Great Journs
ISSN: 2328-4870
Vol.1 No.2, August 2024

Journal homepage: www.greatjourns.com

Journal of Education

Vol.1 No.2, August 2024

Influence of Personal Factors on the Enrolment of Female Students in Engineering Courses inTechnical and Vocational Education and Training Institutions in Uasin Gishu County

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Ekong, (2003), also stated cultural factors as being social instigated process where specified groups with common needs, although they may not be living in a similar geographical region, actively follow-up raising of their needs, make decisions and identify a criterion to settle these needs. Participation by members in community programmes or activities can be viewed in terms of a flow from low to a very high-level. In the lower level, for instance, members of community may avail themselves in events such like health related fairs which have been organized and done by health caregivers, example, the rural members may point out the necessity of information on techniques of planning families, compel the concerned ministry of health to provide supplies and services, and to educate local members on how to distribute and accomplish their own trust plus inventory. Community development is referred by the United Nations as a routine that brings together the

Great Journs
ISSN: 2328-4870
Vol.1 No.2, August 2024

Journal homepage: www.greatjourns.com

ABSTRACT

This study focused on the influence of Personal Factors on the Enrolment of Female Students in Engineering Courses in Technical and Vocational Education and Training Institutions in Uasin Gishu County.The study adopted a concurrent mixed-method design in the mixed-method approach. The target population comprised 6 Principals, 60 Engineering trainers, and 480 female Engineering students. Both probability and non-probability sampling techniques were used. The instruments used were questionnaires, interview schedules, and an in-depth interview guide. Both descriptive and inferential statistics were used to analyze quantitative data. Qualitative data was transcribed, coded, and organized into themes. The first research question focused on establishing the influenceof personal factors on female students' enrolment in engineering courses in TVET in Uasin Gishu County. Through descriptive findings, personal factors such as mathematics and science being difficult for females, engineering courses being masculine, and engineering courses being difficult for females elicited negative attitudes towards engineering among females. These findings were largely corroborated through interviews with trainers and principals. However, the study established that female students are gradually becoming more positive towards engineering, especially after being enlightened. Regression analysis results confirmed that female student's attitudes impacted positively on their enrolment in engineering courses where the more positive they become towards engineering, the higher their enrolment and vice versa. These findings resonate with the true picture on the ground. In most cases, it has been difficult to get females to enroll in engineering courses, and when asked why, their main contention has been the attitude of believing that such courses should be reserved for men. The few who have enrolled in engineering courses have intimated positivity and ambition to go against the grain. In view of the foregoing summary of findings, the following conclusions were drawn. The influence of personal factors was significant and had a negative effect on the enrolment of female students in Engineering courses in TVET institutions in Uasin Gishu County. In light of the findings and conclusions of the study, the following recommendations are made to improve the enrolment of female students in engineering courses in TVET institutions. To address the influence of personal factors of females to engineering courses in TVET institutions there is a need for the Ministry of Education to deliberately develop an advocacy policy on attitudes and stereotypes geared towards changing the attitude of female students towards Mathematics and Sciences from the early stages of education, particularly in the basic education levels. The current paradigm shift to Competence Based Curriculum (CBC) provides an opportunity for policy review leading to learner-centered activity- based learning that will change the attitude of females in mathematics and science. The CBC curriculum also provides an opportunity for exposure of female learners to the aspects of science and technology at an early age; hence they can internalize the concepts early enough in the course of their education and therefore will be able to enroll in engineering courses later in their career training at the TVET level.

Key Words: ***Personal Factors, Female Students, Engineering Courses, Technical Vocational Education &Training Institutions.***

Great Journs
ISSN: 2328-4870
Vol.1 No.2, August 2024

Journal homepage: www.greatjourns.com

1.0 INTRODUCTION

Tertiary institutions, whether public or private, provide Technical and Vocational Education and Training (TVET). This form of education equips graduates with skills and competencies, opening up opportunities for them to enhance their quality of life (Paryono, 2017). By becoming economically productive, they can break free from poverty and marginalization. When people possess a set of abilities, they can become entrepreneurs, employable persons, and well-informed citizens. This, in turn, contributes to the economic growth and development of a country (Ogwo, 2018). Thus, the development of human resources through Technical and Vocational Education and Training (TVET) not only helps economic growth and a decrease in unemployment but also results in the improvement of social inclusion. Approximately half of the global population consists of women, who also make up two-thirds of the global workforce. However, despite these figures, women paradoxically earn just one-tenth of the world's income and own only one-hundredth of the world's property (Srivastava & Cheema, 2019). These disparities may be attributed to inequitable access to educational and training opportunities. A study conducted in Nigeria revealed that female students' participation in TVET and SET programs indicates that females are still underrepresented and tend to occupy lower and middle positions, despite some recent progress in this regard (Okorafor et al., 2015). This is corroborated by separate research that indicated a significant proportion of women were mostly employed in low-wage occupations, while others were compelled to enter into early marriages, engage in prostitution, and endure child labor (Rotich et al., 2020). In addition, the Strategy for Technical and Vocational Education and Training (UNESCO 2016) supports this claim by highlighting that male students outnumber female students in 91 percent of nations worldwide, despite improvements in gender equality in higher education and in Science, Technology, Engineering, and Mathematics fields.

