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Influence of Funding on Students' Participation in Science and Technology Bachelor Degree Programmes in Public Universities, Kenya

Bernard Wasilwa Wanyama, Maurice I. Makatiani & Daniel N. Sifuna
Department of Educational Foundations, Kenyatta University, Nairobi, Kenya
Corresponding Author: Department of Educational Foundations, Kenyatta University, Nairobi, Kenya.

Abstract:
Despite efforts by the government and other interested groups on funding of University students, the level of enrolment and participation in Science and Technology-based Bachelor Degree Programmes remains low. Only 29% of students were studying a course in Science and Technology by the year 2016. Such scenario implies that the country is seriously lagging behind in the realization of Kenya Education Sector Support Programme (KESSP I) participation target of 50%. The purpose of this study was to explore the gaps that existed in the stated government policies on funding and the actual practice during implementation of the stated policies and the impact of the actual practice during implementation. The study analyzed the relationship between funding of University students and participation in these programmes.The study employed descriptive survey design and purposive sampling technique to select three public Universities and three Academic Registrars while simple random sampling technique was employed to select 355 students who participated in the study. Documentary analysis, questionnaire and interview schedules were utilized to collect data. Qualitative data was analyzed thematically and reported in form of tables, quotations and narrations while quantitative data was analyzed by use of frequencies, percentages, means, pie charts and bar graphs.It was established that Differential Unit Cost (DUC) formula has a net effect of decreasing capitation while the HELB loan awarded is equivalent to 53% and 15% of science and technology cost through Government Sponsored Programme (GSP) and Self Sponsored Programme (SSP) per year respectively.
The study concludes that University funding ought to be backed by coherent policies which prioritize quality and quantity.The study concludes that University funding ought to be backed by coherent policies which prioritize quality and quantity.
Key Words**: **Bachelor Degree, Funding, Participation, Public University, Science and Technology Programmes.

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I. Introduction

Global development agenda greatly focuses on science and technology education as one of the prioritized sector components and, as such, students' participation in such programmes in Universities needs to match the expectations of the goals of the development agenda (Kirimi, 2015; Filippetti & Savona, 2017). However, the introduction of repayable tuition loans policy in higher education in England discouraged students from entering science and technology subjects because they were generally more expensive, and within a system of variable fees, students ended up incurring higher level of debt (House of Lords, 2012). In Turkey, the number of Science and Technology University applicants in each year is much higher than the number of places each university is able to offer. Consequently, students from low income families find it difficult to compete on competitive entrance examinations to Science and Technology Programmes with applicants from advantaged backgrounds that have more resources to spend on high quality primary and secondary schooling, private tuition and examination preparations (Caner & Okten, 2013).

The average percentage of students graduating with science-related disciplines out of total graduates in 2013 was 11.7% in Latin America and Caribbean countries (Ferreyra *et al*, 2017).The deficit of scientists and engineers in Latin America and the Caribbean were attributed to the regions low innovation, relative to that of upper middle income economies (Ferreyra *et al*, 2017). In Brazil, more than 50 candidates from low income backgrounds and those from advantaged backgrounds compete for a single place in popular science and technology programmes where chances of passing competitive examinations are linked to prior attendance at high quality primary and secondary schooling and fee-paying preparatory courses, all of which are out of reach for most lower-income students (McCowan, 2016).

In 2016, there were a paltry 55,601 engineers in Africa while the estimated ideal number was 4,364,667 (African Capacity Building Foundation, 2016). The dismal data is a manifestation of dire state of science and technology education, teaching and learning conditions in African Universities, like low and falling funding and declining quality of science and technology education at all levels of education, thus primary, secondary, tertiary and vocational (African Capacity Building Foundation, 2016). Like in Uganda, access to health professional training was skewed to the elite and well-to-do who attended the top ten secondary schools with infrastructure, teaching and learning resources from central region of the country: the capital city (Kampala), Wakiso and Mukono districts (Galukande *et al*, 2018).

In Kenya, only 29% of students were studying a course in Science and Technology by the year 2016 (Commission for University Education, 2016). The low number of students participating was mainly attributed to low funding (Karimi, 2015). 48% of income from government capitation, 42% from students' fees and research grants and other incomes contribute 5% (Mukhwana *et al*, 2016). With regard to government capitation, Universities Fund and the Funding Board were established under the Universities Act No. 42 of 2012 to advise the government on matters relating to financing of Universities (Government of Kenya, 2014). The Board has established maximum Differential Unit Cost (DUC) for academic programmes offered. The Board utilizes student enrolment numbers and the courses offered instead of flat rate per year to allocate funds to Universities (Universities Funding Board, 2019).

