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Research Article

Investigating Gender Disparities in Electronics Engineering Program Enrollments at a State University in the Philippines

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ABSTRACT

The study investigates gender disparities within the electronics engineering program at a state university in the Philippines from 2020 to 2023. There is a significant gender gap occurring in this area of engineering studies that necessitates further investigation to understand gender-related enrollments. The researchers employed data analysis on enrollment data, which included year, course, and gender. By means of data manipulation and visualization using the Python programming language, it facilitated data analysis with Jupyter Notebook. The findings revealed that despite fluctuations over the specified years, male student enrollees significantly outnumbered female student enrollees in the program. Male enrollees have consistently formed around 70% to 72%, on the one hand, female enrollees covered approximately 28% to 30% over the years. The research outcomes implied that gender differences remain significant, and addressing this issue is necessary. If male dominance continues in this field, significant development will not occur. Diversifying the approach to involve more women in the program is crucial to achieving greatness and fostering advancement and development in this field of study.

Keywords: *Data analysis, Data manipulation, Data visualization, Electronics engineering, Enrollments, Gender Disparities*

Introduction

Higher education institutions in the Philippines have had significant fluctuations in the number of students enrolled in the electronics engineering program in recent years, particularly seeing declination in student intake in this program (Joaquin et al., 2022). Nonetheless, there are still gender discrepancies occurring in the electronics engineering program which concerns stakeholders due to recurring circumstances where not all individual students have been given fair opportunities to study this area of engineering discipline. Despite these obstacles, this program holds immense potential, highlighting the urgency to address gender

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imbalances and create an inclusive environment for future advancements in the field.

The academic landscape about gender disparities in electronics engineering education in the Philippines showed a continuing concern that fewer women are considering the electronics engineering program. However, numerous cooperative efforts are being made to address this issue, including changing the engineering curriculum to appeal to more female students by incorporating practical applications, and active learning methodologies (Yunus et al., 2023). Moreover, there is the Advocacy on Women's Education and Empowerment (AWE) Project that empowers young women through capacity-building exercises to make a more inclusive engineering environment in the country (Lanada Laro, 2022). Further program platforms also continue to provide support networks for female students in the Philippines.

The involvement of women in engineering programs holds significant importance in cultivating diversity and inclusivity in this field (Porter & Serra, 2020). Supporting more women to take engineering programs enables engineering schools to achieve substantial developments and fosters an environment making an innovative electronics engineering program (Abioye et al., 2019). In the study of Jung and Kim (2020), it is reported that mixed-gender or diverse teams are generally successful and create patents more frequently than single-gender teams. Organizations with greater gender diversity demonstrate higher performance, boosting productivity and profits. Additionally, although men are generally considered better in Consequently, establishing an inclusive environment that empowers individuals to make actions or decisions, regardless of gender, helps foster a growing community where different viewpoints help make a difference in electronics engineering.

According to a study about the impact of Latinx engineering students in their educational environment, more must be done to address student behavior, including various nuances of students' experience in the engineering field, since implicit biases remain unchanged within a traditional white male dominant competitive field (Smith et al., 2022). These challenges contribute to the ongoing problem of gender bias in an educational setting, which causes more women to feel unrecognized due to stereotypes imposed on them. Moreover, a study that delves into women's experiences in Philippine STEM fields, suggests that having strong social relationships and exerting more effort while leveraging the power of positive thinking can empower women to overcome barriers (Aquino et al., 2023). This statement entails breaking stereotypes and fostering awareness by highlighting how empowering women and encouraging collective effort can pave the way for future success in male-dominated workplaces.

A study conducted at the Ateneo de Manila University regarding gender and diversity in higher education institutions revealed that the BS Electronics Engineering course had approximately 86.2% male students, making it one of the male-dominated courses in the institution's colleges (Lao et al., 2023). This significant investigation highlights the high male dominance in gender participation within the Electronics Engineering program in the country. Another relevant article discusses the University of the East's (UE) decision to close the Electronics and Communication Engineering (ECE) program due to declining enrollment. This also sheds light on the ongoing challenges faced by the program, as it is sometimes underrated in certain schools due to its difficulty and male-dominated nature (Baron, 2021).