Industrialized nations like the United Kingdom have seen a decline in the number of female students enrolling in STEM topics and pursuing careers in associated fields (Codiroli Mcmaster, 2017). The existence of this disparity may be linked to gender bias present in the curriculum, classroom teaching methods, and the education system's inability to provide support for the development of self-esteem, confidence, and aspirations of female students throughout their early years of study. The underrepresentation of females in Technical and Vocational Education and Training (TVET) is a prevalent problem in both developed and developing nations, including Kenya. This research was crucial in examining the impact of selected factors on the enrollment of female students in engineering courses at TVET in Kenya since there are still persistent disparities, hurdles, and inequities despite previous advancements. The primary function of TVET is to provide individuals with the necessary skills and competencies to enhance productivity, increase income levels, and enhance access to work possibilities (Republic of Kenya 2014). Furthermore, advancements over the last thirty years have heightened the significance of Technical and Vocational Education and Training (TVET) in the process of globalization, technical advancements, and intensified rivalry resulting from trade liberalization. This implies the need for workers in both modern sector enterprises and Micro, Small, and Medium Enterprises (MSME) to possess greater skills and be more productive.

According to Kenayathulla et al. (2019), TVET programs provide essential technical skills, as well as entrepreneurial, communication, financial, and leadership abilities, which result in higher wages and more options for self-employment. Kenya acknowledges the significance of education and training in contributing to the Gross Domestic Product (GDP), with a specific focus on Technical

and Vocational Education and Training (TVET) (Ngugi, & Muthima, 2017). The subsector has been highlighted as having the potential to stimulate economic growth in the next decade and contribute to the country's goal of becoming a middle-income economy by 2030.

The study focused on examining the influence of selected factors on the enrollment of female students in engineering courses at Technical and Vocational Education and Training (TVET) institutions in Kenya. TVET is crucial for establishing a solid basis for sustained technical advancement (Omovigho Igberaharha, 2021). It contributes to the development of a nation's human capital and is seen as education for the workforce that enables the adaptation of skills and knowledge to the evolving needs of society. Technical and Vocational Education and Training (TVET) plays a crucial role in preparing individuals for the workforce and equipping them with the skills necessary to pursue sustainable and profitable lifestyles (Okwelle & Deebom., 2018). Kenya has recently reinvigorated the Technical and Vocational Education and Training (TVET) subsector with the aim of strategically positioning itself in both the regional and international arenas (Akala & Changilwa, 2018). However, this goal may not be accomplished if women fall behind their male peers in enrolling in engineering courses at TVET schools and subsequently in securing jobs in both the official and informal sectors.

TVET education in Kenya is provided by several public and commercial institutions, including Vocational Training Centers (VTCs) supervised by County Governments, Technical and Vocational Colleges (TVCs), National Polytechnics, and many Technical Universities. Furthermore, some Ministries, including the Ministry of Agriculture, Ministry of Transport and Infrastructure, and Ministry of Health, have established Technical and Vocational Colleges inside their respective departments. These colleges provide courses in Technical and Vocational Education and Training (Sifuna 2020).

At present, Kenya has many fully accredited institutions that provide Technical and Vocational Education and Training (TVET) programs up to the PhD level (Malechwanzi, 2022). Based on the findings of Chege and Kariuki (2016) and KUCCPS (2018), the proportion of male enrolments in TVET institutions was 65%, while female enrolments accounted for 35%. However, it was observed that the participation of females in Science, Engineering, and Technological courses in TVET institutions was very low. According to the Sessional Paper No. 1 of 2019, a policy framework for reforming education and training for sustainable development in Kenya (Ministry of Education, 2019), the percentage of women in Mechanical Engineering was just 1.4 percent in 2018, whereas it was 4.4 percent in Electrical and Electronic Engineering, and 5.0 percent in Building and Civil Engineering.

The foregoing raises the question of why there was a lower representation of women in Science, Engineering, and Technology fields compared to males. Sessional Paper No. 1 of 2019 (Ministry of Education, 2019) highlights two main difficulties confronting the TVET industry in Kenya: a shortage of trainers who possess pedagogical competence and an insufficient number of TVET Institutions. Additional obstacles include the inadequate dispersion of TVET institutions throughout geographical areas, the unfavorable impression of TVET among high school students and the overall Kenyan populace, and the insufficient participation of women in Science, Engineering, and Technology programs. Although a policy on gender mainstreaming exists, the government must establish appropriate mechanisms to ensure the complete implementation of the policy (Omukhulu, et al., 2016). A research paper on factors influencing the retention of female students in STEM courses at the Technical University of Kenya (Were, 2020) presented during

the National Commission for Scientific, Technology, and Innovation (NACOSTI) research conference of 2019 stresses the need to implement policies that encourage the empowerment and full involvement of women in scientific, technology, and innovation activities.

II: LITERATURE REVIEW

2.1 Personal Factors and Enrolment

The study by Ortiz-Martínez et al. (2023) in Spain aimed to analyze women's retention in higher education STEM programs. The research focused on identifying the factors influencing the permanence of women in STEM careers and potential causes of career abandonment. The study used historical data for admission to STEM careers and a survey to collect data at a private university in Mexico. The historical data indicated that only 17% of the total population were women choosing STEM careers. The survey collected information on factors affecting the decision to pursue or remain in a STEM career.