Apart from government capitation, Higher Education Loans Board (HELB), which is a State Corporation, was established by an Act of Parliament (Cap 213A) in 1995 with the mandate to disperse loans, bursaries and scholarships to students pursuing higher education in recognized institutions (Government of Kenya, 1995). The amount loaned to undergraduate students ranges from Ksh. 40,000/= minimum and Ksh. 60,000/= maximum based on the level of need. The loans awarded are supposed to be used for tuition, books and stationery, accommodation and subsistence. Based on the need basis, the Board also awards bursaries ranging between Ksh. 4,000/= and Ksh. 8,000/= (Higher Education Loans Board, 2017).

However, Universities normally operate on a deficit. For instance, public Universities operated on a deficit of Ksh. 1,860.56 million in 2016 (Mukhwana *et al*, 2016). This led to the use of dual track policy when developing and placement of students into various programmes. Dual track policy is a trend of shifting the cost burden to students and away from government. Through greater contributions by students and their families, they enroll in Self-Sponsored Programmes (SSP)/ Module II Programmes/ Parallel Programmes as they got to be named by different Universities (Oanda, 2013; Sifuna & Oanda, 2014).

This policy posed a number of implications on Science and Technology Programmes participation. First, the Universities developed programmes which attracted many students leading to unethical competition for students in an attempt to finance the deficit. Eventually, skewed development and mounting of programmes which ignored the more expensive Science and Technology Programmes ensued (Mukhwana *et al*, 2016). Moreover, to mount programmes in science and technology cluster, Universities need to invest in very expensive equipment since laboratory-based education costs higher (World Bank, 2016). This implied that science and technology participation was now restricted to privileged few with under-representation of many groups like lower- income earners (Sifuna & Oanda, 2014). In 2018/2019 academic year, only 2.5% of students who applied for admission through government sponsorship to Bachelor of Science in Electrical and Electronic Engineering at Jomo Kenyatta University of Agriculture and Technology (JKUAT) were placed. Similarly, 4.2% and 1.7% of students who applied for the same programme at University of Nairobi (UoN) and Kenyatta University (KU) were placed respectively (Wanzala & Nyamai, 2018). The overall deduction from such trend was that Universities had reduced the number of vacancies for government sponsored students in Science and Technology Programmes to accommodate self-sponsored students (Yokoski & Birubaum, 2013; Oanda, 2013).

Despite efforts by the government and other interested groups, the level of enrolment and participation in science and technology-based Bachelor degree programmes remains low. Only 29% of students were studying a course in Science and Technology by the year 2016. Yet these are the programmes identified as priority area for training with the potential to catapult the country to greater heights of development (World Bank, 2014; Too *et al*, 2018). The purpose of this study was therefore to explore the gaps which existed in the stated government policies designed to guide funding to science and technology Bachelor degree programmes and the actual practice during their implementation and the impact of the actual practice on students' participation. The objective of the study was toanalyze the relationship between funding of University students and participation in Science and Technology Programmes at Bachelor Level in Public Universities in Kenya.

II. Research question

To what extent does the funding of University students relate to their participation in Science and Technology Programmes at Bachelor Level in Public Universities in Kenya?

III. Review of related literature

Review of related literature covers funding and participation in Science and Technology Programmes cascaded from a global viewpoint to regional level and then national level. Usher & Medow (2010) carried out household surveys to compare affordability and accessibility of higher education and the average national household income in Mexico, Canada and New Zealand. The surveys established that the total cost of higher education in Mexico was 1.75 times the level of the average national household income while it was half that in Canada and New Zealand. This study identified one gap of interest in studies conducted by Usher & Medow (2010). Given that calculating the costs of higher education was not a straightforward task since tuition, registration and examination fees often differed by subject area and by institution, it was not feasible how household surveys only could be used to generalize the cost of higher education without the specific information from higher education institutions themselves, particularly in specific programmes. To address this gap, our study focused on the cumulative costs of participating specifically in Science and Technology Programmes by analyzing fees structures of Public Universities in Kenya and administering questionnaires to students. This contextualized financial issues which affected participation in these programmes within the financial environment in Kenya.

Bekir (2016) conducted a study on the challenges of massification of higher education in Turkey. The study found out that Turkey had an expanding public higher education system with no tuition fees since 2013. Consequently, many students, especially in the public Universities faced low quality education experience. A study on cost sharing policy in Zambia's public Universities by Masaiti & Shen (2013) found out that a big proportion of Zambian parents had no capacity of paying economic fees (self-sponsored stream) in an environment where tax funding was becoming limited due to massification in higher education (Masaiti & Shen, 2013). A study by Sumaworo & Ibrahim (2015) on challenges of tertiary education pointed out that Liberia Universities and Colleges struggled with financial constraints which had forced professors to have multiple assignments and jobs in an attempt to meet their financial needs (Sumaworo & Ibrahim, 2015). Another study by Kobla *et al* (2018) on the impact of massification on higher education, the case of Bunda College in Malawi found out that the government had reduced the amount of money being allocated to the College because available resources were not enough. Consequently, the College had resorted to increasing the fees. This led to massive dropouts since a large number of students could not afford to pay the fees (Kobla *et al*, 2018). Mgaiwa (2018) carried out a content analysis of the paradox of financing public higher education in Tanzania and found out that sources of financing public Universities were unreliable and unsustainable since the government budgetary allocation to Universities decreased between 2010/2011 and 2015/2016 academic years. Ironically, the government approved funds and those released to Universities decreased in the same period (Mgaiwa, 2018).