Based on a study about the interest of students in electrical and electronics engineering, boys are more inclined than girls toward pursuing electronics engineering studies due to increased encouragement, guidance, and societal influences. Girls, on the other hand, often experience judgment and questioning by society for their choices (Mozahem et al., 2019). Although both genders show interest in this field of study, these observable factors contributed to the growing gender disparities problem at many institutions. It also indirectly entailed the way electrical and electronics engineering is what society thinks boys should do, thereby driving their higher enrollment rates (Naukkarinen et al., 2023).

In the professional world, discrimination towards women also adds up to the decreasing

number of girls in engineering programs. Despite their desire to stay in the profession, women are compelled to leave due to gender stereotyping and workplace culture. According to Sharma et al., 2019, eight out of fifteen women believe their organizations assign them more administrative tasks than complex technical roles. The lack of a number of successful females in the field discourages girls from pursuing engineering. Therefore, although they show interest, girls tend to back down and choose another major before even getting into it (Weber, 2018) — making the underrepresentation of women in the field persist over time (Colwell et al., 2020).

Recognizing these gender differences, this study aims to investigate gender disparities in Electronics Engineering Program enrollments at a State University in the Philippines from Academic Year 2020-2023. With this, the Researchers formulated the following objectives which focus to: (1) To analyze the gender distribution in the Electronics Engineering program enrollments across specified years; (2) To assess the enrollment patterns of male and female students in the Electronics Engineering program for a detailed examination of their fluctuations; (3) To investigate the yearly gender ratios in the Electronics Engineering program enrollments for enrollment proportion disparities. Through understanding gender disparities in electronics engineering program enrollments, the researchers seek to provide insights into the state of gender diversity in the program and determine the significance of these findings toward fostering sustainable development in this growing field.

Methods

The study thoroughly examined gender disparities in the Electronics Engineering program enrollments at a state university in the Philippines from the academic years 2020 to 2023. The dataset was collected from the state university in the Philippines and analyzed throughout the study to gain insights about the status of gender representation in the program. All gathered data was ensured anonymized and removed from any personal or sensitive information. The researchers took strict measures to maintain the confidentiality and privacy of the dataset.

This research study utilized enrollment records of the Electronics Engineering Program, involving the year of enrollment, the course (BSECE), and the gender categorization of students, as shown in Table 1. The dataset goes through a data cleaning process using Microsoft Excel to remove inconsistencies and prepare it for analysis. Additionally, Python programming language, including essential analytical libraries, was utilized in the Jupyter Notebook environment for data analysis. Performing exploratory data analysis (EDA) in Python helps explain findings visually and suggests further steps for gathering insights from the data (McKinney, 2022).

Table 1. Dataset Attributes and Description

Attributes	Description
year	Refers to the enrollment years of the students, which include 2020, 2021, 2022, and 2023.
course	Refers to the courses of each students in the program, specifically limited to the BSECE program.
gender	Refers to whether the students are male or female.

Results and Discussion

Table 2 shows the gender distribution of the Electronics Engineering Program Enrollment for the years 2020, 2021, 2022, and 2023. In 2020, there were 76 male, and 32 female enrollees, totaling 108 students. In 2021, there were 30 males and 21 females, composing 51 students. Following this, 2022 observed 42 male and 17 female enrollees, calculating 59 students. Finally, in 2023, there were 47 males, 18 females, and a total of 65 students. The higher enrollment of males compared to females in these specified years is evident in the numbers. It is essential to understand the data

on gender differences in engineering so that more women students in the field stay and individuals to comprehend how distinct genders perceive being engineering students differently (Hamlet et al., 2021).

Table 2. Electronics Engineering Program Enrollment by Gender

	year	gender	count	total
0	2020	FEMALE	32	108
1	2020	MALE	76	108
2	2021	FEMALE	21	51
3	2021	MALE	30	51
4	2022	FEMALE	17	59
5	2022	MALE	42	59
6	2023	FEMALE	18	65
7	2023	MALE	47	65

The gender distribution of electronics engineering enrollments is illustrated in Figure 1 through a stacked bar plot. The bars represent specific academic years, each segmented into male enrollments displayed in light blue, and female enrollments in pink. Moreover, there are four years included in this data, with the highest student count recorded in 2020, and the second highest in 2023, although with only half the number of students. In particular, the enrollment distribution across these years is unbalanced, with most observations being either 2020 or 2023. Additionally, the plot emphasizes a persistent gender gap, wherein male enrollees outnumber female enrollees in the engineering program.

