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Transitioning from Social Sciences to Information Engineering: A Case Study of a Taiwanese Female Doctoral Student

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Abstract: This case report explores the learning and developmental experiences of Anita, a 29-year-old doctoral student in information engineering (IE) at a research-oriented university in Taiwan. Anita previously earned a master's degree in social sciences, worked in the field for several years, and eventually transitioned into the IE discipline. Adopting a phenomenological qualitative research approach, data was derived from a semi-structured interview with Anita. The analysis identified five key themes: (1) motivation for transitioning disciplines, (2) academic journey in information engineering, (3) peer collaboration and mutual support in overcoming obstacles, (4) advisor-student interactions to facilitate learning, and (5) gender benefits for women in information engineering. This study concludes with recommendations for female students, educators, policy-makers, and practitioners, and provides directions for future research.

Keywords: Female graduate student, pure sciences, learning, development.

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Introduction

In Taiwan, gender disparities in higher education remain evident, with male students predominantly pursuing STEM disciplines and female students gravitating towards the humanities (Hsieh et al., 2011; Sung & Kao, 2019). For instance, women constitute only 31.24% and 25.58% of all master's and doctoral graduates in science and technology fields, respectively (Ministry of Education [MOE], 2024). Further, female representation in computer science (CS) and information engineering (IE) programs is particularly low, accounting for 29.57% of master's and 15.23% of doctoral graduates (MOE, 2024).

Although women in Taiwan often transition from STEM to non-STEM fields, shifts in the opposite direction—particularly from social sciences to STEM—are rare. This case study addresses this research gap by documenting the learning and growth experiences of Anita, a Taiwanese female doctoral student in IE who formerly pursued social sciences and worked in the field for several years. Motivated by career aspirations, Anita left her job to enroll as a full-time doctoral student in IE. This case report examines her transition to IE, her learning experiences, her coping mechanisms for stress, her adaptive strategies for overcoming challenges, and her developmental progress within the program.

Female Doctoral Students Worldwide

Magano (2013) investigated the academic journey of a female doctoral candidate at a South African university. The participant experienced significant setbacks, including diminished self-esteem, confidence, and assertiveness over eight years. Challenges such as supervisor changes exacerbated her struggles. Despite these adversities, she remained determined to complete her PhD. Bireda (2015) highlighted the multifaceted challenges encountered by five Ethiopian female doctoral students, including academic, psychosocial, and domestic issues. Factors such as inadequate supervision, academic skill gaps, educational system constraints, stress, and balancing personal and professional roles were key concerns.

Zimmerman (2005) analyzed the experiences of three Asian female doctoral students in the United States pursuing degrees in art education. The participants cited family support, external validation, and personal effort as crucial factors in completing their studies. They recommended early career planning and adaptability for future female students embarking on doctoral journeys.

Schwab (2020) studied the experiences of female doctoral students transitioning into motherhood. These students relied on family members, professors, classmates, and other networks for support to navigate their dual roles. Challenges included identity crises, time constraints, insufficient institutional support, and societal pressures. Strategies like cultivating a positive mindset, seeking role models, and arranging reliable childcare proved beneficial. Schriever (2021), through an autoethnography, identified the challenges and tensions of intersecting motherhood and doctoral studies. She also shared the joys, strengths, and benefits of incorporating the multiple identities of mother, wife, doctoral student, and academic. This study offers insights into the contradiction that is mothering during doctoral studies, as mothers concurrently hold guilt and gratitude, and recognize the expense and benefit due to the roles of mother and researcher.

Miller (2015a) examined retention challenges among female doctoral students in mathematics in the United States. Success factors included personal characteristics, mentorship, assistantships, and quality doctoral courses. A related study by Miller (2015b) found that persistence, undergraduate preparation, and advisor support were crucial, with recent graduates reporting reduced gender discrimination. Cabay et al. (2018) conducted interviews with 28 female doctoral students in physical science and engineering programs. Participants highlighted an increasing sense of competence, recognition, and scientific identity. Nevertheless, gender barriers, microaggressions, and work-life balance issues deterred some from pursuing research-intensive career trajectories.