The study found that inspiring faculty and a supportive learning environment positively influenced women's decisions to continue STEM careers. On the other hand, a competitive and less empathetic teaching environment negatively affected women's retention in STEM. The study proposed educational innovation interventions, such as mentoring and workshops, to improve women's retention in STEM fields. Ortiz-Martínez et al. (2023) analysis of women's retention in higher education STEM programs provides valuable insights into factors influencing their career longevity. While the research successfully identifies inspiring faculty and supportive learning environments as positive influences, it does not explicitly explore the role of personal motivations and barriers in the initial enrolment decision. While relevant to STEM retention, the study's findings might not fully align with the specific context and challenges faced by public TVET institutions in Kenya having been done in a private University. Nonetheless, the study's call for educational innovation interventions such as mentoring and workshops to improve women's retention in STEM fields is a positive stride towards promoting gender equity. Therefore, this study explored the influence of personal factors on female enrolment in engineering from a Kenyan perspective.

The research conducted by Whitcomb et al. (2020) in the United States of America examined the levels of self-efficacy and academic performance in female and male undergraduate engineering students across four STEM fields: mathematics, engineering, physics, and chemistry. The study used longitudinal survey data obtained from five cohorts of engineering students at a prominent research institution in the United States. The research examined the correlation between self-efficacy and academic performance. The data analysis computed effect sizes of gender disparities using Cohen's d. The results indicated that women had weaker self-efficacy than males in the fields of mathematics, engineering, and physics, despite little or opposite disparities in academic performance.

Females demonstrated superior performance in chemistry classes. The research proposed focused initiatives to foster fair learning environments and narrow the gender disparity in STEM areas. Although Whitcomb et al. (2020) highlight gender differences within STEM disciplines through a longitudinal survey, the study falls short of explicitly exploring the personal factors influencing initial enrolment choices. Furthermore, the study's applicability might be limited to a US-based research university, making it less relevant to the context of TVET institutions in Kenya. Therefore, this research was a cross-sectional survey conducted in TVET institutions in Kenya. A cross-sectional studyprovides a snapshot of a specific point in time, allowing researchers to collect

data from multiple participants at once. This approach was ideal for capturing the current enrolment status of female students in engineering courses and the factors influencing their decisions.

Razal et al. (2018) in their study on nurturing attitudes towards STEM in Malaysia used a survey design in a total of 398 form-four students in a science stream in a secondary school. The study used a student questionnaire to collect data. The data was analyzed using descriptive and inferential statistics. The research revealed that cultivating a positive attitude towards STEM among students had a crucial role in shaping their future professions in STEM. The study by Razal et al. (2018) found that nurturing students' attitudes at an early age was important in influencing the student's future careers in STEM. However, the study confined itself to the influence of attitude as a factor influencing enrolment in STEM. Besides, the study's focus on secondary school students in Malaysia may not have entirely aligned with the unique context of TVET institutions in Kenya.

Research conducted by Uzor-Isiugo et al. (2023) in Nigeria, investigated the impact of peer influence on the level of interest that young girls had in STEM courses in Imo State, Nigeria. The study used a descriptive research design and applied triangulation, which included mixing qualitative techniques such as thorough interviews and discussions in focus groups, along with quantitative approaches such as surveys, to collect data. The research specifically targeted senior high school pupils in Imo State. The data analysis included descriptive and inferential statistics, such as Pearson product-moment relationship, one-way ANOVA, and multiple regression. The results indicated that peer influence significantly influenced the choices made by students, particularly related to academic interest and achievement in STEM subjects. The study recommended gender-responsive approaches, role models, and supportive policies to promote female interest and enrolment in STEM subjects. By exploring the influence of peer interactions on girls' interest in STEM subjects, Uzor-Isiugo et al. (2023) shed light on the impact of external factors. However, the study's mixed methodology approach, while informative, does not extensively examine the full spectrum of personal factors influencing initial enrolment decisions. Besides, the research's focus on secondary school students in Nigeria may not have entirely aligned with the unique context of TVET institutions in Kenya. This study sought to address these gaps by employing a suitable quantitative approach that would explore the causation between personal factors and enrolment in the Kenyan TVET institutions set up.

A study carried out in Uganda by Musiimenta et al. (2019) investigated the variations in attitudes toward STEM and soft skills among students in rural Uganda, specifically focusing on gender inequalities. The research used a cross-sectional study design, using questionnaires to gather data from a sample of 111 pupils at a single secondary school. According to the survey, a greater number of girls than boys had unfavorable opinions towards STEM subjects. Additionally, both genders showed a lack of interest in 21st-century skills and had limited exposure to role models in the field of STEM.

The research emphasized the need to implement interventions to tackle unfavorable attitudes towards STEM, enhance students' 21st-century competencies, cultivate interest in STEM disciplines and professions, and provide role models, particularly in disadvantaged regions such as refugee settlements. The study by Musiimenta et al. (2019) explored the differences in attitudes toward STEM among secondary school students and found that more girls reported negative attitudes toward STEM when compared to boys. However, the study collected data using only one type of instrument, a student's questionnaire and did not corroborate this data using other

instruments. The study also looked at the difference in attitude to STEM between boys and girls only in one secondary school. To address these gaps the study employed a concurrent mixed method that used a student questionnaire, interview schedules for the trainers, and an in-depth interview guide for the principals to triangulate the research findings. The study also explored many other factors that are influencing enrollment in Engineering courses contextualized in TVET institutions in Kenya.