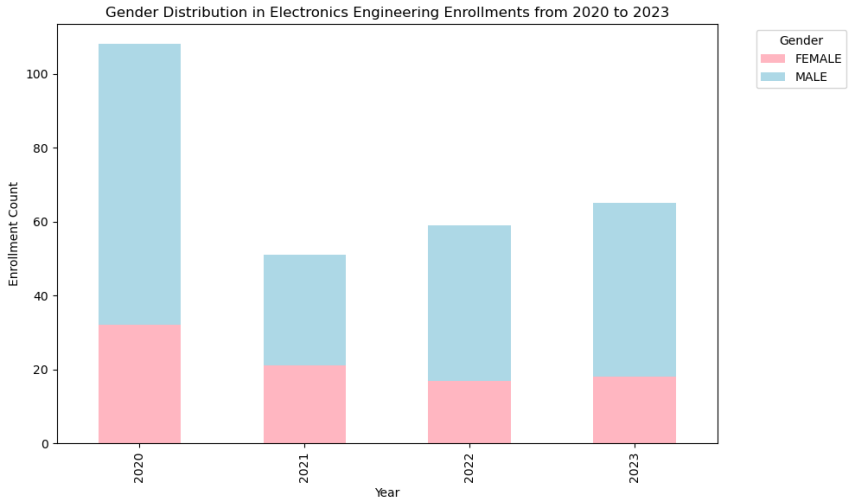

Figure 1. Gender Distribution in Electronics Engineering Enrollments from 2020 to 2023

The line plot in Figure 2 presents the enrollment trends for male and female students in the Electronics Engineering program from 2020 to 2023. Throughout these years, there are different arrangement of enrollment patterns for males and females. Although the total number of students varies yearly, the enrollment trends for males continuously exceed females in enrollment. Furthermore, male enrollees exhibit fluctuating trends, experiencing significant declines initially and by slight growth in the following year. On the one hand, female enrollees also initially experience significant drops, then by continued decline before a slight increase in the latest year. This entails a minor correlation in enrollment changes across these specified years. Consequently, this visual representation highlights yearly changes in

enrollments based on gender, offering a detailed view of patterns that reveal inequality favoring male students in the program. In a research investigation conducted by Kucuk and Sisman (2020) on electronics and robotics attitudes, female students exhibited less interest in learning the field compared to male students. However, there was no gender effect on computational thinking and teamwork.

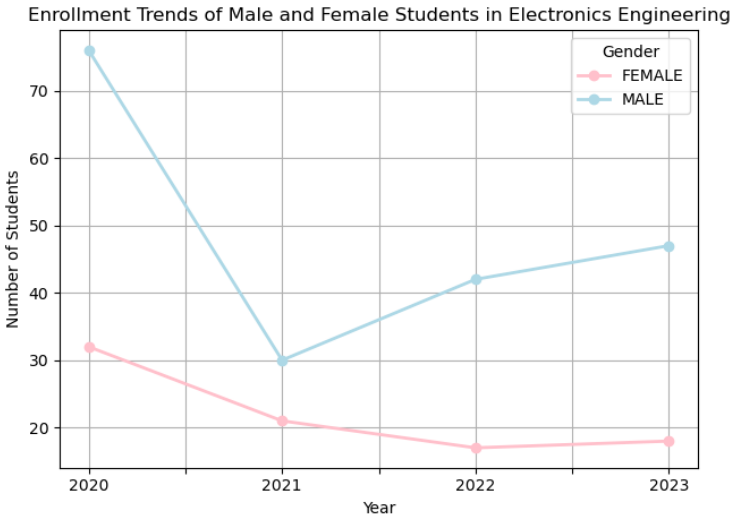

Figure 2. Enrollment Trends of Male and Female Students in Electronics Engineering (2020-2023)

Table 3 provides the yearly gender ratios within the Electronics Engineering program across the years 2020 to 2023. It presents the total count of female and male enrollees for each year, including their respective percentages of the total enrollment. The greater percentages of male enrollments compared to female enrollments entail a consistent gender representation imbalance favoring the male gender over all four years. In 2020, male enrollees made up 70.37%, while female enrollees made up about only 29.63%. However, in 2021, females comprised about 41.18% of enrollees, and 58.82% of males; although the female enrollments saw a slight increase, male enrollees remain dominant, likely due to the smaller total number of enrollees that year, leading to the rise in female enrollment. Correspondingly, 2020 represented 28.81% of female enrollees and 71.19% of male enrollees. Finally, there are about 27.69 % of female and 72.31% of male enrollees in the year 2023. According to the study conducted by Gómez, Tayebi, and Delgado (2022), there is a significant difference in the perspectives of male and female students when choosing engineering, and the next step is finding ways to encourage individuals to stay in the field. Recent studies also suggest that fewer women are choosing STEM studies compared to men and that they are likely to renounce their jobs (López-Iñesta et al., 2020).