Learning and Development of Female Doctoral Students in Taiwan

Liang (2010) conducted a study with 14 female doctoral students to investigate their learning and development. The findings highlighted the strong emphasis their families placed on education and the supportive role this played in facilitating academic growth. Despite their commitment to academic pursuits, participants faced societal pressures rooted in traditional Taiwanese cultural expectations, such as prioritizing marriage, family, and caregiving. These cultural norms often conflicted with their career aspirations. Married participants reported adopting strategies to balance family responsibilities with academic work, which influenced their future career planning. Liang concluded that Taiwanese sociocultural expectations, which prioritize marriage and family, are less conducive to the academic and professional development of female doctoral students.

Wu (2012) examined the experiences of three Taiwanese female doctoral students studying abroad. These students encountered significant cultural and linguistic challenges, progressing through phases of "exploration," "shock and frustration," "academic struggle," "adjustment," and "acceptance." Social support emerged as a key factor in their academic success. Wang and Chang (2016) emphasized the pivotal role of advisor-student and mentor-student relationships in female science and engineering graduate student's academic trajectory, describing these relationships as multifaceted, dynamic, and adaptable. Wu et al. (2013) explored the academic experiences of female doctoral students, identifying diverse motivations for pursuing doctoral degrees, such as job requirements, self-fulfillment, family honor, and peer influence. However, the participants faced challenges including role conflicts as doctoral students and mothers, changes in marital dynamics, compromised work quality, academic pressure, and difficulties with health and time management. They addressed these challenges through external resources, psychological resilience, time management, cognitive adjustments, and self-encouragement.

Female STEM Students and Professionals in Taiwan

In Taiwan, STEM students make up the majority of the graduate student population (MOE, 2024). However, a pronounced gender disparity in academic discipline selection persists, with men predominantly pursuing STEM and women gravitating toward the humanities (Chen, 2002). While there has been an increase in female participation in male-dominated fields, STEM disciplines in Taiwan remain largely male-centric. Men continue to dominate STEM fields, fostering an environment of masculine competition and hierarchical authority. Wang (1990) studied factors influencing Taiwanese female students to pursue non-traditional career paths, highlighting the importance of parental, sibling, and peer support. Hsu (2000) examined career choices and coping strategies among women in non-traditional fields, identifying key traits like clarity of goals, persistence, independence, and courage. Family encouragement and recognition from educators and supervisors emerged as significant contributors to their success.

Hung et al. (2013) surveyed 720 junior and senior female engineering students from a technology university and found that only one-quarter of these students had completed over 12 credits of mathematics courses, including calculus and engineering mathematics. This indicates that most female students tend to shy away from mathematics courses. The study recommends enhancing female engineering students' identification with mathematics to help them recognize and strengthen their mathematical abilities.

Hsu (2000) examined career choices and coping strategies among women in non-traditional fields, identifying key traits like clarity of goals, persistence, independence, and courage. Family encouragement and recognition from educators and supervisors emerged as significant contributors to their success. Yu (2019) investigated gender roles and societal expectations among female university students in non-traditional majors. Interviews with three female mechanical engineering students revealed that participants challenged traditional gender norms, aiming to demonstrate that women can succeed in engineering despite societal stereotypes. Their choice of non-traditional majors was supported by family and educators.

Chin (2019) collected narratives from 12 female technology professors to explore gender-related experiences in the technology sector. Participants noted that Taiwanese societal and educational norms often discourage women's advancement in technology fields. They perceived STEM fields as being dominated by male-centric cultures, which they found unconducive to women's development. Chen (2020) explored the challenges faced by female engineers in Hsinchu Science Park, focusing on workplace and familial experiences. Findings showed that family responsibilities often led women to leave the workforce, opt for lower-paid flexible jobs, or become homemakers. Liu (2001) discussed internal barriers to women's career development, emphasizing how stereotypes about gender identity and roles reinforced negative perceptions and reduced women's self-efficacy.

