

Female Engineering Education in the University of Mines and Technology, Tarkwa – Ghana

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Abstract

The study investigated the female engineering education in the University of Mines and Technology, Tarkwa. Numerous studies have examined the participation of women in engineering education, and the reasons for the low number of female engineers are complex. The University of Mines and Technology established a gender mainstreaming policy in 2005 with the goal of raising female enrollment to 25% by 2014. Data on admission and completion rates were gathered for the study from the 2004/2005 through 2015/2016 academic years. The study found that female admission rates gradually rose from a low of 4.6 percent in 2005 to a maximum of 22.1 percent in the academic year 2010–2011. The next year, there was a dramatic decline to 12.8%, and by 2015, it had averaged out at 14%. Analysis of department-by-department admission data shows that though engineering is generally regarded as a “men’s sphere,” within the engineering programmes some are more preferred by females to others. For the period under consideration, the preferences at UMaT are in the order; ES > CE > GL > PE > GM > EL > MR > MN > MA > MC. The study concluded that there has been a steady increase in the enrollment and completion rate for females in engineering programmes. It was recommended that UMaT and other engineering institutions in Ghana should vigorously pursue female enrollment drive to ensure higher enrolment and completion rate for female students in engineering programmes.

Keywords: UMaT, Female admission, Gender mainstreaming, engineering.

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1. Introduction

Impacting knowledge and principles relevant to the professional practice of engineering is what engineering education entails. Engineering education at the university level sometimes starts with technology education in primary and secondary schools (Douglas, Iverson and Kalyandurg, 2004). Universities and technical institutions frequently offer engineering education. As more bachelor's degrees have been awarded over time, so has interest in engineering. Unfortunately, women are still underrepresented in this field (Douglas, Iverson and Kalyandurg, 2004).

The participation of women in engineering education has been the focus of numerous studies, and the proportion of women in these fields continue to draw interest in many nations throughout the world. Women still make up a small portion of the engineering workforce, even in wealthy nations. For instance, female undergraduate engineering students in the United States of America increased from a low of 1 percent in the 1970s to 15 percent in the 1980s. The proportion of women had increased to nearly 20% by the year 2010. (Nguyen, 2000; WES, 2016; Cunningham, Lachapelle, & Lindgren-Streicher, 2005).

The UK contains fewer than 10% of the Europe’s total female engineering professionals, according to the Women Engineering Society (WES, 2016). About 30% of other nations, including Cyprus, Latvia, and Bulgaria, have a higher rate. 15.8% of engineering and technology undergraduates in universities across the United Kingdom are female, compared to more than 30% in India. In Australia, the percentage of students studying engineering increased from 1% in 1969 to 15% in 2000, and this number has not significantly increased since then. Additionally, the proportion of women working in engineering rose from 10.6% in 2006 to 11.8 percent in 2011 (Nguyen, 2000).

While it is encouraging to see an increase in the enrolment of women in engineering, with a peak of 14.05 percent in 1996, it is important to remember that women still make up less than 15% of the overall engineering population, as stated by Nguyen (2000) in her study in Australia. Given that women make up slightly more than 50% of the general population, it is obvious that urgent effort must be taken to increase the number of women

who choose to pursue careers in engineering.

Why are there so few women studying engineering, in a nutshell? Nguyen (2000) identified several factors in her study of "The Status of Women in Engineering Education" that might discourage women from majoring in engineering, including: the demanding environment of engineering schools, a feeling of isolation and a lack of acceptance from the faculty, staff, and male students; the psychological scripting that women lack the necessary skills and abilities to become engineers; and societal expectations that women are more accomplished in linguistics. In a broader sense, men are perceived as being more technically oriented and women as being less technical. The author swiftly disregarded aptitude and competence as being crucial because, in her perspective, women engineers have proven themselves to be equally capable as their male colleagues. Authors (Ofori-Sarpong 2014; Amankwah et al. 2015) identified some factors, such as low girl-child education, name-calling, and branding of women who veered into science and mathematics educations as "witches" and "iron-ladies," that have contributed to the low female engineering population in Ghana.

Mining has the highest male predominance percentage among engineering fraternities. The mining business is well known for having a male predominance. In the mining business in underdeveloped nations, women make up roughly 10% of the workforce. Less than 5% of women work in Ghana's primary mining-related technical service units (geological, mining, mineral extraction, and surveying) (Ofori-Sarpong, 2014).

