



## Factors Affecting Learners' Enrollment into STEM Programs in TVET Institutions within Kisumu County, Kenya: A Comparative Analysis

Kevin Otieno Ochieng', RDN  
Mawego Technical Training Institute  
Homabay County, Kenya

### Abstract

*There is presently a lot of debate around science, technology, engineering, and mathematics (STEM) programmes and how they prepare trainees for the future economy and innovation. Moreover, the debate has been even more about inclusion of female trainees to pursue STEM programmes in technical, vocational, education, and training (TVET) institutions in Kenya. While this is the scenario, it is important to understand the various factors that motivate or demotivate trainees' enrollment into these programmes. In this light, this paper seeks to investigate factors that either motivate or demotivate trainees to enroll into STEM programmes and compare the influence of such factors between female and male trainees. The study adopted a survey design where questionnaires and focus group discussions were used as the data collection approaches. 5 TVET institutions, both private and public, within Kisumu County were randomly selected, and purposive sampling used to identify 120 respondents, 87 males and 33 females, for the structured semi-structured questionnaires and case narration. Study findings showed that socioeconomic factors; parents' level of education and personal factors (self-motivation and confidence and attainment of social and academic satisfaction) are the key factors influencing trainees' enrolment into STEM programmes in TVET institutions within Kisumu County. However, there was significant difference in motivating factors between female and male trainees for enrolment into STEM programmes. It is recommended that trainees, both male and females, should be given equal opportunities to pursue their careers in STEM..*

**Keywords:** *STEM programmes, TVET institutions, gender*

### Introduction

Since their inception, Technical Vocational Education and Training (TVET) institutions have proved to be best suited and worthy alternatives for trainees who have not joined Universities to pursue their dream careers in Science, Technology, Engineering, and Mathematics (STEM) (Ngugi & Muthima, 2017). In Kenya, the debate about relevance of TVET in the country's economy has been perpetuated not only by the political class, but also by industrialists, economists, educationist, and technocrats (Ngugi & Muthima, 2017). To emphasize on this, the current government administration, has come out clean and shown evidence and interest that it supports the TVET agenda as the surest means to scaling higher the industrialization dream and to provide skills to the youths, which would then enable them to get the most desperately needed jobs (Dávila Dos Santos et al., 2022). This therefore, proves that the current Kenyan administration would invest heavily on TVET as a catalyst to keep the economy snowballing.

Although the TVET agenda in Kenya has received a warm reception and goodwill from the political class, there are other aspects around key stakeholders, the trainees, that still need to be addressed. Such aspects include the factors that motivate the trainees to join these institutions of training to pursue STEM courses. Studies have shown that motivation plays a vital role when prospective trainees decide to join any TVET institution to pursue a STEM program (Davila Dos Santos et al., 2022). The motivation can, therefore, affect the trainee either negatively (demotivate) or positively (encourage) when deciding to join STEM programs

in TVET institutions. Additionally, some studies have also emphasized that motivation factors to join TVET to pursue STEM programs vary significantly between male and female trainees (Vela, et al., 2020). For example, one study found that confidence is a motivating factor among male trainees to enroll into STEM programs while the majority of female trainees are motivated by attainment of social and academic satisfaction to pursue programs in STEM (Vela, Pedersen, & Baucum, 2020). In other words, this means that while the majority of male trainees have the innate push, their female counterparts on the other hand are motivated by the urge and thirst to prove the society that they are equal to men and can do equally better.