Table 3. Gender Representation Proportions in Electronics Engineering Enrollments

gender year	female	male	total	female_percentage	male_percentage
2020	32	76	108	29.629630	70.370370
2021	21	30	51	41.176471	58.823529
2022	17	42	59	28.813559	71.186441
2023	18	47	65	27.692308	72.307692

The yearly gender ratios in Electronics Engineering program enrollments from year 2020 to 2023, involve the proportion of male and female enrollments, as shown in Figure 3. Each bar represents a specific academic year, segmented into percentages of male and female

enrollments. A noticeable pattern observed across all specified years is the outlier status of male enrollments when compared to female enrollments. The difference remains clearly consistent, entailing significant enrollment proportion disparities at the state university. The visualization elucidates that there is a discrepancy in gender representation in the program. For this reason, the institution needs to evaluate enrollment data to ensure proper representation and address any underlying factors causing this disparity.

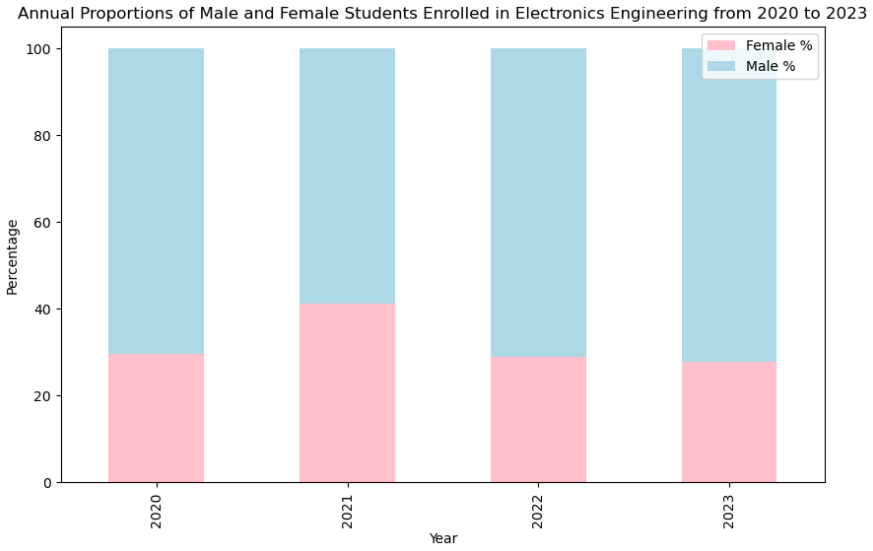

Figure 3. Annual Proportions of Male and Female Students Enrolled in Electronics Engineering

Conclusion

The exploration of gender differences in the electronics engineering program at a state university in the Philippines has consistently revealed a preference for male student enrollment. Across the specified years, a clear gender gap in enrollments became apparent, approximately 70% to 72% of enrollees were male, whereas only around 28% to 30% were female. In 2021, there was a slight difference: female student enrollees made up 41.18%, and male student enrollees composed about 58.82%. Although fluctuations were observed in annual enrollment data, male students consistently outnumbered female students for this program. Moreover, the visual representations extracted from the data analysis illustrated the superiority of male students in that engineering program. These findings have a significant impact on the issue of tackling gender representation in the engineering field. For this reason, developing strategies and devising necessary actions where gender gaps are becoming more evident may help increase the involvement of female students in the program.

Future research could investigate further understanding the declining enrollment of female students in Electronics engineering studies and STEM-related fields. This might involve looking into several factors, such as society's expectations, the mechanisms by which these areas of engineering studies are encouraged, and having a fuller understanding of the perspective of various stakeholders. Consequently, addressing this gender gap would make these advancing disciplines more innovative and diverse in making different approaches toward making the overarching field of engineering education universal.

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