The University of Mines and Technology (UMaT) implemented a gender mainstreaming policy in 2005 in an effort to increase the number of qualified women in the industry. This policy was to ensure that female applicants who fulfil the minimal requirements for admission are accepted. By 2014, UMaT set an aim of 25% female enrolment, however the enrolment rate as at 2014 is only about 15%. (Kuma, 2014). Even though this may seem like a negligible percentage, it represents a huge improvement over the initial 0.24 percent in 1992. Thus, there have been some advances in female involvement, and the goal of 40% established in 2015 was to be reached by 2024. (UMaT Strategic Plan, 2015).

In order to better understand the role UMaT played in the education of women in engineering from the academic years of 2004/2005 to 2015/2016, this study looked at the trend in admissions and gave recommendations.

1.1 The Study Area: University of Mines and Technology

As the Tarkwa Technical Institute (TTI), which was founded on November 3rd, 1952, the University of Mines and Technology (UMaT) later revised its objective to adopt the training of mining technicians and other middle level workers for the nation's mining and affiliated institutions. The organization thereafter adopted the name Tarkwa School of Mines (TSM). It is known that in 1976, the TSM joined the faculty of the Kwame Nkrumah University of Science and Technology (KNUST) and changed its name to KNUSTSM. KNUSTSM was reorganized in 2001 as the Western University College of KNUST until November 3, 2004, when it became an independent, full-fledged university.

The primary mission of UMaT, an engineering school, is to offer higher education in the fields of mining, petroleum, technology, and associated disciplines through teaching, research, and extension activities. The University's goal is to develop into a centre of excellence for creating top-tier professionals in the mining, petroleum, technology, and associated engineering disciplines in Ghana and Africa. Its overarching goal is to help students advance their academic prowess and recognize morally upright principles.

The University's strategic goals is to increase the enrolment of female students through implementing its gender mainstreaming policy. All female applicants who meet UMaT's minimal entry standards are admitted as a result of this policy, which is intended to promote the enrolment of numerous female students.

Records readily available indicate that since the institution's founding as a technical school, the number of female admissions has been low. When it became an independent institution, it started developing a strategy plan to direct Management's efforts to accomplish its goals. The 2005 SPLAN2K14 Strategic Plan spanned the years 2005 through 2014. The SPLAN2K14 estimates that there were 410 students enrolled in 1992, of whom 409 were male and 1 female. The number had increased to 625 by the start of the 2000–2001 academic year, composed of 597 men and 28 women. 860 students were enrolled at the start of the 2004–2005 academic year, including 801 men and 59 women. Female enrolment from 2000/2001 to 2004/2005 academic years showed some form of improvement but it was still low as compared to male enrolment (UMaT Strategic Plan, 2015).

2. Data Acquisition and Investigations

Data was obtained through the review of KNUST and UMaT papers, including the Strategic Plan, Statutes, Vice Chancellors Annual Reports, and Basic Statistics of the University, provided the data for this study. Also included in the open-ended conversations were admissions officers, female instructors, graduates, and students. The Academic and Students Affairs Unit of the University provided the study with admission statistics for new students.

3. Results and Discussions

3.1 Admission Requirements and data

Admissions are made according to merit. Since the Gender Mainstreaming Policy went into effect in 2005, which aimed to increase female enrolment to 25%, females who meet the minimum requirements for admission (aggregate 24 for Senior Secondary Certificate Examination (SSCE) and 36 for West African SSCE) have been given consideration for admission. A cut-off point is then established based on the applicants' academic standing for the specific year. The cut-offs typically vary from department to department.

The sciences serve as the foundation for all of UMaT's admission requirements, therefore credits in technical drawing, metal work, applied electricity, or applied electronics must be earned before other required courses like English, mathematics, and integrated science are taken into account. Education in STEM fields—science, technology, engineering, and mathematics—has been identified as one of the barriers keeping women out of the engineering profession (Accenture, 2014). As a result, many young girls could decide against studying these topics in senior high school.