While these motivating factors emerge at the time when a trainee is deciding to join the institution of advanced training, it is also important to try and revisit the entire academic journey of these trainees and find out if there could be some other underlying factors in their past that could also motivate their enrollment into TVET institutions to undertake courses in STEM (Miller, et al., 2018). These include comparing the performance of these trainees in sciences and mathematics in their Kenya Certificate Primary Education and Kenya Certificate Secondary Education. Statistics have shown that there is a significant difference between females and males pursuing STEM courses in TVET institutions (Miller, 2018) not only in Kisumu County, but also Kenya at large. For example, the most recent studies have shown that while males have a representation of over 80% in STEM programs in TVET institutions, females on the other hand are barely 20%. The discrepancy in representation is a phenomenon that some scholars have also linked to performance of these trainees in Sciences and Mathematics while in Secondary or Primary schools (Miller, 2018; Vela, 2020). For example, the data shown in the table below exhibit average performance of students in their KCSE examinations over a span of three years. From the results, it is evident that while the average is dismal in general, but males still outshined females in performance of mathematics and sciences (Biology, Chemistry, and Physics) (KNEC, 2021) Since STEM courses require that a prospective trainee exhibits a good performance in sciences and mathematics in the KCSE results, this could also be another reason for relatively low enrollment of females in these programs because most of them, compared to males, do not perform well in these subjects in high schools (Vela, Pedersen, & Baucum, 2020).

**Table 1**

*K.C.S.E Students % Mean Score in Science Subjects*

		KCSE % Mean Scores		
Subject	Gender	2018	2017	2016
Mathematics	Female	24.23	23.54	18.25
	Male	28.55	27.29	23.08
	Total	26.44	24.48	20.78
Mathematics	Female	24.65	17.98	28.31
	Male	26.78	19.91	30.07
	Total	25.69	18.93	29.19
Mathematics	Female	25.68	22.55	22.69
	Male	28.02	25.45	24.65
	Total	26.88	24.05	23.71
Mathematics	Female	33.30	34.48	40.63
	Male	34.70	35.30	39.41
	Total	34.27	35.05	39.77

Source: Kenya National Examination Council (2021)

Whereas the government has introduced mechanisms to improve performance of sciences and mathematics, such as Strengthening of Mathematics and Sciences in Secondary Education (SMASSE), provision of capitation to equip science laboratories and encouraging science congresses, innovation fairs, and science clinics in secondary schools, all these have not born

any significant results to improve performance to the satisfactory level (Ng'ang'a, 2018). And as it is evident, these eventually have a ripple effect on demotivating females to pursue STEM programs which are purely science and mathematics-based. According to KUCCPS (2022), girls who sat for KCPE exams in that year performed better in English, Kiswahili and Kenyan Sign Language while boys performed better in Mathematics, Social Studies, and Science. All these together could explain the genesis of small representation of females in STEM whereas males exhibit an exemplary representation.

Another angle to view females and males in STEM is also through the registered professionals in this field. To pick on one, a critical review of the Engineers Board of Kenya (EBK) reveals skewed representation of professionals considering gender balance. While the current Chief Executive Officer (CEO) of EBK is a female, Eng. Margaret Ogai, females are still underrepresented in this Board. According to the EBK's data in 2022, out of the licensed 2501 engineers in Kenya, only 211 of them are women, representing only about 8.4% (EBK, 2022). According to Eng. Ogai, the problem of few females enrolling and becoming professionals in STEM begin at the community and family levels where girls are assigned roles of caregiving and boys given the opportunity to pursue their dreams.

Whereas the Kenyan government has put more emphasis on developing and improving TVET education in the country, it is obvious that if the motivating factors to enrollment of trainees into these institutions are not studied and recognized, the stakeholders in this important sub-sector in education can fail to realize their dreams in the near future. As has been outlined in the previous section, scholars have identified a number of factors that motivate trainees to enroll especially into STEM programs in TVET institutions across the country.

First and foremost, studies have shown that there are a number of factors which have contributed immensely to demotivating trainees to enroll into TVET institutions and pursue courses not only in STEM but also in other programs such as Agriculture, Business, and Hospitality among others. One such factor according to Ng'ang'a, et al. (2018), is stereotyping where most individuals still associate TVET institutions with "failure" because the majority of trainees in these institutions did not achieve cutoff points for university entry. Moreover, girls also fail to join STEM courses once they get admission to TVET institutions because these programs are stereotyped to be masculine. Actually, a study has shown the about 70% of girls do not pursue Building Technology, Automotive and Mechanical Engineering, Welding and Carpentry because they feel they are male-only programs (Were, 2020).