Yan (2011) examined the academic and professional experiences of Taiwanese female mathematicians. While some participants navigated their studies smoothly, others encountered challenges that they addressed through personal resilience or relational support. Hsieh (2016) conducted interviews with 25 female STEM undergraduates from two universities, exploring their motivations to persist in science courses. Participants expressed interest in their studies, valued interpersonal support, and planned diverse career paths that balanced work and family life. Sung and Kao (2019) interviewed five Taiwanese female STEM students about how their life experiences shaped their creativity. The results highlighted their rigorous and goal-oriented approaches to tasks, as well as their confidence, flexibility, and diverse interests. These students viewed creativity as a problem-solving ability influenced by their training in logical thinking within STEM disciplines.

Wu (2008) examined the factors contributing to the success of seven exceptional female scientists in Taiwan, focusing on personal, familial, and environmental influences. The participants exhibited qualities such as innovative thinking, strong research insights, professional expertise, excellent time management, resilience, and passion for their work. They attributed their achievements to factors including parental encouragement, spousal support, shared family responsibilities, recognition and mentorship within the workplace, academic freedom, intellectual exchanges with peers, and their ability to seize professional opportunities.

Students in Information Engineering and Computer Science

Fan and Li (2011) synthesized research on gender disparities in computer education in Taiwan. They found that women displayed lower computer self-efficacy and literacy, higher

levels of computer anxiety, and less positive attitudes toward technology. Chang (2018) examined gender dynamics within Taiwan's information technology sector, revealing a gender ratio of approximately four men to one woman. Workplace cultures often replicated traditional gender roles, thereby impeding women's promotions, roles, and access to training opportunities.

Yates and Plagnol (2022) investigated the experiences of female CS students navigating male-dominated academic settings. Interviews with 23 participants indicated that stereotypical assumptions of male superiority, combined with an agentic, masculine learning environment, negatively impacted their confidence and motivation. Similarly, Sader (2007) explored the career decisions and expectations of ten women in CS, finding that the participants perceived programming positively and resisted gendered career limitations. However, they reported feelings of isolation as their biggest challenge. Lagesen (2007) studied inclusion strategies aimed at recruiting more women into CS, emphasizing that increasing female representation improves the learning environment for women in the field.

Rationale of the Study

Female graduate students pursuing studies in the pure sciences often experience significant stress due to both academic demands and an unfavorable learning environment. This dual burden can heighten psychological pressure and negatively impact their educational outcomes. This study conceptualizes the learning experiences of Ann, a female graduate student in the pure sciences, as a dynamic interaction between her personal characteristics and various environmental factors that influence her academic journey. To navigate these challenges effectively, Ann must develop a comprehensive understanding of her personality traits, motivations, and expectations regarding her studies in the pure sciences. Furthermore, she must actively engage in strategies that enhance her academic performance, foster interpersonal collaboration, and strengthen her ability to cope with the gender-related barriers prevalent in her field.

Method

This research employed a phenomenological approach, which emphasizes the detailed description of conscious experiences in everyday life and explores the essential structures of consciousness as perceived by individuals or groups (Schwandt, 2015). This approach was utilized to examine the learning and development experiences of a female doctoral student enrolled in an information engineering (IE) program.

Participant

The study focused on a 29-year-old female doctoral student (Anita) attending a research-oriented university in Taiwan, majoring in IE. Prior to entering the IE field, she earned a master's degree in social sciences and worked professionally in that domain for approximately four years. Anita is currently a third-year doctoral student and is expected to complete his studies within two to three years. Her decision to transition from social sciences to IE reflects an uncommon academic and career pathway. She provided valuable insights into her doctoral journey, including her learning and development experiences in IE.

Interviewer

A research assistant (RA) with a master's degree in counseling conducted the interviews. The RA had completed courses in interviewing techniques, qualitative research methods, and research methodology. Additionally, she underwent specialized training and carried out pilot studies to refine her interviewing skills. Throughout the study, the RA fostered a trusting relationship with the participant, Anita, and adopted an open, nonjudgmental stance during the interviews to facilitate candid and meaningful dialogue.