The University has two faculties: the Faculty of Engineering (FoE) and the Faculty of Mineral Resources Technology (FMRT). Seven undergraduate programs, including Geomatic Engineering (GM), Geological Engineering (GL), Mining Engineering (MN), Minerals Engineering (MR), Mechanical Engineering (MC), Electrical and Electronic Engineering (EL), and General Drilling (GD), were offered by UMaT between the academic years of 2004 and 2006. All of the other programs were Bachelor of Science (BSc) programs, with the exception of General Drilling, which was a certificate program. FMRT has introduced Petroleum Engineering (PE) and Environmental and Safety Engineering (ES), while FoE has expanded its degree offerings with the addition of Mathematics (MA) and Computer Science and Engineering (CE).

Fig. 1 shows the admission information for the years 2004 to 2015. 2005, the year that the gender mainstreaming strategy was first implemented, instead experienced a drop from 7.1 percent to 4.6 percent. Female admittance rates subsequently rose from this low level, peaking at 22.1 percent in the academic year 2010–2011. The next year, there was a dramatic decline to 12.8%, and by 2015, it had averaged out at 14%. The number of students admitted increased from 212 to 510 throughout the same time period, reaching a high of 595 in the academic year 2013–2014 due to the admission of two SHS groups.

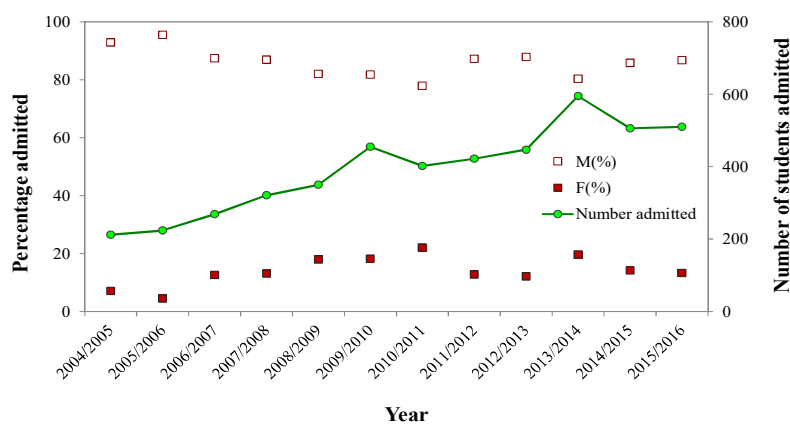


Fig. 1. UMaT Admission Data for the Period 2004 to 2015

3.1.1 Department-by-department Enrolment

According to Fig. 2a, there were 22.6 percent of female admissions for Geomatic Engineering (GM) for the 2004–2005 academic year, 5.7 percent for Geological Engineering (GL), 0 percent for Mining Engineering (MN), and 7.9 percent for Minerals Engineering (MR). Geomatic Engineering continued to lead with the highest female enrollment rate of 11.8 percent the next year, however this number was less than half of the prior admissions (22.6 %). The percentage of female admissions in the mining department was 3 percent as opposed to none the year before, while the geological engineering department had 6.5 %, somewhat more than the previous year's (5.7 %).

Geological engineering had an increase from 6.4 percent to 21.1 percent in the following years, and mining and mineral engineering saw increases from 3 percent to 13.9 percent and 8.3 percent, respectively. The averages during the time were GM (15.9%), GL (19.8%), MN (14.1%), MR (15.5%), and 16.5 percent for Petroleum Engineering, which was launched in 2009. Since then, female admittance to the other programs has increased, surpassing Geomatic Engineering.

According to Fig. 2b, female students were admitted to Mechanical Engineering (MC) at 3.1 percent and Electrical and Electronic Engineering (EL) at 5.3 percent in 2004. In the academic year 2006–2007, mathematics was introduced. This increased the overall number of executing programs to eight. Female admittance rates rose

significantly from the previous year's 2.6 percent to that year's 5 percent for mechanical engineering and 11.4 percent for electrical and electronic engineering. Unexpectedly, the new program in mathematics had a high female admittance rate of 36.8%; however, the percentage fell precipitously the following year to 13.8%. The average percentage of female students admitted throughout the time was 10.1% for MC, 15.5% for EL, 12.9% for MA, and 20.2% for Computer Science and Engineering (CE), a program that was added in 2009.

