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BREAKING BARRIERS: AN IN-DEPTH EXPLORATION OF CHALLENGES AND RESILIENCE AMONG FEMALE ENGINEERING STUDENTS AT THE NATIONAL UNIVERSITY'S COLLEGE OF ENGINEERING, MANILA

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ABSTRACT

This study aims to shed light on the unique experiences of female engineering students in many disciplines, including Civil, Mechanical, Electrical, Electronics and Communication, and Sanitary Engineering. A carefully crafted survey is used as the main tool to clarify the complex web of these students' academic experiences, reasons for choosing engineering, and the difficulties they face. The study examines occurrences of gender bias and discrimination in academic settings, investigating their influence on participants' experiences. Furthermore, an analysis is conducted to determine any connections between academic difficulties and gender imbalances in particular engineering programs.

Moreover, the study investigates the coping strategies utilized by female engineering students to deal with academic stress. An analysis is conducted on support systems, such as academic, peer, and mentorship networks, to see how effective they are in helping individuals overcome difficulties. The paper also examines strategies for promoting inclusion and improving the overall experience of female engineering students at academic institutions. Finally, participants articulate their ambitions and forthcoming strategies within the engineering domain, offering essential perspectives that enhance comprehension of the distinctive challenges encountered by women pursuing careers in engineering. The objective of this research is to provide information that may be used to develop policies and practices that improve the inclusion and academic achievement of female engineering students.

Keywords: Female Engineering Students, Gender Bias and Discrimination, Coping Strategies, Academic Inclusion, Engineering Career Perspectives

INTRODUCTION

Gender disparities persist in the field of engineering, an issue extensively documented by various studies (Riegle-Crumb, 2013; Sassler, 2017; Sax, 2016). This underrepresentation of women is observable not only in higher education but also in high school settings, indicating a multifaceted challenge that begins early in academic trajectories. The intricate nature of this gender gap in engineering is shaped by individual attitudes, perceptions of the engineering climate, and the prevailing dynamics of employment in STEM fields (Riegle-Crumb, 2013; Sassler, 2017; Sax, 2016).

Addressing this persistent gender gap requires a comprehensive understanding of the factors influencing women's participation in engineering. The need for interventions spans from increasing exposure to engineering during secondary education to enhancing the representation of women within engineering programs. Recognizing the evolving dynamics of the gender gap within undergraduate engineering majors is crucial for informed and targeted initiatives (Riegle-Crumb, 2013; Sassler, 2017; Sax, 2016). This research aims to contribute to the existing body of knowledge by delving into the experiences of female engineering students at the National University's College of Engineering, exploring the challenges they face and the resilience strategies employed to navigate their academic journey. Through a thematic analysis, the study seeks to uncover insights that can inform policies and practices aimed at fostering a more inclusive and supportive environment for female engineering students.

PURPOSE OF THIS STUDY

The primary goal of our research is to explore the viewpoints of successful female engineering students enrolled at the National University in the Philippines. Our focus is on understanding their career choices by investigating both the contextual hindrances and the support structures that shape their experiences. It's crucial to note that our study does not intend to draw comparisons with females opting for non-engineering fields or those discontinuing engineering studies at the university level. Instead, we aim to gain insights into the perceptions of these female students regarding the barriers and support mechanisms within their immediate environment and the broader social landscape at the National University. Specifically, we aim to identify any perceived obstacles and unravel the motivating factors that drive their commitment to pursuing engineering as their chosen path.