Data Collection

Data were collected through two in-depth interviews, each lasting approximately 120 minutes. Anita was recruited by the RA because of her unique experience in transitioning academic disciplines. Before the interviews, she was fully briefed on the study's objectives, procedures, and ethical considerations. She provided informed consent prior to participation. The interview was designed to elicit detailed narratives of her experiences, utilizing sample questions such as: "Can you describe your learning and development experiences in the field of IE?" and "What significant perceptions or reactions have shaped your academic journey at the doctoral level in IE?"

Data Analysis

The author, serving as the analyst, used Creswell's (2009) phenomenological approach for data analysis. She bracketed off her assumptions about female students in pure sciences, seeking new and fundamental meanings. The analysis involved: (1) reviewing transcripts, scanning materials, typing field notes, and classifying data into different sources, (2) reading all data for an overall sense, reflecting on its inclusive meaning, and recording general thoughts, (3) arranging material into textual portions and conducting comprehensive analysis through a coding process, (4) using the coding process to create descriptions of the setting or people and identifying groupings or themes, (5) creating additional layers of complex analysis and forming themes into an overall description, (6) expanding beyond description and theme identification into complex theme networks and (7) progressing descriptions and themes to capture the essence of the data.

To enhance validity and reliability, steps were arranged into a detailed protocol and database (Gibbs, 2007). The transcript was examined for accuracy during transcription, with careful comparison of data with codes and forming notations. Validation strategies proposed by Creswell and Miller (2000) were employed, including extended engagement and continuous observation. Multiple sources and methods were integrated to clarify themes or perspectives. Rich, thick narratives were formulated to elaborate the participant and settings encountered in the interview. Member checking was adopted, inviting the participant to review rough drafts and offer feedback. A peer of the researcher served as an external auditor, scrutinizing the research process and evaluating the results.

Results

The analysis of data revealed five major themes, each comprising several sub-themes that provide insights into Anita's experiences and development during her doctoral studies in IE.

Motivation for Transitioning Disciplines

Career Considerations and Self-Expectations

Anita transitioned from social sciences to IE to pursue better career prospects and personal growth. Despite excelling in her social sciences career for several years, she aspired to challenge

herself academically and professionally. Her ultimate goal was to become a university professor and researcher, prompting her decision to enroll in a doctoral IE program that accepts students from non-STEM backgrounds. As Anita explained: "I had work experience in the social sciences... I decided to change my career... I want to return to academia, specifically higher education... The job opportunities in IE are much better... I want to be a teacher at a university."

Emphasis on Science and Technology over Social Sciences in Taiwan

Anita observed the societal emphasis on science and technology in Taiwan, which overshadowed the recognition of social sciences. Her transition to IE brought her increased recognition, contrasting with the limited attention her earlier work had received. She noted: "When I studied sociology, people would ask, 'How could you find a job?'... Now, when I say I'm in an IE program, people respond, 'So, you want to be an engineer?'... Taiwanese view IE as great and see it as a promising future."

Academic Journey in Information Engineering

Systematic Learning in Information Engineering

The IE program provided structured pathways, requiring students to select advisors and begin laboratory work in their first month. Weekly lab meetings fostered collaborative problem-solving, with distinct timelines for master's and doctoral students. Anita explained: "From the first month, students find an advisor and start their lab work... By the first semester of the second year, students write proposals, and by the second semester, they defend their final thesis." However, she emphasized the importance of self-reliance in research: "As a researcher, one mainly relies on oneself to conduct research, while advisors and the lab teammates play supportive roles."

Acknowledging and Compensating Weaknesses

Transitioning to IE required Anita to address gaps in her foundational knowledge. She enrolled in undergraduate-level courses and sought support from teaching assistants (TAs) and peers. Despite being a doctoral student, she emphasized the importance of humility in asking for help: "Our school provides doctoral students with classroom training... TAs lead new doctoral students in coding and solving problems." Anita's limited mathematics background was another challenge. She took supplementary courses and actively enhanced her skills to gain acceptance into a professor's laboratory: "I knew little, so I needed to learn diligently in IE... thus, I could convince a professor to be my advisor."

Challenges Encountered in Information Engineering

Learning Difficulties in Information Engineering. Anita faced significant learning difficulties, particularly with technical terms and mathematical concepts. She described her initial experiences as overwhelming and demoralizing: "I couldn't understand the technical terms the professor used... I felt like quitting. Attending classes where I understood nothing was demoralizing."