In a study conducted in Ethiopia by Egne (2014) on equal treatment of women in public higher education institutions, a descriptive survey and analytical research design techniques were used. The participants included university professors, gender equality officials, and female students. Data gathering included the use of questionnaires, interviews, and document analysis. The data was evaluated using a combination of qualitative and quantitative methodologies. The survey revealed a significant lack of female students in STEM subjects among Ethiopian higher education institutions. The primary determinants that impact these aspects include insufficient aptitude or academic readiness, lack of knowledge or consciousness, student self-assurance, educational opportunities that are less readily available to females, and inadequate assistance from higher education institutions. The study by Egne (2014) on gender equality in higher education was important in shedding light on reasons for the serious underrepresentation of female students in STEM in Higher Education in Ethiopia. However, the research's focus was on two institutions of higher learning in Ethiopia which may not have entirely aligned with the unique context of TVET institutions in Kenya.

A study by Were (2020) in Kenya aimed to investigate the factors affecting the retention of female students in STEM courses at the Technical University of Kenya (TUK). The research design used was descriptive, and the study focused on drop-out trends, systemic factors, and sociocultural factors influencing female students' retention in STEM. Data was collected by use of structured questionnaires distributed to female students, and interviews were used to gather additional information from other respondents. The sample consisted of 149 female respondents from diploma and bachelor programs, selected using simple random sampling. Key informants, including teaching staff and assistant registrars, were selected using purposive sampling. The data analysis involved using SPSS version 20.0 to perform frequency, percentage, and correlation tests. The study revealed that female students in STEM courses were more likely to drop out than their male counterparts. Systemic factors, including institutional and student factors, were found to influence the retention of female students in STEM. The study recommended implementing targeted strategies and mentorship programs to improve the retention of female students in STEM courses. The study by Were (2020) recommended targeted strategies and mentorship programs to enhance female students' retention in STEM courses is a promising step toward addressing the gender gap. Besides, in examining factors influencing the retention of female students in STEM courses at the Technical University of Kenya (TUK), the study's reliance on structured questionnaires and interviews provided valuable insights into systemic factors affecting retention. However, the research missed exploring the personal motivations and barriers influencing initial enrolment decisions. Additionally, the study's narrow focus on TUK limits the generalizability of its findings to TVET institutions in Kenya. The study also selected respondents using purposive sampling a non-probability approach. This study maintained a structured questionnaire and used both non-probability and probability sampling procedures but focused on the TVET institutions' context in Kenya.

Omukoba (2018) conducted a cross-sectional and exploratory study in Kenya to examine the perceptions and attitudes of female students toward STEM courses at the University of Nairobi. The research used qualitative methods, including semi-structured interviews, key informant interviews, and case narratives. The sample size included 50 respondents chosen through purposive sampling. The semi-structured questionnaires collected demographic information and explored the attitudes and perceptions of non-STEM female students towards STEM courses. Key informants and case narratives provided additional data on women's attitudes towards STEM. The study revealed that female students felt unwanted in STEM studies due to male dominance and lacked role models in STEM fields. Negative stereotypes and cultural norms also played a significant role in influencing their perceptions of STEM. The study concluded that gender inequalities were present in STEM and suggested the need for interventions to promote equitable learning environments and encourage female students to pursue STEM courses. The study by Omukoba (2018) emphasized gender inequalities and the need for interventions to promote equitable learning environments is commendable. Indeed, the research investigating female students' perceptions and attitudes toward STEM courses at the University of Nairobi offers valuable qualitative insights. However, the study's qualitative methods might lack the quantitative rigor to explore personal factors influencing initial enrolment choices comprehensively. Moreover, findings in a university context may not have exhaustively reflected the TVET context. These gaps were addressed by conducting a quantitative study on the causal relationship between personal factors and female students' enrolment in Engineering at the TVET level.

A study by Akama (2019) in Kenya examined legislation and policies' effectiveness in promoting gender equality in access to education in Kenya, focusing on Technical and Vocational Education and Training (TVET) institutions. The research used a mixed methodology approach and gathered data from ten TVET institutions in Nairobi and Kiambu counties. Questionnaires and interviews collected qualitative and quantitative data. The study employed feminist theories such as Liberal, Socialist, and Marxist feminism to explore women's freedom in accessing education as a tool for empowerment and independence. The findings revealed that despite existing laws and policies, gender equality was inadequately addressed in educational institutions due to a lack of implementation mechanisms and oversight. The study concluded that the gap in achieving gender equality in TVET institutions could be attributed to the insufficient implementation of policies, urging stakeholders to take decisive measures to align institutional policies with national and international gender equality goals. In examining gender equality in access to education, the study by Akama (2019) uncovered inadequacies in policy implementation within TVET institutions in Kenya. However, the study's focus on legislative and policy aspects did not extensively explore the personal motivations and barriers influencing female students' initial enrolment decisions. The research would have been more comprehensive by including a deeper investigation into the personal factors affecting STEM enrolment. In retrospect, this study sought to address this gap by exploring the effect of personal factors on female students' enrolment in Engineering courses in TVET.