Our study identified gaps of interest in studies conducted by Bekir, 2016; Masaiti & Shen, 2013; Sumaworo & Ibrahim, 2015; Kobla *et al*, 2018 and Mgaiwa, 2018. The gap in Bekir study was that it never desegregated how free tuition impacted on quality in specific programmes. The gap in the Masaiti & Shen study was that it generalized the effects of payment of economic fees in higher education without focusing on Science and Technology Programmes given that science education was more expensive. Sumaworo & Ibrahim looked at financial constraints affecting professors generally in Colleges and Universities without considering financial constraints in specific programmes while Kobla *et al* equally looked at the impact of government reduced funding to Bunda College which led to massive dropouts without considering specific programmes like science and technology which were more expensive. Mgaiwa also looked at the impact of unreliable and unsustainable financing of higher education in general. The studies never desegregated finance data down to specific programmes. Secondly, they all focused on finance payable to Universities by students or received by Universities from the government and never considered other costs that students incur. Our study desegregated finance data down to Science and Technology Programmes, given that laboratory education costs more. This precisely established the effect of funding on participation in Science and Technology Programmes. Also, this study considered other costs incurred by students. Hence, it came up with cumulative costs of participating in these programmes.

Debrah (2008) conducted a study on financial challenges for students at the University of Ghana. The study adopted a multi-strategy approach and interviewed 117 first year students. It found out that majority of the students at the University of Ghana had at least a parent with high or middle income. The second finding was that the main source of funds which majority of the students at the University depended on came from parents. The third finding was that few students whose parents fell within low income group faced challenges in financing their education (Debrah, 2008). In the upper west region of Ghana, Pantah & Asante (2018) conducted an evaluation of students' sources of financing at University of Development Studies and Wa Polytechnic. The study surveyed 153 students and revealed that the main source of financing included: self- financing 22%; parents 34%; friends and relatives 12%; and scholarship, one per cent. It further found out that late payment of school fees and inability to meet basic needs were major challenges faced by the students (Pantah & Asante, 2018).

Failure to provide cumulative costs per year in Science and Technology Programmes, in both Debrah (2008) and Pantah & Asante (2018) studies, indicated the first gap for this study since it was not possible to conclude on challenges of funding on the basis of family income without getting the cumulative cost per year. The second gap in the study by Debrah was sampling only first year students, yet these had not been in the university long enough to clearly understand financial challenges. Consequently, both family income and cumulative costs in Science and Technology Programmes per year, as listed in the University fees structure, were calculated for comparison. This led to a clear understanding of the relationship between funding of University students and their participation in Science and Technology Programmes in Public Universities in Kenya. In Kenya, there are two systems of funding University education. One is where students receive government subsidy and the other system is where they pay fees themselves as determined by an individual University as self-sponsored. Our study sought to get the relationship between family income and participation in the stated programmes in both systems of funding. Hence, it established how funding of University students related with participation in the programmes. With regard to sampling, this study targeted students in the first, second, third, fourth and fifth years of study. This was decided on the basis that students at different levels have different experiences of funding and participation in Science and Technology Programmes.

In Nyeri North and Kieni West Sub- Counties, Central Kenya, Gichuhi (2015) conducted a study on alternative methods of financing higher education and found out that household financing of education was faced by several challenges, especially if the mechanisms included fees from savings, borrowing from commercial banks and relying on friends and relatives for contributions. The study concluded that education expenditures were major components in consumption of households with children in school. Therefore, as the government funding reduces in higher education, this affected access, especially for the poor. Another study on inequalities in accessing higher education in Kenya by Mulongo (2013) established that education was mostly dependent on a student's social-economic background. It found that 84% of students at UoN came from high income potential areas and only 0.5% of the total female students came from Arid and Semi-Arid Lands (ASAL). Also, access to higher education was determined by quality secondary schools (Mulongo, 2013).

One of the limitations in the studies by Gichuhi (2015) and Mulongo (2013) was that they focused on higher education in general without desegregating access data down to specific programmes. But our study established how reduction in government funding and students socio-economic background, particularly in Science and Technology Programmes affected participation given that these programmes were more expensive.