Other than stereotype, another demotivating factor that affects enrollment of both girls and boys into STEM programs in the TVET institutions is lack of role models (Amunga & Amadalo, 2020). However, girls are the most affected by this factor. Role models range from parents, trainers, peers, and professionals already practicing. Girls are the most disadvantaged because there are few females in STEM who can motivate the younger ones to join these programs in TVET institutions as statistics have shown in the previous section (Amunga & Amadalo, 2020). Some studies have also shown that unconscious bias especially in hiring and promotion disadvantage women in STEM leading their low representation (Amunga & Amadalo, 2020; Akgunduz & Canan, 2021).

On the other hand, the majority of employers tend to favor male candidates in STEM-related industries, further demeaning the small gains made in motivating girls to get enrollment in STEM programs. As mentioned previously, stereotypes exist even among prospective employers who still perceive women as "weak gender" who cannot be seasoned and dedicated engineers (Akgunduz & Canan, 2021). For example, studies show that for every 10 males employed in STEM-related industries, only 1 female gets a chance leading to a below 10% representation of female employees in such industries (Amunga & Amadalo, 2020). Moreover, some scholars have also shown that some employers discriminate females because being home-makers, they might not attain a work-life balance that makes them productive in the high-

demanding industries. Due to these factors, males have been favored against the few females in STEM and this further complicates the already existing underrepresentation of women in STEM, and in return the motivation for the younger ones to enroll into these programs in the TVET institutions (Amunga & Amadalo, 2020). As exhibited, a number of factors exist which either motivate or demotivate trainees, both males and females, to join TVET institutions to pursue STEM-related courses. In this light, this study aims at investigating factors that motivate trainees, both males and females, to join TVET institutions to pursue STEM courses in Kisumu County.

The objectives for the study were: to investigate factors that either motivate or demotivate trainees to enroll into STEM programmes, and to compare the influence of such factors between female and male trainees in Kisumu County.

### Methodology

The study adopted both a cross-sectional and exploratory research design. This is a research design that is descriptive in nature. The design is time-related and provides the researcher with an overview of the matter being studied. In this design, patterns are established. This study made use of qualitative approaches to data collection as a means of guiding the exploration of perceived motivation that influence enrolment of trainees into STEM programs within TVET institutions in Kisumu County.

The study purposely targeted trainees, both males and females, enrolled into STEM programs within TVET institutions randomly selected in Kisumu County. From the sample size, it was estimated that 120 respondents were adequate to enable an analysis depending on the nature of the survey to be undertaken. Consequently, the respondents in this study were picked in line with the data collection methods. To pick the respondents, a purposive sampling approach was adopted. This kind of sampling ensures that only those in STEM were picked to participate in the study.

The study adopted the use of semi-structured questionnaires to collect demographic data from the respondents. The questionnaires also helped to collect data about the motivating factors for the trainees to enroll into TVET institutions to pursue STEM programs in Kisumu County. The data collected was the measured quantitatively by checking on frequencies, percentages, and statistics. Case narratives also played a key role in collection of data about motivation to enroll into STEM programs. Alongside semi-structured questionnaires and case narratives, key informant interviews (KII) were also conducted through any of the following members of the administration to provide information about attitudes of their trainees towards STEM programs; Principals, Deputy Principals, Registrars and/or Deans.

Thematic analysis of the qualitative data collected from semi-structured questionnaires, case narratives, and KII was done after transcription and coding. Quantitative data was then derived from the semi-structured questionnaires. Verbatim quotes from the case narratives was also used accurately from case narratives, together with the general description of data to project and determine the respondents stand-point.

### Results

**Table 2**  
*Gender Distribution of Trainees in STEM*

Gender	Frequency (f)	Percentage (%)
Male	87	72.5
Female	33	27.5
<b>Total</b>	<b>(N=120)</b>	<b>100</b>

From Table 2, it is evident that there are more male trainees in STEM courses at 72.5% compared to females at 27.5%. These findings are in agreement with other studies that have also shown that there is a skewed distribution of female trainees in STEM courses across all TVET institutions in Kenya (Sichangi, 2017). While this is the scenario, females are also overrepresented in other courses, especially Business, Hospitality, Social Sciences, Dress making and Hair Dressing and Beauty Therapy. In fact, statistics from previous studies have exhibited that in the mentioned courses, female trainees make up 93.2% while male trainees make up only about 6.8%. This evidently reveals that the society still institutionalize the stereotypical thinking that some programs are meant for boys while others are meant for girls, and this study has only confirmed further that STEM courses are still dominated by male trainees.