Empirical Context

The Philippines has ranked 17th among 156 countries in the Global Gender Gap Report 2021 of the World Economic Forum (WEF) (Crismundo, 2021)

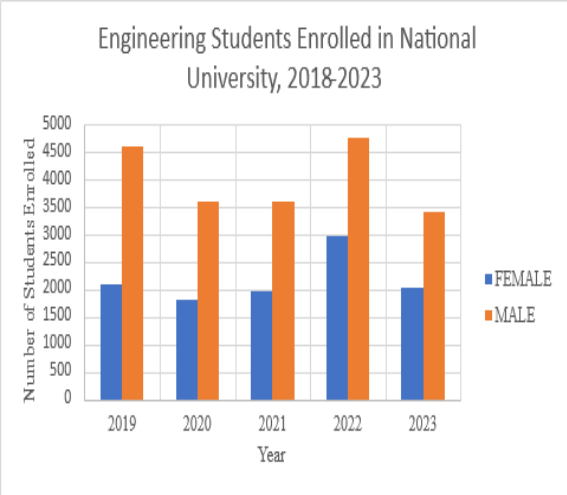

Figure 1. Population data of female and male engineering students from 2019-2023

Over the period spanning 2019 to 2023, the National University in Manila has demonstrated a consistent commitment to providing quality engineering education, with an average annual enrollment of approximately 6,161 students in engineering programs. (National University Manila Campus, 2024) This sustained interest in engineering education reflects both the demand for technical expertise and the university's role in meeting these educational needs.

Notably, the data reveals a significant advancement in gender representation within the engineering programs. Of the enrolled engineering students, 35% are female, a statistic that gains importance when viewed through the lens of global gender equality metrics. The Global Gender Gap Report assesses gender disparities across various sectors, including education. The Philippines, being a participant in this global assessment, has seen notable progress in achieving educational parity between genders, as reflected in the increased representation of women in engineering at the National University.

The inclusion of female students in engineering aligns with the country's efforts to bridge gender gaps in education. The Philippines, with its commitment to promoting gender equality in education, has implemented policies and initiatives aimed at ensuring parity in educational opportunities. This aligns with the broader global agenda to address gender imbalances and empower women in traditionally male-dominated fields.

The empirical context provided by the National University's enrollment data not only highlights local efforts but also contributes to the broader narrative of gender inclusivity in STEM fields, aligning with global aspirations for a more equitable and diverse workforce. The university's achievement in maintaining gender-inclusive enrollment in engineering programs becomes particularly significant when viewed against the backdrop of global efforts to close gender gaps in education and employment.

RESEARCH QUESTION

The objective of our research is to explore the perceptions of successful female engineering students at the National University, Manila Campus concerning their career choices. Specifically, our study aims to examine contextual barriers and support systems that influence their career decisions. It is important to note that our research does not intend to draw comparisons between this cohort of students and females who opt not to pursue engineering or those who discontinue engineering studies at the university level. Instead, our focus is on comprehending the perceptions of female engineering students regarding both the barriers and support systems within their immediate academic environment and the broader social context. We are particularly interested in discerning whether participants perceive any challenges and, if so, what factors contribute to their persistence in pursuing a career in engineering. This research aims to provide valuable insights into the experiences of successful female engineering students at the National University, Manila Campus, shedding light on the factors that shape their career choices and their ability to overcome perceived obstacles.

METHODOLOGY PARTICIPANTS

The participant pool for this study comprises 68 respondents, offering a diverse representation of engineering students at various stages of their academic journey. The majority of participants, constituting 73.5%, are first-year college students in engineering. This substantial portion of first-year students adds a valuable perspective, capturing the initial experiences and impressions of those embarking on their engineering education.

Furthermore, 19.1% of the respondents belong to the second-year cohort, bringing in insights from individuals who have progressed beyond the initial stage of their engineering studies. This subgroup contributes to a nuanced understanding of the evolving perspectives and challenges faced by students as they advance through their academic programs.

The remaining participants, constituting a collective 7.4%, represent third-year and fourth-year college engineering students. This group, encompassing those who have spent a considerable duration in their engineering studies, provides insights into the experiences, reflections, and potential adaptations that occur as students approach the conclusion of their undergraduate programs.

In sum, the diverse distribution of participants across different academic years enhances the comprehensiveness of the study, allowing for a holistic exploration of the perceptions and experiences of engineering students at various stages of their college journey.

