of the One Belt One Road initiative's connections impacted the participants' interest in potential career developments in member states and regions. The researcher found that the participants' decision-making processes were highly related to the recommendations and modelling of the participants' peers and government policies, particularly women in engineering. Many believed that the political impacts and the One Belt One Road initiative had become the means to encourage women in engineering, particularly Thai women in engineering, into the international arena. Also, the participants further argued that their lectures and images would influence the social stigma and challenges for women in engineering and engineering students in developing countries and regions (Dennehy and Dasgupta, 2017; McCullough, 2019; Carnemolla and Galea, 2021). This finding also echoed previous research (Ballen et al., 2017), which suggests that modelling from others may influence individuals' and groups' motivations and career decisions.

Limitations and future research direction

The researcher highlighted five limitations and aligned these with potential future research recommendations. First, the current study only collected data and lived experiences from doctoral students in civil engineering studies. Although engineering students and professionals may share meaningful ideas and perspectives, it is important to capture stories from other scientific professionals, such as biologists and medical professionals. Therefore, future research studies may expand the scope of the study to include these other professionals in order to cover and capture more voices.

Second, it is likely that master's degree students in engineering will have some insights from their academic journey, learning experiences, working backgrounds, and lived experiences. Future research studies should thus also collect data from such postgraduate students for further understanding of the issues at stake.

Third, due to the development of the One Belt One Road initiative, many scientists may accept international promotions and seek career development in other member states and regions. Therefore, future researchers may expand the scope of this study to other fields, such as chemical engineering and biomedical engineering, to understand how the One Belt One Road initiative can positively influence Thai scientists' motivations and career decisions more broadly.

Fourth, the researcher only recruited participants with professional work experience in the field. However, many doctoral students enter programmes without work experience. Therefore, in the future, research studies may focus on groups of students without work experience in order to extend this study's findings to cover a wider population.

Finally, this study was conducted and completed by only one researcher and therefore, potential biases may have arisen. However, the researcher reduced potential bias by using various forms of data collection, such as by staging three interview sessions and one focus group activity. In future research studies, researchers may invite additional researchers and team members to join the study in order to avoid potential biases.

Contributions to the practice and conclusion

Four contributions have been highlighted from this study. First, the results of this study indicated that although gender plays a significant role in decisions to enter the engineering profession in Thailand, many participants believe their work and qualifications will help them to reach their goals. The outcomes of this study will help to close the gender gap and end social stigma in the Thai engineering profession.

Second, university leaders, policymakers, curriculum developers, and researchers may use this study as a means to create a gender-free teaching, learning, and working environment for women in engineering and engineering students who may face challenges due to their gender roles. Gender must play no role in the engineering profession as both men and women can achieve excellent qualifications and skills. Therefore, the outcomes of this study offer recommendations to the interested parties to close the gender gap.

Third, based on the findings, it is important to note that international opportunities played a significant role in the motivations and decision-making processes of this group of participants. University leaders, government leaders, and policymakers may continue to create international opportunities for Thai engineering professionals for international cooperation.

Fourth, for engineers and engineering educators, human resources management, workforce development, motivations, and career decisions are significant in the field of engineering. The results of this study outline the problems, challenges, concerns, opportunities, and sense-making processes of a group of doctoral students in civil engineering in Thailand. Government leaders, human resources planners, department

heads, university leaders, organisational managers, and other researchers may use this study as a blueprint to reform and improve human resources management and engineering education schemes based on the recommendations and desires of scientists. Many developing states and regions are in need of engineering professionals and educators; therefore, long-term development and management are essential for regional schemes and planning.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Woosong University Academic Research Funding. The patients/participants provided their written informed consent to participate in this study.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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