Problem-Solving and Coping Strategies. Anita adopted a growth mindset and sought help from professors, TAs, and peers. She leveraged her previous experiences, such as proficiency in statistics and data visualization, to address challenges. She remarked: "I utilized my previous experiences and connections to solve current learning problems."

Adopting Effective Questioning Techniques

Anita emphasized the importance of asking meaningful questions to address learning obstacles and problem-solving effectively: "Asking good questions helps find the right direction... Sometimes the problem isn't with the programming language of IE but with the system itself."

Choosing Preferred Courses and Gaining a Sense of Achievement

Anita selected courses that aligned with her interests and past experiences, which helped boost her confidence and motivation: "I took a game theory course... I was familiar with the subject materials due to my past work experiences, and I learned the course quite well."

Peer Collaboration and Mutual Support in Overcoming Obstacles

Formation and Collaboration of Peer Teams

Anita built social connections with peers who shared similar academic challenges and formed study groups to address these difficulties collaboratively. She explained: "We all have similar backgrounds... We form an alliance to help each other adapt to the coursework." By dividing tasks among team members and maintaining an active group chat for discussions, Anita found teamwork essential for overcoming obstacles.

Emotional Cohesion and Mutual Support Among Peers

Anita highlighted the emotional support and positive energy fostered within her peer group: "Learning with these classmates is enjoyable... We all go through the same struggles and help each other, giving each other high positive energy."

Importance and Effectiveness of Peer Mentors

The interviewees underscored the importance of peer mentors in supporting new graduate students, who often feel disoriented upon enrollment. They recommended that academic departments assign senior students as peer mentors to provide guidance and share their learning and adaptation experiences. Peer mentors can offer both instrumental and psychological support, assisting new students in stabilizing their emotions and managing their academic responsibilities, such as course scheduling, experiments, and other challenges related to academics and everyday life. Anita remarked: "New students often feel lost when they start. Having seniors share their experiences about coursework and life would be helpful."

Advisor-Student Interaction to Facilitate Learning

Maintaining a Positive Relationship with Advisor

Anita highlighted the pivotal role of advisors, who serve as laboratory leaders and academic guides. Graduate students are expected to select their supervisors early in their studies, which marks a significant step in their academic journey. Anita emphasized the importance of mutual trust and cooperation in building a productive relationship with advisors, acknowledging the inherent power imbalance in the dynamic. She stated: "New (doctoral) students must find an advisor early on. Advisors are very important. I as a doctoral student follow his guidance... There is an unequal power dynamic between me and him."

Proactively Seeking Help from Professors

Due to her limited mathematics background and insufficient expertise in IE, Anita frequently sought assistance from her professors. She emphasized the importance of cultivating good relationships with professors and proactively seeking their guidance. As Anita explained: "IE professors are very independent... I had to email them and find time to discuss my questions. Being proactive is crucial; some professors are very willing to share their research and guide students."

Establishing Good Relationships with Professors

Beyond her primary advisor, Anita built relationships with other professors in the department, each of whom offered unique expertise. Given the diverse challenges faced by doctoral students, Anita sought advice and opportunities from multiple faculty members. This proactive approach allowed her to gain professional experience and build a positive impression among professors. She explained: "I asked a professor if he needed an assistant... He mentioned a project needing an assistant. Thus, I got that job. I ask questions and seek advice from professors... Being proactive gives professors a positive impression of me."

Gender Benefits for Women in Information Engineering

Anita appeared to have not experienced situations of discrimination or devaluation based on gender, nor had she encountered difficulties or obstacles in learning environments due to her gender. On the contrary, Anita observed that the IE field offers certain gender-based advantages for female students. Male peers often take the initiative to handle technical tasks, thereby reducing the workload for female students. She noted: "In IE departments, you can see clear benefits for women... Male classmates often handle various tasks and technical issues... These are benefits for women!" While some female students rely on male peers for assistance with assignments, exams, experiments, and thesis writing, Anita took a different approach. She emphasized the importance of building her professional skills to remain competitive in the job market: "How you use these benefits depends on you... For me, my goal is to develop my skills and competitiveness, not just to get the IE degree."