Akumu *et al* (2017) conducted a study on whether loan amount affected choice of programme of study from privately sponsored undergraduate Higher Education Loans Board (HELB) loan recipients in Kenyan Public Universities. It found out that there was no significant relationship between HELB loan amount and the choice of programme of study by self-sponsored students in Public Universities. However, there was one major limitation in the study conducted by Akumu *et al*. The data was collected from privately sponsored HELB loans recipients' in Public Universities. This finding narrowed so much on privately sponsored HELB loans recipients and left out the wider picture on the relationship between HELB loans recipients and choice of Science and Technology Programmes. Yet in Kenya, we also have a category of students who receive HELB loans but are government sponsored. Our study considered both categories of students who received HELB loans as regular and self-sponsored in Public Universities in order to get a wide and balanced relationship between HELB loans and participation in Science and Technology Programmes.

Another ex-post-facto study on the relationship between the socio-economic status of diploma students bursary recipients and the amount awarded by HELB by Aliva & Amunga (2017) established a positive significant relationship between the socioeconomic status and the amount of bursary awarded to college students in Kenya (Aliva & Amunga, 2017). The idea of narrowing down to socioeconomic status and the amount of bursary awarded indicated yet another gap for this study. In Kenya, the government finances students in higher education at various levels. One level is government sponsorship through capitation and subsidies. The second level is through awarding of loans through HELB and the third level is award of bursaries through HELB. This study considered further the relationship between socioeconomic status and these other two levels of financing, that is, capitation and subsidies and HELB loans.

Mbirithi (2013) conducted a descriptive research on management challenges facing Kenya's Public Universities. The study found out that insufficient funds were the biggest management challenge since they affected all the areas of research, teaching and learning (Mbirithi, 2013). By focusing on financial challenges in Public Universities, the endeavour by Mbirithi (2013) pointed to another gap for this study. The latter further focused on students' financial challenges with regard to participation, particularly in Science and Technology Programmes since the students were the ones who enrolled and participated in the programmes.

IV. Methodology

Research Design: This study adopted descriptive survey design method to analyze the relationship between funding of students and participation in science and technology programmes at bachelor level. Descriptive survey is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals (Kombo & Tromp, 2006). Cohen *et al* (2007) observed that data gathered from descriptive survey serve three main purposes, namely: describing the nature of existing conditions, comparing them to certain standards of life and determining the relationship between specific events. The design was found appropriate because it assisted the researchers to analyze science and technology participation costs and students' social-economic status.

Location of the Study*:* The study was carried out in three Public Chartered Universities in Kenya, namely; Technical University of Kenya (TUK), Moi University (MU) and Egerton University (EU) which were purposively sampled. Purposive sampling is intentional selection of informants based on their ability to elucidate a specific theme, concept or phenomenon and is often used when working with small samples after the researcher identifies diverse characteristics of the sample selection criteria prior to selecting the sample (Patton, 2002).The Universities were purposively sampled based on the set criteria. First, the University must have been operational during the time of the implementation of 2010 KESSP I admission policy which targeted enrolment of 50% of all students in science and technology related courses (UNESCO, 2010). Secondly, the University had a strong foundation in science and technology demonstrated by high enrolment numbers in these programmes and offering a variety of them. The selection of students to respond to issues of funding was based on the fact that they were the ones who understood the cost of University education, their respective family income and challenges they faced while undertaking their studies. The opinions of Academic Registrars was sought since they were directly involved in admission of students. The summary of target population, sample size and sampling technique are presented in Table 1:

Table1: Summary of target population, Sample size and sampling technique

Category	Target population	Sample size	%	Sampling technique
Universities	31	3	9.7	**Purposive**
Manufacturing and Veterinary students	3179	355	11.1	**Simple random**
Academic Registrars in the sampled Universities	31	3	9.7	**Purposive**
Total	**3210**	**358**		

Data Collection Instruments: The study utilized three methods to collect data: self-administered questionnaire, open-ended interview, and document analysis.

Self-administered Questionnaire for Students: The students' questionnaire yielded both qualitative and quantitative data like amount of HELB loan awarded per year, average annual family income, cumulative cost of education per year (quantitative) and main financial challenges (qualitative).The choice of this tool was due to the advantage of being flexible, saving time in administration, confidentiality and capturing of variety of data relevant to this study.

Open-ended Interviews for Academic Registrars: Open-ended interviews yielded mainly crucial information on gaps in funding of students participating in Science and Technology Programmes. Open-ended interviews were used to collect information from Academic Registrars because they were flexible, adaptive and offered credible- in-depth responses to compliment quantitative data already captured in the questionnaires and document analysis from a smaller group.

Documentary Reviews: Documentary analysis involves the study of existing documents in order to illuminate deeper meanings which may be revealed by their coverage. Quantitative data was obtained from University records and fees structures on costs of participating in science and technology programme. Documentary analysis was used as a supplementary method of gathering information, especially from institutional records. Analysis of records has the advantage of being available at low cost. They are also, factual, especially if prepared by professionals, and they contain valuable information and are insightful (Cohen *et al*, 2007).

Data Analysis: This study utilized mixed method analysis to analyze the relationship between funding of university students and participation in Science and Technology Programmes.