Due to reorganizing the SHS program, two streams of students graduated from senior high school (SHS) in 2013. In Ghana, a pre-university curriculum is called the SHS. With this, it was anticipated that admissions would double, if not double, at all Ghanaian universities. In absolute terms, UMaT admissions climbed from 447 in 2012/2013 to 595 in 2013/2014. Additionally, the number of female admissions climbed from 54 in 2012/2013 to 117 (19.7%) in 2013/2014. Data on female admissions for the academic years 2013/2014 to 2015/2016 are shown in Figure 5. It should be noted that the percentage of female applicants dropped from 19.7% in the 2013–2014 academic year to 14.2% in the 2014–2015 academic year, and then again to 13.3% in the 2015–2016 academic year. Female admissions to the departments were undoubtedly impacted by these reductions. The Environmental Safety Engineering (ES) program was introduced in 2013, and in a three-year period, the average percentage of female enrollment was 25.3%.

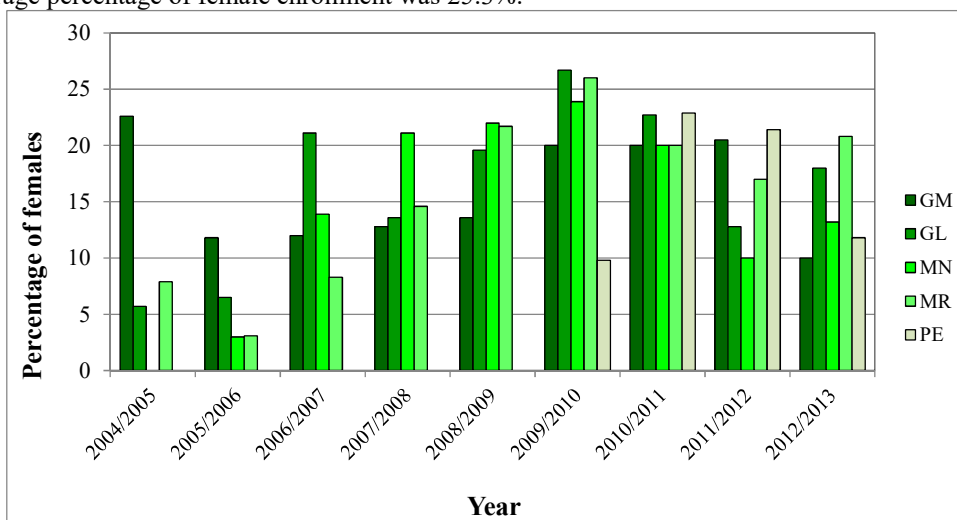


Fig 2a. Department-by-department female enrolment in the Faculty of Mineral Resources Technology from 2004/2005 to 2012/2013.

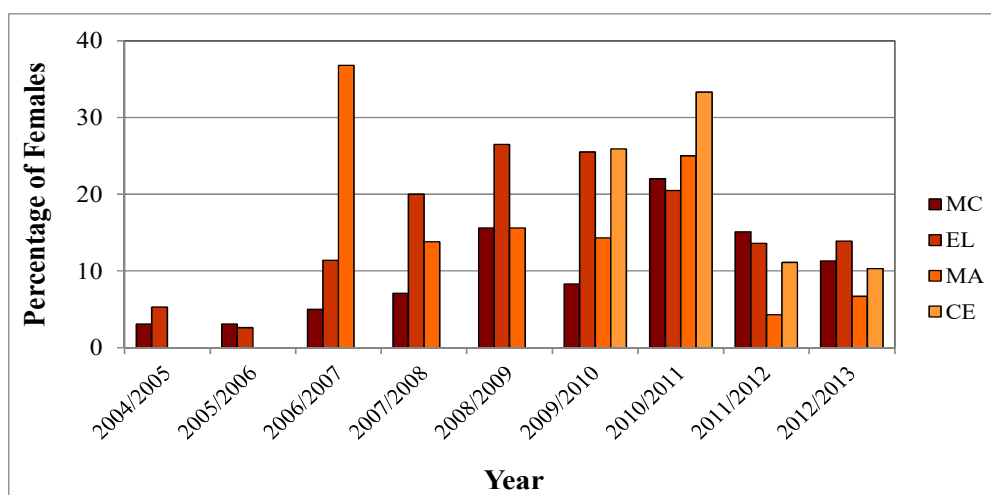


Fig 2b. Department-by-department female enrolment in the Faculty of Engineering from 2004 to 2012.