Discussion

Anita transitioned from the field of social sciences to pursue a doctoral program in IE, a choice that contrasts with the more common pattern of women moving from STEM fields to non-STEM fields. This major academic and career shift was not due to dissatisfaction or challenges in her prior field; rather, Anita had already achieved professional success and recognition within social sciences. Her decision was primarily driven by future career development, particularly her recognition of the significance and growth potential of IE in Taiwan. Anita carefully considered her goals, aspiring to join academia and serve as a university professor. Demonstrating a clear understanding of herself and her professional ambitions, she resolutely entered the IE field, showcasing perseverance and adaptability while striving to master the subject. These findings align with Hsu's (2000) conclusion that women in non-traditional fields often make career decisions based on key personal traits, including interest, clear professional goals, self-awareness, perseverance, independence, and courage. Furthermore, Anita's strong motivation to study IE resonates with Wu et al.'s (2013) assertion that women's pursuit of doctoral degrees often stems from career needs and self-realization.

Anita is aware of Taiwan's societal emphasis on STEM over the social sciences and humanities. She has been familiar with the gender stereotype of “men in STEM, women in humanities.” Her primary motivation for studying IE centers on personal career planning and the desire for achievement, which differs from Yu's (2019) findings that STEM female students often challenge societal norms to demonstrate women's capability to succeed in engineering and to break the gender stereotype of “men in STEM, women in humanities.”

Being single and without considerations of marriage or future family, Anita appears unaffected by traditional Taiwanese expectations that women prioritize marriage and family. This study's findings diverge from previous literature emphasizing traditional cultural expectations for Taiwanese women, including prioritizing marriage, family, and caregiving over professional development. For instance, Liang (2010) noted Taiwanese society's insufficient support for women's academic and professional advancements, while Chin (2019) highlighted societal expectations for women to fulfill domestic roles as a prerequisite for professional success. Similarly, Liu (2001) argued that women's prioritization of marriage and family negatively impacts their career progression.

At nearly 30, Anita's decision to switch fields and enroll in a PhD program was self-driven and uninfluenced by her parents or siblings. This finding contrasts with Wang's (1990) research that highlighted the importance of family and peer support in women's career decisions in non-traditional fields. In this study, Anita emphasized the significance of peer support but did not mention family influence on her decisions. Moreover, unlike Wu et al. (2013), who identified “bringing honor to the family” as a motivation for women's doctoral pursuits, Anita's autonomy may be attributed to her single status and approaching 30s, reflecting societal shifts that allow more women in Taiwan to independently choose their fields of study and career paths.

Before embarking on her IE doctoral journey, Anita consulted professionals in the field, adjusted her mindset, and gained an understanding of the doctoral learning process. These preparations helped her maintain emotional stability in the early stages of her program. This aligns, to an extent, with Zimmerman’s (2005) recommendation that early-career doctoral women carefully plan their career paths and strengthen their adaptability. Anita's doctoral experience partially echoes Zimmerman’s findings regarding Asian female doctoral students in the U.S., who emphasized external validation and personal efforts as critical for completing their studies. Anita mentioned receiving praise for majoring in IE, with others acknowledging her bright career prospects.

As a full-time doctoral student, Anita, being single and financially stable, did not face the conflicts between academic, family, and work responsibilities commonly experienced by married or mothering female doctoral students. Therefore, this study did not reflect Wu et al.'s (2013) findings regarding Taiwanese female doctoral students’ struggles, such as student-parent role conflicts or marital changes. However, it did align with Wu et al. on the academic stress, health, and time management challenges female doctoral students encounter.

Anita observed significant differences between IE and social science studies. While social science graduate programs often feature flexible courses and autonomy in research, IE required a systematic curriculum progression from foundational to

advanced courses. In her first year, Anita focused on coursework and familiarizing herself with the lab, then proceeded in her second year to drafting a research proposal for extended experimental research. IE graduate students typically join research teams upon enrollment, working under an advisor's supervision while adapting to laboratory operations. Recognizing her weak mathematical foundation, Anita faced her deficiencies head-on, seeking help from peers, teaching assistants, and professors to strengthen her skills.