Data Collection

The data for this research was systematically collected through a Google Survey Form link, ensuring a standardized and efficient means of gathering insights

from female engineering students at the National University, Manila Campus. All participants engaged in this interview were actively enrolled in engineering programs, spanning from first-year to fourth-year, providing a comprehensive representation of experiences across different stages of their academic journey. The utilization of the Google Survey Form facilitated a structured and accessible approach to data collection, enhancing the reliability and consistency of the gathered information.

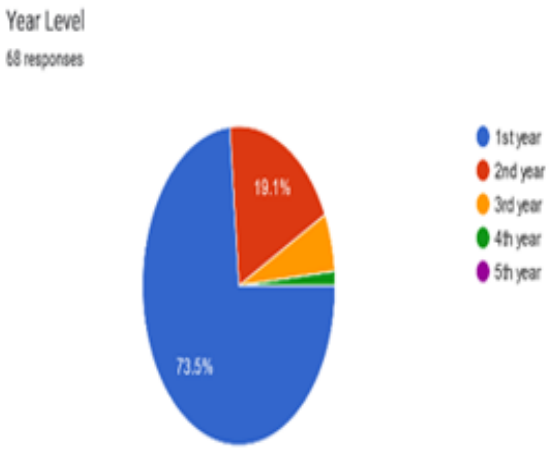

Figure 2. Percent distribution of participants per year level

Data Analysis

The data analysis for this research, conducted to illuminate the unique experiences of female engineering students at the National University, Manila Campus, was executed using a structured Google Survey Form as the primary data collection method. The survey was meticulously designed to explore various dimensions, including academic experiences, motivations for choosing engineering, and challenges encountered across diverse engineering disciplines, such as Civil, Mechanical, Electrical, Electronics and Communication, and Sanitary Engineering.

The analysis commenced by uncovering occurrences of gender bias and discrimination within academic settings, with a focus on understanding their potential impact on the overall experiences of female engineering students. Additionally, an in-depth investigation was carried out to discern potential connections between academic difficulties and gender imbalances within specific engineering programs.

To comprehend the coping mechanisms employed by female engineering students in managing academic stress, a systematic analysis of responses was undertaken. Furthermore, the effectiveness of support systems, encompassing academic, peer, and mentorship networks, was evaluated to gauge their role in assisting individuals in overcoming academic challenges.

The study also explored strategies for promoting inclusion and improving the overall experience of female engineering students within academic institutions. Insights into participants' ambitions and forthcoming

strategies within the engineering domain were analyzed, providing essential perspectives on the distinctive challenges faced by women pursuing careers in engineering.

This data analysis adheres to established ethical standards and principles of research integrity, ensuring confidentiality and respect for participants' responses.

Reference: National University, Manila Campus. (2024). Female Engineering Students Survey: Unpublished raw data.

RESULTS

The interview results provide comprehensive insights into the challenges and coping strategies of female engineering students, shedding light on their experiences in both academic and societal contexts.

Shane highlighted the significant challenge of balancing academics and societal expectations as a female engineering student. This speaks to the broader societal dynamics that can impact individuals pursuing engineering, emphasizing the need for effective strategies to navigate these expectations.

Roxette, a second-year student, shared instances of experiencing gender bias, noting moments where her contributions were questioned based on her gender. This underscores the presence of gender-related challenges within the academic environment and the importance of fostering an inclusive and supportive culture.

Academic challenges in engineering studies were addressed, with responses indicating that time management for multiple projects posed a consistent hurdle. Additionally, advanced calculus courses were highlighted as particularly challenging, emphasizing the demanding nature of certain subject areas.

Concerning the gender ratio in their engineering program, a majority of respondents expressed satisfaction with a balanced ratio, contributing to a collaborative learning environment. This positive perspective suggests that an equitable gender representation positively influences the overall study experience.