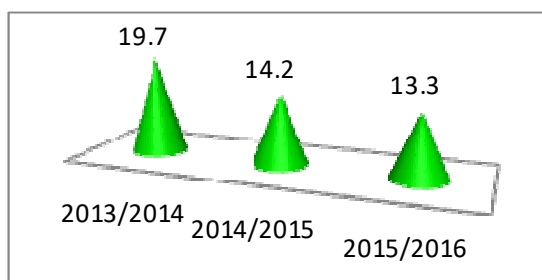


Fig. 3: Female admission from 2013/2014 to 2015/2016

Due of the alleged physical exertion and demanding nature of the profession, engineering is typically seen as a "men's sphere" (Gupta, 2015). The research reveals, however, that even within engineering programs, some are more popular with women than others. For the period under consideration, the preference is in the order; ES > CE > GL > PE > GM > EL > MR > MN > MA > MC.

3.2 Student Enrolment at UMaT

Despite the fact that the UMaT started admitting students for degree programs in 1976, the study's data are from 1992, the year the institution admitted its first female student to a degree program. Figure 4 depicts the admissions trend from 1992 to 2015. The years before and after the achievement of full university status in 2004 are separated by a line.

It is clear that from 1992 to 1998, there were fewer than 500 students admitted each year. These students were accepted into six departments, five of which offered diploma-level coursework, with one (Mining Engineering) offering both degree- and diploma-level coursework. The others were mine surveying, mine mechanical engineering, mine electrical engineering, mine geology, and mineral technology. The lone female student at the time was enrolled in the Mining Engineering degree program.

Figures 5a and b show a comparison of enrollment for males and females from the academic years 1992/1993 to 2015/2016. From one (0.24 percent) in 1992/1993 to 100 (12 percent) in 2003/2004, the numbers demonstrate a gradual rise. The percentage of female students gradually increased after the institution was established in 2004 and gender mainstreaming was implemented in 2005, reaching a maximum of 33 percent in both the 2008–2009 and 2009–2010 academic years with about 420 female students. However, these figures were not maintained and gradually fell, reaching 14.1 percent and 14.3 percent by the academic years 2014–2015 and 2015–2016, respectively. The goal to maintain 25% female enrollment by 2014 was not met, despite the university's efforts to "raise student enrolment and promote female involvement in all programs."

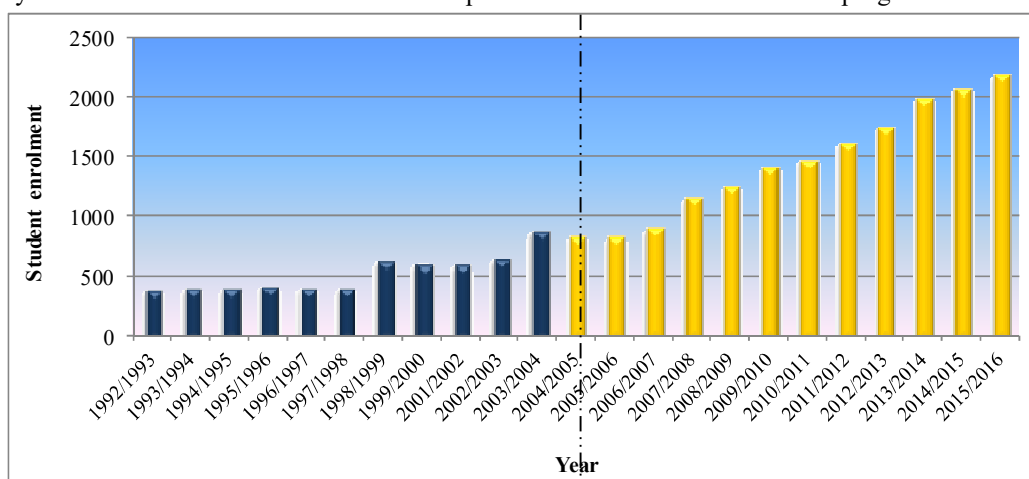


Fig 4: Total Student Population from 1992/1993 - 2015/2016 Academic Year (Source: UMaT, 2016)