Ngugi and Muthima (2017) conducted a desk review in Kenya to assess the participation of females in the Technical and Vocational and Education Training (TVET) subsector, particularly in STEM-based courses. The research highlighted that although progress had been made in enhancing access, equity, retention, and quality in education and training, the TVET subsector continued to experience low female enrolment in STEM fields. The study recommended

supporting equal opportunities for girls and boys to excel in TVET-related subjects, providing gender-responsive approaches in education, increasing female role models, and implementing gender-responsive policies to promote inclusivity and shield vulnerable groups from exclusion in TVET education. Ngugi and Muthima (2017) highlighted persistent gender disparities in STEM-based courses. However, by using the desk review approach, the study fell short of explicitly examining the causal relationship between personal factors driving these disparities and initial enrolment. The research's focus on enrolment, access, and retention could have been enriched by delving into a quantitative approach based on cause-effect analysis.

III: RESEARCH DESIGN AND METHODOLOGY

3.1 Research Design

The study used a concurrent mixed research design. The concurrent mixed-methods research design involves collecting both quantitative and qualitative data simultaneously, ensuring independence and not informing the collection of one type of data from the other (Bell et al., 2022). This approach allows for comprehensive and effective research. In this study, this design was deemed suitable because it allowed the collection of in-depth quantitative and qualitative data regarding the influence of selected factors on the enrolment of female students in engineering courses from different categories of respondents using a combination of questionnaires, interview schedules, and in-depth interview guides (Halcomb & Hickman 2015). In this approach, cross-sectional survey design was used for the quantitative strand while phenomenology design was used for the qualitative strand.

3.2 Description of study area

The research was carried out in Uasin Gishu County, located in Kenya. The county has a total of 492 public primary schools and 246 private primary schools, with a Gross Enrollment Rate (GER) of 98.1%. The high rate of enrollment may be attributed to the adoption of the Free Primary Education (FPE) program by the Government.

The GER for females in primary schools is 96.2%, which is slightly lower than the GER of boys at 99.9%. The County has a total of 184 secondary schools, with a Gross Enrollment Ratio (GER) of 66.5%.

The GER falls short when compared to the national average, which stands at 76.5%. The GER for females in secondary schools is at 69% which is higher compared to that of the boys at 64%. (Republic of Kenya, 2020). The County is home to two public universities, three satellite campuses of private universities, and five satellite campuses of public universities. Additionally, the county has one national polytechnic, five publicly funded Technical and Vocational colleges, eleven Vocational Training Centers (VTCs) under the county government, and many privately owned commercial colleges located in the urban areas of the county.

3.3 Target Population

The study targeted engineering students, engineering trainers, and principals drawn from Technical and Vocational Education and Training (TVET) institutions in Uasin Gishu County. The target population is the whole collection of components that a researcher aims to draw conclusions about. Population elements are the individuals or subjects on whose measurements are being collected (Dahabreh & Hernán, 2019). Therefore, this study comprised of a total population of 6 TVET institutions and in retrospect 6 principals, 60 engineering trainers, and 480 female engineering students as shown in Table 1.

Great Journs
ISSN: 2328-4870
Vol.1 No.2, August 2024

Table 1

Target population

Category	Target population
TVET Institutions	6
Principals	6
Engineering Trainers	60
Female Engineering Students	480

Source: County Director TVET Office, Uasin Gishu

3.4 Description of Sample and Sampling Procedures

3.4.1 Sampling

This study employed both probabilistic and non-probabilistic sampling approaches. Sampling is a specific plan for obtaining a sample from a population, involving the researcher's selection of items and determining the sample size, which may also include the number of items to be included. Therefore, this research employed the systematic quasi-random and stratified random probability approaches when sampling female engineering students and trainers respectively, with a view of giving all female students and trainers in the population equal chances of representation in the sample. In contrast, the purposive non-probability approach was used to sample TVET institutions and principals. The choice of purposive sampling was based on the criteria that the institution is a TVET institution, that it is in Uasin Gishu, and offers engineering courses.

3.4.2 Sample size

Determining the sample size remains central to research. For this study, the sample size included a predetermined size of 4 TVET institutions and in retrospect, 4 Principals. Next sample sizes of 214 and 52 respectively for female engineering students and engineering trainers were calculated using the formula for calculating sample size for finite populations used by Etikan and Babatope (2019). The formula is as follows:

$$n = \frac{Z^2 \times p \times q \times N}{((Z^2 \times p \times q) + (E^2 \times (N-1)))}$$

Where:

n = Sample size

Z = Z-score corresponding to the desired level of confidence (e.g., 1.96 for a 95% confidence level)

p = Estimated proportion or expected prevalence in the population

q = 1 - p

N = Total population size

E = Margin of error (desired level of precision)

Assuming the same values for the confidence level (Z = 1.96) and the margin of error (E = 0.05), and considering a conservative estimated proportion of 0.5, the sample size for female engineering students was given by:

$$n = \frac{1.96^2 \times 0.5 \times 0.5 \times 480}{[(1.96^2 \times 0.5 \times 0.5) + (0.05^2 \times 479)]}$$

n = 213.629

≈214

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ISSN: 2328-4870
Vol.1 No.2, August 2024

Therefore, the sample size for female engineering students in this study was 214 respondents. Similar calculations confirmed 52 as the sample size for trainers. The sample sizes for institutions and principals were predetermined as 4 each. Table 2 presents a summary of the sample size, clearly outlining the targeted sample and sampling criterion.