Analysis of Quantitative Data: Quantitative data from household incomes, annual participation cumulative costs, and amount of HELB loan received was captured. Data were coded and analyzed using the Statistical Package for Social Sciences (SPSS) version 20. This software was applied to allow production of consistency checks which helped to eliminate errors in the data entry. Comparative analysis was done to obtain the relationship between programme costs and students' social-economic status with respect to science and technology participation.The statistical data was transformed into frequencies, percentages, means, pie charts and bar graphs in order to address the research questions.

Qualitative Data Analysis: The qualitative data analysis focused on description and analysis of data from questionnaires from students and open- ended interview schedules from Academic Registrars. Simple descriptive analysis was utilized where data was grouped and presented in form of narrations and quotations in order to address effects of funding on science and technology participation at Bachelor Level. The voices of the participants validated specific findings from the quantitative data.

V. Results and discussion

Comparison of government capitation based on the old flat rate formula used in 2017/2018 and DUC used in 2018/2019 academic year was done and the findings are shown in Figure 1:

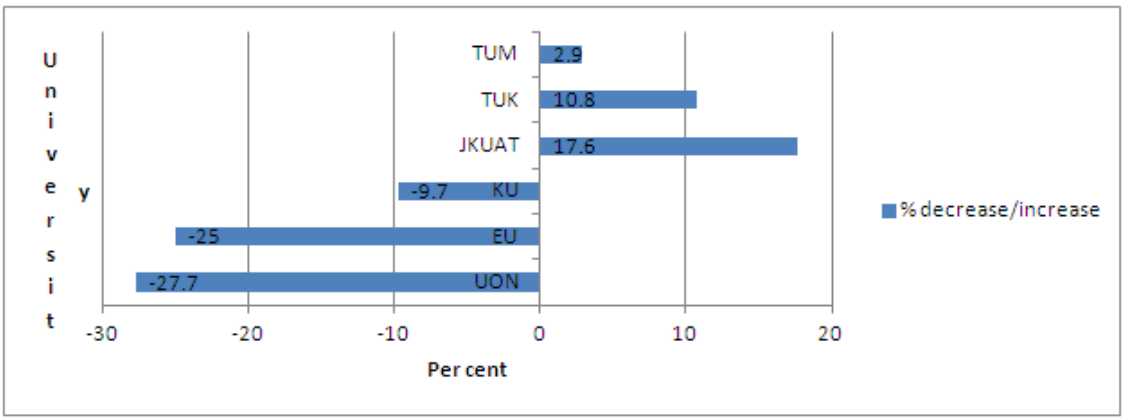

Figure 1: Comparative government capitation using the old flat rate formula in 2017/2018 and Differential Unit Cost in 2018/2019 academic year

Figure 1 above shows that UoN recorded a decrease of 27.7%, EU 25% and KU recording a decrease of 9.7%. Yet JKUAT received an increase of 17.6%, TUK 10.8% and TUM 2.9%. In this connection, another Academic Registrar explained:

Some Universities received increased capitation and this is attributed to the technical nature of the programmes they offer and high enrolment numbers in the same programmes. On the other hand, some Universities received decreased capitation because they offer more non-science programmes. (Registrar's response during interview, September, 2019)

Comparative enrolment numbers of government sponsored students into Medical and Health Sciences and Humanities and Social Sciences at MU for the period 2013-2017 was done a d the findings are shown in Figure 2 below:

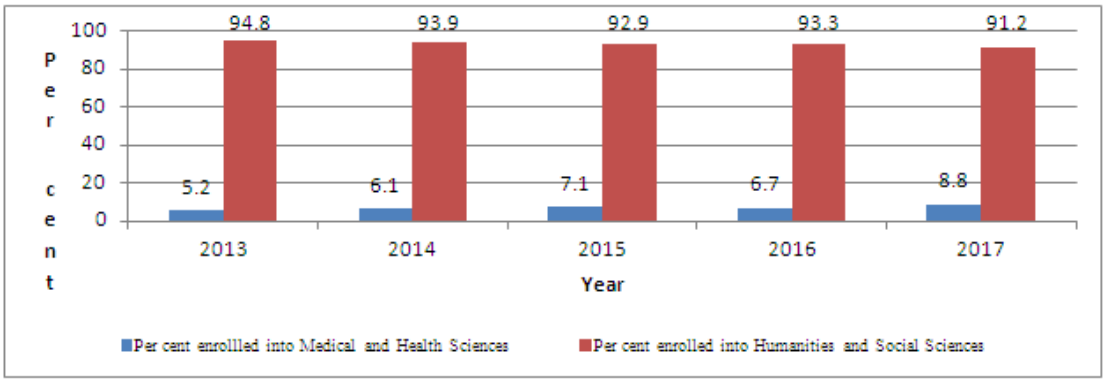

Figure 4.10: Comparative enrolment numbers of government sponsored students into Medical and Health Sciences and Humanities and Social Sciences at MU for the period 2013-2017

were unreliable and unsustainable when the government budgetary to Universities decreased over time.Figure 4.10 above indicates that enrolment into Medical and Health Sciences was ranging between 5.2% lowest in 2013 and 8.8% highest in 2017. But, Humanities and Social Sciences oscillated between 91.2% lowest in 2017 and 94.8% highest in 2013. Averagely, only 6.78% enrolled into Medical and Health Sciences which apparently were the schools targeted for the highest capitation while a lion's share of 93.22% enrolled into Humanities and Social Sciences which received the lowest capitation using DUC formula.