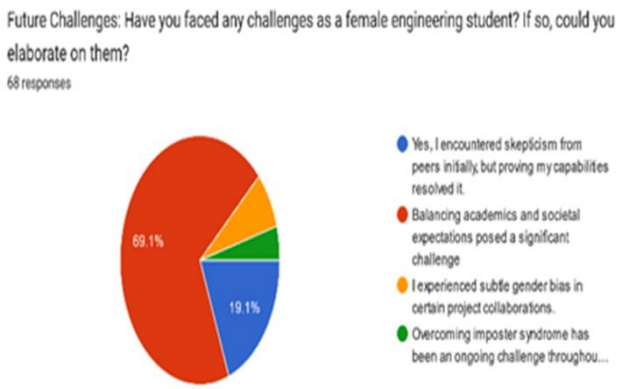

Figure 3. Distribution of responses among female engineering students on future challenges

Coping mechanisms for academic challenges and pressure were diverse, with students emphasizing the importance of detailed study schedules, prioritizing tasks, taking regular breaks, and maintaining a healthy work-life balance. These strategies reflect a proactive approach to managing academic stress. More than 50% of respondents actively sought support systems, with peer study groups being highlighted as invaluable for tackling complex engineering concepts. This underscores the significance of collaborative learning and peer support in overcoming academic challenges.

Personal methods for maintaining work-life balance and managing stress varied among respondents. Strategies included setting realistic goals, breaking down tasks into manageable steps, regular exercise, mindfulness practices, and allocating specific time slots for work, study, and leisure. These diverse approaches highlight the importance of tailoring coping mechanisms to individual preferences and needs.

The additional interview results provide further depth to the experiences and aspirations of female engineering students, offering valuable insights into their engagement in extracurricular activities, perceptions of university support, and advocacy for institutional changes.

Several students shared their involvement in extracurricular activities that positively contribute to their engineering journey and help overcome challenges. Engaging in leadership roles within women in engineering organization was highlighted as empowering, volunteering for outreach programs allowed students to inspire younger generations and find a sense of purpose, while participating in engineering competitions honed skills and built a strong network of peers.

In terms of university or College of Engineering support, Lana advocated for awareness campaigns to eliminate gender bias and promote inclusivity within the engineering community. Francine suggested establishing a dedicated resource center for female students to address their unique needs and challenges. Others echoed the importance of mentorship programs connecting female students with experienced

professionals.

Regarding changes or initiatives within the academic institution to improve the overall experience for female engineering students, common responses included organizing workshops on overcoming gender bias and building confidence, establishing a feedback system for reporting instances of gender bias or discrimination anonymously, and creating networking events to connect female students with successful alumnae.

In terms of specific policies or practices to strengthen a more inclusive and supportive environment for female engineering students, suggestions included establishing a mentorship program, implementing a zero-tolerance policy for gender discrimination, providing flexibility in coursework and exams to accommodate unique challenges, and encouraging faculty to undergo diversity training.

Looking into the future, many civil engineering students expressed a goal of establishing consultancy firms specializing in civil engineering projects that prioritize environmental sustainability, showcasing a commitment to contributing to sustainable development within their field.

In offering advice to aspiring female engineering students, the majority emphasized embracing challenges as opportunities for growth and never doubting one's capabilities. These insights not only reflect the resilience and determination of female engineering students but also serve as inspiration for future generations entering the field.

CONCLUSION

Understanding the Experiences and Perspectives of Female Engineering Students

The comprehensive insights gathered through the interviews with female engineering students at the National University, Manila Campus, provide a nuanced understanding of their academic journey, challenges faced, coping mechanisms employed, and aspirations for the future. The research findings reveal a diverse range of experiences and perspectives, contributing to a deeper comprehension of the multifaceted nature of being a female engineering student.

Motivations and Challenges: The study highlights various motivations that drive female students towards engineering, including a passion for problem-solving, familial influences, and early exposure to engineering backgrounds. However, challenges such as balancing academic commitments with societal expectations were acknowledged, underlining the need for effective strategies to navigate external pressures.

Gender Bias and Discrimination: Instances of gender bias and discrimination were reported by some participants, emphasizing the ongoing challenges within the academic environment. Feeling that contributions were questioned based on gender underscores the importance of fostering inclusive and supportive cultures within educational institutions.