According to the National Commission for Science, Technology and Innovation (NACOSTI), programs under STEM in the TVET institutions include; Mechanical and Automotive Engineering, Building and Construction Engineering, Information, Communication and Technology (ICT), Carpentry, Electrical and Electronics Engineering, and Biological Sciences among others (NACOSTI, 2022). From the TVET institutions where data for this study was collected, those were also some of the STEM programs that were identified and in which the respondents were enrolled in. From the findings, it shows that Building and Construction Engineering is the STEM program that the majority of trainees are enrolled in at 20.9% and followed closely by Mechanical and Automotive Engineering at 16.7%.

**Table 3**

*Distribution of Trainees in Different STEM Programs*

STEM Program	Frequency (f)		Percentage (%)	
	F	M	F	M
Mechanical/Automotive Engineering	2	18	1.7	15
Building/Construction Engineering	2	23	1.7	19.2
ICT	9	13	7.5	10.8
Carpentry	1	8	0.8	6.7
Electrical/Electronic Engineering	3	16	2.5	13.3
Biological Sciences	16	9	13.3	10.8
<b>TOTAL</b>	<b>(N=120)</b>		<b>100</b>	

However, the STEM program that was identified to have the least representation is Carpentry at 7.5%. Considering the STEM programs preferred by different genders, the majority of male trainees prefer Building and Construction Engineering and Mechanical and Automotive

Engineering 19.2% and 15% respectively. On the other hand, more female trainees prefer biological sciences and ICT at 13.3% and 7.5% respectively.

**Figure 1**

*Distribution of Trainers in STEM by gender*

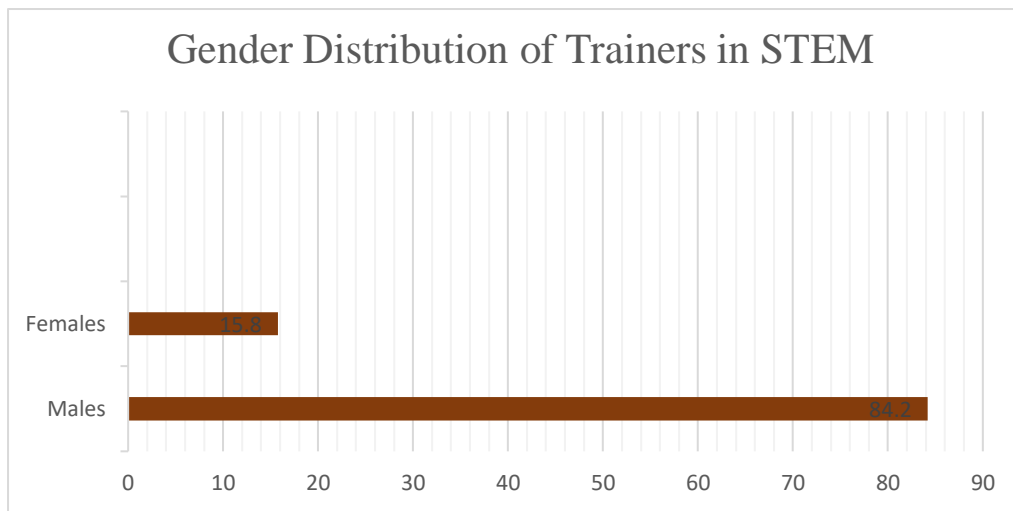


Figure 1 reveals the distribution by gender, of trainers in STEM, showing that 84.2% of trainers in STEM in Kisumu County are males while only 15.8% of these trainers are females. These findings reveal a worrying state of reality where females are less represented even in the professions related to STEM. This is consistent with the EBK’s position as at 2022 which revealed that only about 8% of the registered and licensed Engineers in Kenya are females (EBK, 2022). Such a revelation is a worrying reality that needs a well-thought intervention to increase the number of female representations in STEM.