Records from Universities Funding Board (UFB) revealed that in 2019, the unit cost for Dental Surgery was Ksh. 720,000/= per year, Ksh. 720,000/= for Bachelor of Medicine and Surgery per year, Ksh. 504,000/= for Bachelor in Pharmacy per year, Ksh. 396,000/= per year for Engineering and Ksh. 564,000/= for Veterinary Medicine per year. Comparatively, Humanities and Arts-based courses varied between Ksh. 180,000/= and Ksh. 144,000/= per year (Universities Funding Board, 2019; Oduor, 2017).What this one meant was that if the trend of enrolling fewer students into Science and Technology Programmes would continue as the current situation, then DUC formula had a net effect of decreasing capitation. Consequently, lack of enough funding had led to shortage of basic learning resources and teaching staff, thus raising the question of quality. In conclusion, DUC was not working since by their nature, Science and Technology Programmes demanded a significant investment to establish, maintain and expand the engine of physical infrastructure. With decreasing capitation, Universities were unable to expand their resources to support participation. In this regard, the study by Mukhwana *et al.* (2016), on state of University education in Kenya, corroborated our findings in that Universities were operating on a deficit which led to skewed development and mounted programmes which ignored the more expensive Science and Technology Programmes. Mbirithi (2013) found out that insufficient funds were the biggest management challenge to Universities since it affected all the areas of research, teaching and learning. Furthermore, Kobla *et al* (2018) in Malawi established that the government had reduced the amount of money allocated to Bunda College while Mgaiwa (2018) in Tanzania found out that the sources of financing public Universities

With regard to entry criteria through Government Sponsored Programme (GSP), one Academic Registrar explained:

The placement of GSP students to Universities is coordinated by KUCCPS and the placement policy requires that programmes for placement must be identified as a priority area by the government. KUCCPS considers the number of available slots in Kenyan Universities and the maximum performance index per cluster for all students and subjects, raw cluster performance index per cluster for all subjects enrolled, aggregate performance index and maximum performance index recorded in KCSE year preceding admission year. These are then used to calculate the cut off points required to pursuing a particular degree programme in each University. The maximum possible cluster points are 48 and the cut-off points are known at the end of placement. (Registrar's response during interview, September, 2019)

Another Registrar stated:

After placement exercises, applicants who do not make it to their programmes are given a second and third chance to reapply. The limitation with second and third window is that applicants are restricted to programmes that were not filled during the first selection and given the competitive nature of Science and Technology Programmes, it's a common occurrence that prospective applicants do not get placement in the Universities and programmes of their choices through GSP during the second and third placement, their KCSE performance notwithstanding. (Registrar Academic's response during the interview, December, 2019)

Another Registrar expressed the following:

KUCCPS normally gives one month window for students to request review of their placement through inter-University transfer. The window normally ends when students have already reported to the University. Our registration is normally synchronized to the first week of September and, therefore, by the time this student's application for University transfer succeeds, the classes will have covered in excess of a third of the semester work making it extremely difficult to register such student. Majority of the applicants fail to transfer and find themselves stuck in the programmes they wished to change from. Consequently, they take offense not with the process but with the admission office. (Academic Registrar's response during an open-ended interview, November 2019)

The sentiments above allude to the fact that GSP admission policy only considers placement of applicants who sat for the KCSE examination in the year preceding the admission year. Secondly, very few applicants succeed at second and third revision as well as the inter-University transfer window to enroll into Science and Technology Programmes, their KCSE performance and cut-off points notwithstanding. The implication is that, if qualified students miss entry into a programme of interest in a given year, they are not considered during subsequent placements. Furthermore, the criteria exclude the possibilities for credit transfer among Universities. In conclusion, the GSP admission criterion is so rigid that it results into many qualified students not being enlisted.