Table 2
Sample Size and Sampling Criteria

Category	Target population	Sampling Technique	Sample Size
TVET Institutions	6	Purposive	4
Principals	6	Purposive	4
Engineering Trainers	60	Stratified random	52
Female Engineering Students	480	Systematic quasi random	214

3.4.3 Sampling Techniques

As described in the sampling design, both probability and non-probability sampling techniques were employed in this study. First, the total sample of 214 female engineering students was stratified into their respective categories on the strength of formula by Etikan and Baptope (Table 2). Next, the four TVET institutions were purposively sampled on the criteria that they offer TVET courses, and are in Uasin Gishu County. Meanwhile, the 4 Principals were also purposively sampled based on the criterion that they are principals of the selected institutions. Two TVET institutions were used for the pilot study leaving 4 TVET institutions and Principals to take part in the study. The participating trainers were sampled using stratified random sampling where the trainers were stratified based on gender and from each strata, a random sampling technique was used to select the required number of trainers. Finally, a systematic quasi-random sampling approach was used to sample the female engineering students. Every $\frac{480}{214}$ = 2nd student was selected until the 214 had been identified.

3.5 Description of Data Collection Instruments

The study utilized three instruments of data collection. These included questionnaires, interview schedules, and an in-depth interview guide. According to Almalki (2016), the choice of questionnaires as an instrument of data collection was because questionnaires have a higher response rate and are less time-consuming since you can collect information from a large number of respondents within a short time. Questionnaires also allow for the researcher to clarify areas where respondents need clarity and provide anonymity to the respondents hence, they are at ease and are encouraged to give honest and accurate responses. The choice of interview schedules for trainers in TVET institutions was because they allowed the researcher to systematically gather qualitative data from a large group of participants within a short time. The schedules also helped to ensure that the interview remained focused on the research questions and allowed for consistency in data collection from across the different participants. The in-depth interview guide was also used as a data collection instrument as it allowed the researcher to get detailed information on the area of study from the respondents.

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3.6 Validity and reliability of research instruments

3.6.1 Validity

Two validation techniques were used in this study, face and content validity. Validity is the degree to which an instrument accurately measures what it was intended to measure (Mueller & Knapp, 2018). Therefore, under face validity, experts in the field of technical and vocational education and training (TVET), drawn from the engineering discipline conducted a preliminary measure of validity by looking at the instruments to eliminate subpar items quickly. During this process, it was noted that the open-ended items in the questionnaire were not necessary since they had been addressed by the interview guides for trainers and principals. These items were subsequently deleted from the questionnaire. Meanwhile, under content validity, the experts assessed whether the instruments were representative of all aspects of the constructs under study. During the process of content validation, the main concern raised was the mixing of positive and negative definitive items in the questionnaire. For instance, one item was initially structured as "Most students drop out of college due to lack of fees" while the next one was "Most families are not poor and can afford to pay fees". The experts noted a clash in responses and suggested a change of the second item to "Most families are poor hence they cannot afford to pay fees". This suggestion was therefore applied to all questionnaire items.

3.6.2. Reliability

Cronbach's alpha measure for internal consistency was used to test the reliability of the engineering student's questionnaire, while trustworthiness was used to assess the reliability of the interview guides for trainers and principals. Cronbach's alpha is a reliability measure that compares the covariance of an instrument's items to the overall variance, with an acceptable threshold of 0.7 (Hair et al., 2016; Kaur & Mittal, 2021). A pilot study was conducted among forty female engineering students. The pilot test was carried out in two public TVET institutions that were not participating in the study. According to Malmqvist et al. (2019), piloting provides an early warning regarding potential risk areas for the main research project. It also identifies potential areas in which the research procedures may not have been adhered to as rigorously as they should have been. Results of the pilot test demonstrate that the Cronbach's alpha coefficients were all in the excess of 0.7 which is evidence that the scales, including student personal factors (0.911), in Table 3.

Table 3

Reliability Test Results

Variable	No. Items	
Student personal factors	9	0.911

3.6.3 Trustworthiness of Qualitative Instruments

The trustworthiness of the interview guides was determined by assessing four key factors: credibility, transferability, dependability, and confirmability (Coleman 2022). The researcher audited the pilot responses on the qualitative items along the four factors. Under credibility, the researcher determined that responses made on the influence of personal factors, economic factors, sociocultural factors, role models, and career guidance on the enrolment of female students in Engineering courses sounded reasonable based on existing information in the field. Regarding transferability, the responses fitted within females' broader attitudes. The responses were largely broad indicating that they were unbiased and unaffected by the researcher's attitudes or biases and

that the items were dependable to be used in the main research.

3.7 Data collection procedures

The researcher sought a letter of introduction from the Catholic University of Eastern Africa, to facilitate a research permit from NACOSTI. After obtaining the permit, the researcher went for approval from the County Director of TVET Uasin Gishu County. A copy of the research permit was presented to the principals of the targeted TVET institutions to facilitate permission to carry out the study. On the appointed date and time, the sampled female students were presented with the consent note which they were expected to read and give consent to participate in the study (See Appendix I). Those who gave consent were issued with the questionnaires. They were allowed time to respond to the questionnaire items and the researcher later collected the filed questionnaires. Immediately thereafter the researcher dropped the interview schedules for the sampled engineering trainers for them to respond to and later they were collected after the interview with the principal. The researcher then conducted an in-depth interview session with the principal from the selected TVET institution in Uasin Gishu County.