**Table 4**

*Different Motivating Factors to Join STEM Programs by Different Genders*

Motivating factor	Gender	Frequency (f)	Percentage (%)
Personal Interest	M	46	38.3
	F	4	3.3
Parental Advise	M	12	10
	F	5	4.2
Influence from Professionals in STEM and Role Models	M	15	12.5
	F	13	10.8
School Environment	M	14	11.7
	F	11	9.2
<b>Total</b>		<b>(N=120)</b>	<b>100</b>

Table 4 reveals the different factors that influence/motivate trainees to enroll into STEM courses in TVET institutions in Kisumu County. From the findings, it is exhibited that personal interest is the most significant motivator for males to enroll into TVET institutions to pursue STEM courses at 38.3% while only 3.3% of female trainees enroll into STEM because they have a personal interest to pursue such programs. Influence from professionals and roles models in STEM cumulatively motivate 23.3% of both male and female trainees in STEM.

However, one unique thing is that female trainees are mainly motivated to join STEM programs by influence from role models and professionals in STEM as well as the school’s environment at 10.8% and 9.2% respectively. During the case narration, majority of girls in these STEM programs revealed that they are pursuing these courses because they either know another female who is a professional in STEM or the environment of their institution favors them.

There are a number of things they revealed to play a key role in school environment such as availability of female-friendly amenities and female staff in STEM such as trainers, technicians, and female members of the administration who are supporting girls in such programs. While females are less represented in STEM, the few that are already professionals are playing a key role in motivating others to join the programs (Sichangi, 2017) and this was revealed by the case narration of the 10.8% of the females who got admission into STEM due to motivation from female role models or professionals in STEM.

**Table 5**

*The Respondents' Parents' Level of Education*

Parents' Level of Education	Gender of the respondents	Frequency (f)	Percentage (%)
No education	M	8	6.7
	F	2	1.7
At least Primary Education	M	13	10.8
	F	5	4.2
At least secondary education	M	30	25
	F	11	9.2
At least college or university education	M	36	30
	F	15	12.5
<b>Total</b>		<b>(N=120)</b>	<b>100</b>

Another angle of viewing the motivating factors that eventually determine a trainee's decision to enroll into STEM programs is their parents' level of education. From the study, it shows that there were few trainees whose parents had no education at 8.4% both cumulatively. However, one thing that became evident is that more boys compared to girls, 6.7% and 1.7% were in STEM. This could mean that the majority of uneducated parents could not be supporting girl-child education as opposed to boy-child education.

Moreover, parents who had at least college or university education had the majority of their children in TVET institutions studying STEM courses in Kisumu County, at cumulative percentage of 32.5%. It is also evident that majority of such parents also had their daughters pursue STEM course at 12.5%. This is an indication that such parents understand the value of educating girl child and supporting them to pursue their dreams in STEM. This is in agreement with the Sichangi (2017) findings which also revealed that the more a parent is learned, the more they are most likely to support their children to pursue higher education in tertiary learning institutions. The same study also agrees with findings that educated parents are also more likely to educate their daughters the same way they educate their sons.

### Conclusion

While there has been significant support given to TVET education by the government, the benefits of this might not be enjoyed by every trainee, especially girls who would want to join STEM programs. The study has examined the motivating factors for boys and girls to join STEM programs in TVET institutions. From the findings, however, it has been shown that the motivating factors for girls and boys to join STEM programs vary significantly.

### Recommendations

More female trainees should be encouraged to enroll into STEM programs to pursue courses in this line. Moreover, professionals and female role models in STEM should also actively take part in encouraging girls to join STEM programs in these institutions. As the findings show, these female professionals in STEM are highly regarded by girls who enroll in STEM

programs. TVET institutions should also provide suitable learning environment for girls to join STEM. This can be done by hiring more female trainers in STEM, hire more female technicians in the workshops, and give leadership positions to women who can support STEM and encourage more girls (Chan & Mohammad, 2019). Lastly, the institutions should also provide female-friendly amenities to encourage. Members of the community should be enlightened to provide equal opportunities to both boys and girls to pursue career paths of their dreams. Stereotypical attitudes and perceptions that there are course only meant for boys and other for girls should not be encouraged.

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