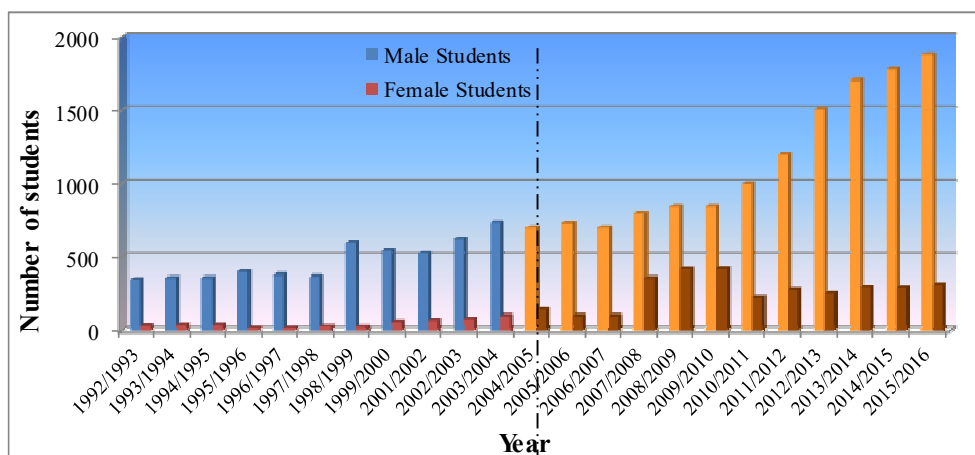


Fig. 5a: Trend of Student Population by Gender from 1992/1993 - 2015/2016 Academic Year (Source: UMaT, 2016)

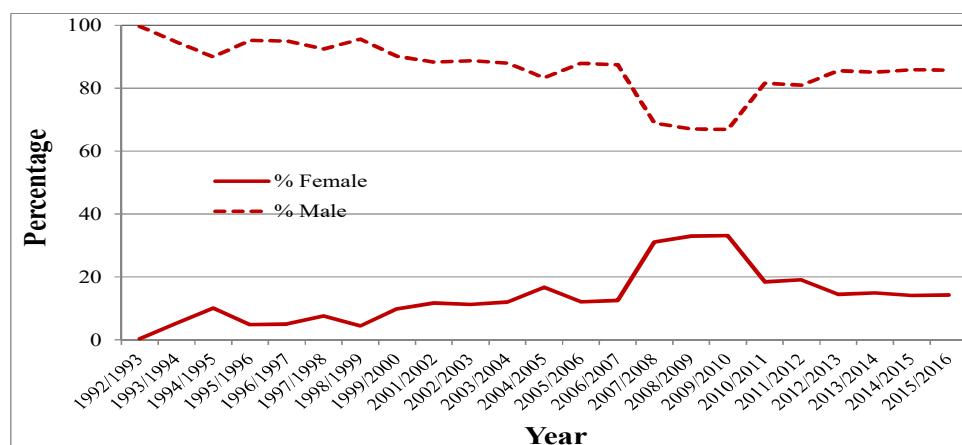


Fig. 5b: Percentage of Student Population by Gender from 1992/1993 - 2015/2016 Academic Year (Source: UMaT, 2016)

4. Conclusions

The Strategic Plan (SPLAN2K14), which planned to run from 2005 to 2014, was created by UMaT after it was granted full university status in 2004. The university would admit more female students in order to raise their enrollment to 25% of overall enrollment by the conclusion of the plan period, according to the Strategic Plan (SPLAN2K14). In order to measure progress, this study studied the female student population 2004 to 2016.

According to the report, there were over 2200 students enrolled in school in 2015, up from less than 500 in 1992. Female enrolment has also increased throughout this time, rising from less than 0.5 percent to about 14 percent. The percentage of female applicants rose from 4.6 percent in 2005 to a high of 22.1 percent in the 2010/2011 academic year. The next year, there was a dramatic decline to 12.8%, and by 2015, it had averaged out at 14%. The average during the time frame was close to 15%.

Though engineering is typically thought of as a "men's realm," department-by-department admission analysis reveals that some engineering programs are more popular with female students. The preference at UMaT is as follows for the time period under consideration: ES > CE > GL > PE > GM > EL > MR > MN > MA > MC.

4.1 Recommendations

Through the gender mainstreaming program, UMaT has been able to increase the enrollment of women, and even though the target enrollment rate of 25% was not met, numerous improvements have been made. Maintaining the gender mainstreaming policy along with special seminars on engineering and technology education for SHS students, the establishment of award programs for female engineering students, and mentorship programs that make use of the few female engineers who have succeeded in their various fields may help to make further improvements in the future.

Further, it is recommended that UMaT and other engineering institutions in Ghana should vigorously

pursue female enrollment drive to ensure higher enrolment and completion rate for female students in engineering programmes.

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