3.8 Data Analysis Procedures

For the purpose of preparation for analysis, the data were first coded and then input into SPSS version 22. After that, the data were analyzed and thoroughly cleaned to remove any missing values and univariate outliers. Data were first edited for accuracy, completeness, uniformity, order, and consistency. This was a key step in this study that was employed to ensure high-quality of data. Every questionnaire was checked and edited soon after collection. Any case with more than 5% of the responses missing was rejected, while those with less than 5% of the responses missing were accepted after establishing the pattern of missing data and conducting hot deck imputation (Hair et al., 2016). Immediately after the completion of the input, a data cleaning procedure was carried out in order to compare the data that was entered with the coding sheet and/or the initial questionnaire. The imputation of missing values and the assessment for the presence of outliers via the use of Box and Whisker plots were the primary focuses of this data-cleaning process.

Descriptive statistics focused on female students' demographic characteristics and study constructs. Female students' demographic characteristics were assessed. Students' age, year of study, fee sponsorship, parents/guardian's profession, and the course pursued were the demographics of interest. These demographics have been found to have extraneous effects on the choice of course to pursue (Aydin and Bayir, 2016). Consequently, these demographics were deemed as confounding variables in this research. Meanwhile, proportions of agreement and disagreements were generated for each of the constructs under study. The data was then displayed using tables.

Before carrying out the multiple regression analysis, it was necessary to evaluate five assumptions that were to be met before carrying out the multiple regression analysis. (Hair et al., 2016) These assumptions included the assumption of multicollinearity, linearity, and homogeneity of variances, as well as the assumption of standard deviation and independence of residuals. A single model was developed in accordance with the imagined connections in order to determine whether or not the five hypotheses were correct. The direct impacts of the five variables that influence female students' enrollment in engineering courses at technical and vocational education and training (TVET) institutions in Uasin Gishu County were tested via the use of multiple regression analysis.

In analyzing qualitative data, thematic content analysis was used. This was done by reading through the data multiple times to become familiar with the content and to make notes of the initial impression of the ideas. The data was then coded by systematically identifying and labeling meaningful segments of the data. Inductive coding was used to identify the themes that emerged

from the data. Similar codes were then grouped into themes based on commonalities, patterns, and connectedness. The consistency and clarity of the themes identified were checked and refined to ensure they accurately reflected the data. The themes were then analyzed in depth providing explanations and interpretations for each theme in relation to the research questions.

3.9 Ethical Considerations

Ethical guidelines and principles were adhered to during this research to safeguard the individuals who participated in the study and the researcher. The ethical guidelines that are listed below were followed. The researcher obtained consent from the TVET institutions to carry out research in their institutions. Female Engineering students, Principals, and Engineering trainers were invited to willingly take part in the survey through a consent note attached to the questionnaire. The respondents were assured of confidentiality over the information gathered through the questionnaire. A second step that the study took was to utilize codes rather than names, which allowed them to conceal characteristics that were unique to TVET Institutions and participants and might be traced back to them. In this research, the names of TVET institutions were not included in the questionnaires; rather, numbers were allocated to each questionnaire in order to protect the respondents' confidential information.

IV: PRESENTATION OF THE FINDINGS

4.1 Personal Factors and Students' Enrolment in Engineering Courses

The first research question explored how personal factors influence the enrolment of female students in engineering courses in Technical and Vocational Education and Training Institutions in Uasin Gishu County. Descriptive findings of personal factors as depicted among female students enrolled in engineering courses are presented in Table 8.

Table 4

Influence of Personal factors

Statement	Strongly agree %	Agree %	Neutral %	Disagree %	Strongly disagree %
Mathematics and science are difficult for girls	47.2	47.8	3.3	1.1	0.6
Male and female students perform equally well in mathematics and sciences	2.8	6.1	1.7	60.6	28.9
Engineering courses are generally considered to be masculine.	58.3	37.8	2.2	1.7	0.0
Engineering courses are difficult for females to pursue	56.7	38.3	2.2	2.8	0.0
Engineering courses are dirty and not suitable for female students	58.9	37.2	2.2	1.7	0.0
Engineering occupations are difficult for females	59.4	36.7	2.2	1.7	0.0
Female engineers find it had to get jobs	12.2	7.8	14.4	10.0	55.6
Parents contribute to their children’s choice of careers	53.9	37.8	2.8	5.6	0.0

Nine items measured the influence of personal factors in the enrolment of female students in Engineering courses. Female students were asked to check statements pertaining to the influence of personal factors on a five-point Likert scale where checking SA meant strong agreement, A- agreement, D- disagreement, SD- Strong disagreement, and N- Neutral. As shown in Table 8, the influence of personal factors appeared to be weighing upon female students’ enrolment in engineering courses. For instance, the proportions strongly

agreeing (47.2%) and agreeing (47.8%) that mathematics and science were difficult for girls were quite high. There was also the perception that male and female students did not perform equally well in mathematics and science as demonstrated by 60.6% disagreement. Female students strongly agreed (58.3%) or simply agreed (37.8%) that Engineering courses were masculine, that they were difficult for females (59.4%) and (36.7 %), that parents contributed to their choice of career (53.9%) and (37.8%) and that investment in girl's education got lost at marriage (37.8%) and (38.9%) respectively. However, the respondents strongly disagreed (55.6%) that female engineers found it hard to find jobs. These descriptive results revealed that personal factors play a significant role in female students' enrolment in engineering courses. Entering into the course with a negative attitude towards mathematics and science does not make matters any easier for female students. The self-concept is identified as an important factor in confidence building (Asika, 2020). Therefore, when female students perceive male students to be better in Engineering courses, that the courses are masculine and dirty, their self-concept decreases and with it their confidence and self-esteem (Piran, 2014). The results showing feelings among female students that Engineering occupations were difficult for females exacerbate the negative attitude further making Engineering courses appear irrelevant to them. The result however offered a ray of hope due to the high proportion who disagreed that it is hard for female engineers to get jobs. Some females indicated positivity towards Engineering, giving an encouraging aspect.