The competitiveness for Manufacturing Engineering between 2015 and 2018 were calculated and the findings are presented in Table 2 below:

Table 2: The competitiveness for Manufacturing Engineering between 2015 and 2018

University	Maximum Possible CoP	Year							
		2015		2016		2017		2018	
		CoP	% comp	CoP	% comp	CoP	% comp	CoP	% comp
EU	48	34.074	71	34.868	72.6	33.959	70.7	36.337	75.7
TUK	48	41.216	85.9	41.573	86.6	41.083	85.6	40.941	85.3
MU	48	43.162	86.7	38.627	81.1	38.592	80.4	38.901	81.0

Key:TUK- Technical University of Kenya **EU**-Egerton University **MU**- Moi University **Comp**-competitiveness **CoP-** Cut-off Points

From table 4.9 above, EU recorded the highest competitiveness of 75.7% in 2018 and lowest of 70.7% in 2017, bringing average competitiveness to 72.5%. TUK had the highest of 86.6% in 2016 and lowest of 85.3% in 2018 averaging at 85.85%, while MU recorded the highest of 86.7% in 2015 and the least of 80.4% in 2017, making an average of 82.3%. Therefore, TUK was the most competitive with 85.85%, followed by MU at 82.3% and then EU came third with 72.5% for Manufacturing Engineering.

The findings revealed that competitiveness in each programme at University keeps changing every year. Also, apart from minimum entry qualification known by the applicant, cut-off points are only known at the end of placement exercise. This means that applicants can only rely on cut-off points from previous intakes to predict the chances of placement into programmes. Hence, the entire process subjects applicants to mere speculation of what mainly constitutes entry requirements. Consequently, this failure to enlist students with minimum University entry grades by subjecting them to a speculative process implies that qualified students are shunted from enrolling into Science and Technology Programmes. Yet GSP admission policy requires that programmes for placement must be identified as a priority area.

With regard to admission to science and technology through Self Sponsored Programme (SSP), one Registrar (Academic) stated:

SSP students are admitted by individual University using criteria set and approved by the Senate. To be eligible for admission into Veterinary Medicine, we have four admission channels, namely: KCSE qualifications,A-Levels or equivalent qualifications, diploma holders, and holders of degree in biological sciences. Further,credit transfer and exceptions for non-veterinary medicine courses may be considered. (Registrar Academic response during open-ended interview, October, 2019)

These sentiments revealed that SSP admission process considered placement of applicants who possessed either KACE or KCSE examination qualifications or their equivalent and the minimum entry qualifications were clearly known by the applicant. This implied that these criteria provided clear avenues for students to matriculate anytime they were ready by promoting entry through properly coordinated middle level education and training institutions. For example, accumulations of credit at diploma levels and transfers of degree programme, pre-University programmes and alternatives and continuing education. Entry mode directed students into programmes of their choices since minimum entry qualification was known.

Enrolment trends into Bachelor of Mechanical Engineering through GSP and SSP between the period of 2013 and 2017 at TUK was analyzed and the findings are presented in Figure 3 below:

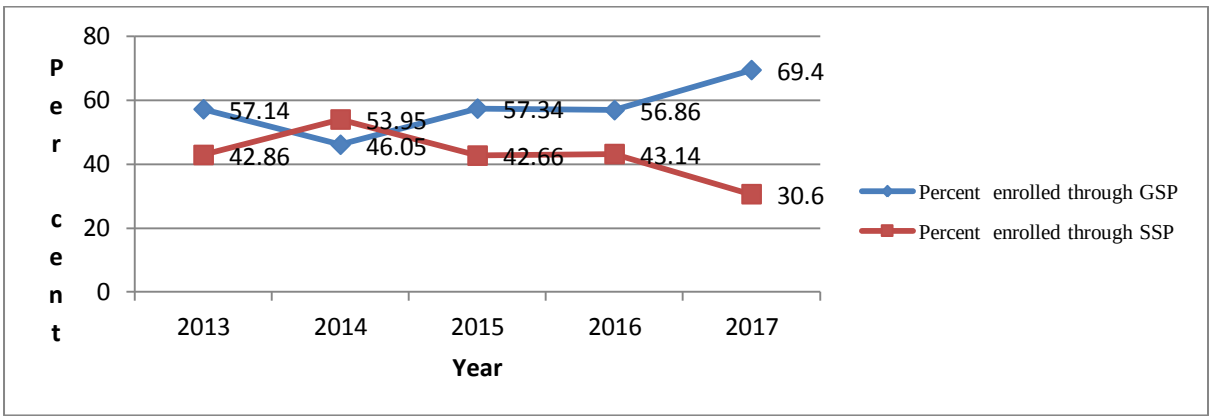

Figure 3: Enrolment trends into Bachelor of Mechanical Engineering through GSP and SSP between the period of 2013 and 2017 at TUK:

The results from Figure 3 above shows that the highest enrolment through GSP was 69.4% in 2017 and lowest of 46.05% in 2014, making the averages to be 57%. The highest enrolment through SSP was 53.95% in 2014 and lowest of 30.6% in 2017 bringing the average to 43%. In 2014, 53.95% enrolled through SSP surpassing those enrolled through GSP. This meant that although GSP admission process set cut-off points based on capacity, and whereas the enrolment was highly constrained and shunting many qualified students, SSP entry mode allowed applicants to gain admission into same programmes that they were probably denied through GSP admission process.