She exemplified resilience and adaptability, focusing on learning and research with the goal of pursuing a IE academic career. Additionally, she highlighted the value of serving as a research assistant, emphasizing the importance of maintaining positive relationships with advisors and faculty. These findings support Miller's (2015a) study, which identified personal traits, career considerations, advisory support, and assistantship benefits as key factors for American female math doctoral students' success. Anita particularly emphasized the importance of advisors in STEM, advocating respect for their guidance and prioritizing their input on academic planning and research progress. She believed consistently improving her abilities to earn the advisor's approval and maintaining good relationships with advisors were fundamental responsibilities of doctoral students. This aligns with Wang and Chang's (2016) perspective that female science and engineering students stress the importance of advisor-student relationship.

Unlike Cabay et al.'s (2018) findings on the subtle discrimination or gender bias encountered by female physics and engineering doctoral students within male-dominated STEM cultures, Anita reported overall satisfaction with her IE PhD program. She found department resources ample and enjoyed positive interactions with faculty, teaching assistants, and male peers. Male classmates often readily assisted female students, including guidance on coursework and experimental research tasks. This study did not corroborate Chin's (2019) claim that Taiwan's societal and educational systems hinder women's learning and development in technical fields or Yates and Plagnol's (2022) observations of women in computing facing stereotypes of male superiority in male-dominated academic environments. It also diverged from Liu's (2001) assertion that gender identity and stereotypes create career barriers for Taiwanese women.

Anita flexibly utilized various approaches to learning and problem-solving during her doctoral studies. She proactively formed peer support groups for collaborative learning and task completion, leveraging resources and social networks to address challenges. This aligns with Wu et al. (2013), who noted Taiwanese female doctoral students' effective use of external and psychological resources, time management, and self-motivation to overcome academic challenges. Despite hardships, Anita remained committed to improving and found the journey rewarding, resonating with Wu's (2008) findings on the success factors for outstanding Taiwanese female scientists. She also emphasized peer and faculty interactions as crucial to her learning, reflecting Sader's (2007) insights on how isolation hinders women's educational experiences. In brief, Anita's doctoral journey echoed the notion addressed by Cabay et al. (2018) that female doctoral students tend to grow a sense of competence, recognition, and identification as scientists in their academic career.

Implications

Prospective students for major switching could seek advice from professionals, faculty, and current graduate students to understand the characteristics of the new field and learning process, which aids in overcoming psychological obstacles. Newcomers might benefit from alumni sharing experiences, which helps build support networks providing instrumental and psychosocial support. Additionally, foundational courses tailored for transitioning students can bolster academic success. For single women, the absence of marital, family, or work-related constraints enables full focus on doctoral studies. For those balancing work, marriage, or caregiving responsibilities, universities can offer scholarships or stipends, while administrative agencies, and the government can provide childcare and respite services to support women pursuing doctoral degrees.

Counseling professionals, student affairs personnel, and educational specialists can support female doctoral students transitioning to a different major in adapting to various challenges, particularly addressing coursework difficulties and pressure of studying during their initial stages. Future research could explore the learning and psychological adaptation needs of female doctoral students transitioning to new fields at various stages, as well as investigate ways to encourage and assist women interested in STEM and aspiring for STEM-related careers to pursue higher education in these areas.

Conclusion

Female graduate students in STEM remain underrepresented in Taiwan, with many transitioning from STEM to non-STEM. This study highlights the experiences of a woman from a non-STEM background who overcame challenges to pursue a PhD in IE. Her single status and financial stability shielded her from familial or professional resistance. Before transitioning, she clarified her goals and consulted relevant individuals, preparing thoroughly. Facing academic challenges early in her program, she employed various strategies—forming collaborative peer groups, improving her weaknesses, strengthening foundational knowledge, and leveraging personal and external resources—to overcome learning obstacles. Her persistence and adaptability culminated in launching a new chapter in her academic and professional journey within IE.

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