The questionnaire responses were corroborated in some quarters and contradicted in others through interviews with principals and trainers, code-named participants. Several participants noted that female student's attitudes towards Engineering courses were largely negative, believing that these courses were masculine. For instance, when asked to comment on female students' attitudes towards enrolment in engineering courses, some of the narratives cited verbatim include.

The female students genuinely have a negative attitude towards engineering. These courses have a low enrolment of females. (P1, Feb 2022)

Female students view the engineering field as a male-dominated profession. (P 20, Feb 2022)

They think it is hard and meant for male students. (P23, Feb 2022)

Female students still fear pursuing engineering courses leading to a very low enrolment rate of females in the disciplines. (P 18, Feb 2022)

However, another strand of participants divulged, that female students' attitude towards Engineering courses was becoming positive as they get more enlightened. Some of the narratives made by trainers and principals in this strand include,

Female students are showing a positive attitude after being enlightened that engineering is not necessarily for one gender (P 18, Feb 2022)

Attitudes across female students toward engineering courses are becoming more positive leading to improved enrolment (P 15, Feb 2022)

I have noticed that female students who liked physics in high school show a positive attitude toward engineering courses and are likely to enroll in them (P11, Feb 2022).

The emerging themes in these narratives include the changing attitude towards Engineering, the perception of masculinity in Engineering, and the high school science and math background. The interviews confirmed that the negative attitude was largely borne from the masculine perception and the attitudes towards mathematics and physics in high school. However, some participants noted that the negative attitude was slowly dissipating with appropriate enlightenment. This group of participants observed that some female students were even outperforming their male counterparts in the engineering disciplines.

By showing that the masculine factor contributes largely to the negative attitude towards engineering, this research resonated well with other studies. Madara and Namango (2016) for instance, demonstrated that the perception of Engineering as too hard and masculine was a critical factor in female enrolment in engineering and was the reason for their minority status in those courses. Furthermore, Madara and Namango (2016)

established that perceptions of Engineering as noisy and dirty manual work were inherent in most female students while in high school. However, in acknowledging the low levels of enrolment of females in engineering, Verdin et al. (2018) lauded the implicit interest in females towards engineering. They argued that above-average enrolments of females were experienced in some engineering courses. The import of this argument is that with proper enlightenment touching on beliefs, attitudes, career plans, and goals, the negative attitude could be replaced with positivity. The positive thought was also noted through interviews with Engineering trainers and principals. The descriptive results confirmed that the influence of personal factors could not be ruled out from factors that lead to the low enrolment of female students in engineering courses in TVET institutions in Kenya.The study revealed that the influence of personal factors was indeed a positive and significant determinant of female students' enrolment in engineering courses in TVET, $b = .128$, $p < .05$. The regression coefficient indicated that a unit improvement in the influence of personal factors was likely to result in a 0.128 unit increase in female student's enrolment in engineering courses. Therefore, the researcher rejected the hypothesis and concluded that personal factors positively influence the enrolment of female students in engineering courses in TVETs in Uasin Gishu County.

V. SUMMARY

5.1 Summary of the Findings

The first research question focused on establishing the influence of personal factors on female students' enrolment in engineering courses in TVET in Uasin Gishu County. Through descriptive findings, personal factors such as mathematics and science being difficult for females, engineering courses being masculine, and engineering courses being difficult for females elicited negative attitudes towards engineering among females. These findings were largely corroborated through interviews with trainers and principals. However, the study established that female students are gradually becoming more positive towards engineering, especially after being enlightened. Regression analysis results confirmed that female student's attitudes impacted positively on their enrolment in engineering courses where the more positive they become towards engineering, the higher their enrolment and vice versa. These findings resonate with the true picture on the ground. In most cases, it has been difficult to get females to enroll in engineering courses, and when asked why, their main contention has been the attitude of believing that such courses should be reserved for men. The few who have enrolled in engineering courses have intimated positivity and ambition to go against the grain.

5.2 Conclusions

In view of the foregoing summary of findings, the following conclusions were drawn. The influence of personal factors was significant and had a negative effect on the enrolment of female students in Engineering courses in TVET institutions in Uasin Gishu County.

5.3 Recommendations

In light of the findings and conclusions of the study, the following recommendations are made to improve the enrolment of female students in engineering courses in TVET institutions.To address the influence of personal factors of females to engineering courses in TVET institutions there is a need for the Ministry of Education to deliberately develop an advocacy policy on attitudes and stereotypes geared towards changing the attitude of female students towards Mathematics and Sciences from the early stages of education, particularly in the basic education levels. The current paradigm shift to Competence Based Curriculum (CBC) provides an opportunity for policy review leading to learner-centered activity-based learning that will change

the attitude of females in mathematics and science. The CBC curriculum also provides an opportunity for exposure of female learners to the aspects of science and technology at an early age; hence they can internalize the concepts early enough in the course of their education and therefore will be able to enroll in engineering courses later in their career training at the TVET level.

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