Academic Challenges and Coping Mechanisms: Academic challenges, particularly in time management for multiple projects and advanced calculus courses, were identified. Coping mechanisms varied, with students emphasizing the importance of detailed study schedules, prioritizing tasks, taking regular breaks, and maintaining a healthy work-life balance. The role of peer study groups as invaluable support for tackling complex engineering concepts emerged as a prominent theme.

University Support and Advocacy: Participants expressed their perspectives on the support the university or College of Engineering could provide. Suggestions included conducting awareness campaigns to eliminate gender bias, establishing resource centers for female students, and implementing mentorship programs connecting students with experienced professionals.

Institutional Changes and Initiatives: Several recommendations were made for institutional changes and initiatives to enhance the overall experience for female engineering students. These included regular workshops on overcoming gender bias, feedback systems for reporting instances of bias or discrimination, and networking events connecting students with successful alumnae. Policy suggestions encompassed mentorship programs, zero-tolerance policies for discrimination, flexibility in coursework, and faculty diversity training.

Future Aspirations: Looking into the future, many civil engineering students expressed a shared goal of establishing consultancy firms specializing in projects prioritizing environmental sustainability. This indicates a collective commitment to contributing to sustainable development within the engineering field.

Advice for Aspiring Female Engineering Students: The majority of participants offered valuable advice to aspiring female engineering students, encouraging them to embrace challenges as opportunities for growth and never doubt their capabilities. This underscores the resilience and self-belief that female engineering students recognize as essential in navigating their academic and professional journeys.

In conclusion, the research provides a holistic understanding of the experiences and perspectives of female engineering students at the National University, Manila Campus. The findings not only shed light on the challenges faced by these students but also highlight their resilience, determination, and aspirations for positive change within the engineering field. The insights garnered from this research can inform institutional policies, support systems, and initiatives aimed at creating a more inclusive and supportive environment for female students pursuing engineering education.

RECOMMENDATIONS

Based on the comprehensive study exploring the experiences of female engineering students at the National University, Manila Campus, several recommendations emerge to address challenges and enhance support systems, fostering a more inclusive and supportive environment within engineering education.

1. Awareness Campaigns and Education on Gender Bias

Implementing awareness campaigns within the university can play a pivotal role in eliminating gender bias and promoting inclusivity. Workshops, seminars, and educational initiatives can sensitize students, faculty, and staff to recognize and address unconscious biases, fostering a more equitable learning environment.

2. Establishment of Resource Centers

Recognizing the unique needs and challenges faced by female engineering students, the establishment of dedicated resource centers can provide tailored support. These centers can offer mentorship programs, counseling services, and resources that specifically address the concerns of female students, creating a supportive community.

3. Peer Support Programs

Building on the positive perspective regarding the gender ratio and its influence on the study experience, encouraging and formalizing peer support programs can be beneficial. Creating platforms for peer study groups, mentorship, and collaboration can provide valuable networks that enhance academic and emotional support among female engineering students.

4. Feedback Systems for Reporting Bias

Implementing anonymous feedback systems can empower students to report instances of gender bias or discrimination without fear of reprisal. This transparent process can aid in identifying and addressing specific challenges, contributing to the continuous improvement of the academic environment.

5. Flexibility in Coursework and Exams:

Recognizing the demanding nature of certain engineering courses, providing flexibility in coursework and exams can accommodate the unique challenges faced by female students. This flexibility could include reasonable adjustments, alternative assessment methods, and support for balancing academic and personal responsibilities.

6. Faculty Diversity Training

Ensuring that faculty members undergo diversity training can create a more inclusive and understanding academic environment. Training programs can promote awareness of gender-related issues, enhance sensitivity, and equip educators with the tools to create a supportive atmosphere for all students.

7. Networking Events and Alumni Connections

Organizing networking events that connect female engineering students with successful alumnae can provide valuable role models and mentors. Establishing these connections can offer insights, guidance, and opportunities for career development, contributing to the overall success of female engineering students.

These recommendations, if implemented collectively, can contribute to breaking down barriers, fostering inclusivity, and creating an environment where female engineering students can thrive academically and professionally

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