These findings points to the fact that SSP entry mode had the potential of allowing students to enroll into competitive programmes which they may have not managed to access through competitive GSP. Also, in situations where students paid for their education, the need to attract, retain and satisfy customers could be met at the expense of quality education provided to them by ignoring the declared capacities. Consequently, the academic merit in determining access to Science and Technology Programmes was slowly waning in preference for financial capacity. In conclusion, SSP admission processes applied double standards, raising the question of fairness, accountability and quality on the part of University administration. These findings were reinforced by Yokoski & Birubaum (2013) and Oanda (2013) who pointed out that some Public Universities had reduced the number of vacancies for government sponsored students.

Comparative cumulative costs for GSP and SSP Bachelor's Degree in Veterinary Medicine at Egerton University were analyzed and the findings are shown in Table 3 below:

Table 3: Comparative cumulative costs for GSP and SSP Bachelor's Degree in Veterinary Medicine at Egerton University

Description	GSP Cumulative cost in Ksh.	Per cent	SSP cumulative cost in Ksh.	Per cent
Tuition	80,000	22.2	1,200,000	81
Registration	7,500	2.1	7,500	0.5
Medical	12,500	3.5	12,500	0.8
Caution Money	2000	0.6	2000	0.1
Material Development	21,000	5.8	21000	1.4
Library	12,500	3.5	12,500	0.8
Examinations	18,500	5.1	18,500	1.2
Activity	6000	1.7	6,000	0.4
Student ID	500	0.1	500	0.03
Student Union	2000	0.6	2,000	0.1
Field attachment	13360	3.7	13,360	0.9
Vaccinations	12500	3.5	12,500	0.8
Laboratory	12,500	3.5	12,500	0.8
Catering services	90,000	25	90,000	6.0
Books	45,000	12.5	45,000	3.0
Accommodation	25,000	6.9	25,000	1.7
Total	**360,860**	**100**	**1,480,860**	**100**

Table 3 above shows that a total of 16 items were charged. The cumulative cost in GSP was Ksh. 360,860/=. The most expensive items were catering services which accounted for 25% of the total cost, followed by tuition fee which was 22% and books constituting 12.5%. All other remaining 13 items combined, constituted 40.5% of the total cost. But the cumulative cost in SSP was Ksh. 1,480,860/= and the most expensive item was tuition which accounted for 81% and the remaining 15 items combined constituted only 19% of the total cost.

Comparatively, pursuing Veterinary Medicine as SSP student was more expensive and, cumulatively, it cost four times more than pursuing the same programme through GSP. Moreover, tuition fees took the bulk of the cost at 81% in SSP while it only accounted for 22% of GSP.

The comparative cumulative cost in both GSP and SSP entry modes in Bachelor of Engineering Programmes at MU are presented in Table 4 below:

Table 4: Comparative cumulative cost for GSP and SSP Bachelor of Engineering Programme at Moi University

Description	GSP cumulative cost in Ksh.	Per cent	SSP cumulative cost in Ksh.	Per cent
Tuition fees	40,000	12	850,000	77.2
Direct charges	40,000	12	-	-
Registration	2,000	0.6	2,000	0.2
Student organization	500	0.2	500	0.05
Student ID	250	0.08	250	0.02
MUSO annual subscription	2500	0.8	2,500	0.2
Caution money	1000	0.3	1,000	0.1

Medical fee	7500	2.3	7,500	0.7
Examination	6000	1.8	6,000	0.5
Activity fee	5,000	1.5	5,000	0.5
Amenity	5,000	1.5	5,000	0.5
Computer	10,000	3.0	10,000	0.9
Field attachment/ workshop practices	50,100	15.2	50,100	4.6
Catering services	90,000	27.3	90,000	8.2
Books	45,000	13.6	45,000	4.1
Accommodation	25,000	7.6	25,000	2.3
Total	**329,850**	**100**	**1,099,850**	**100**

Table 4 above shows that a total of 16 items were charged. The cumulative cost in GSP was Ksh. 329,850/=. The most expensive items were catering services which accounted for 27.3% of the total cost, followed by field attachment/workshop practices at 15.2%. Books constituted 13.6%, tuition fees and direct charges tallied at 12% each. All other remaining 11 items, combined, constituted 19.9% of the total cost. But, the cumulative cost in SSP was Ksh. 1,099,850/= and the most expensive item was tuition which accounted for 77.2%. The remaining 15 items, combined, constituted only 22.8% of the total cost. Comparatively, pursuing Engineering programme through SSP mode is more expensive and, cumulatively, it costs three times more than pursuing the same programme through GSP. Moreover, tuition fees took the bulk of the cost at 77.2% in SSP while it only accounted for 24% of GSP cumulatively.

The analysis from the fees structures and specific voices revealed that same programmes in the same University were priced at different rates and the cost through SSP was much higher than GSP. Therefore, apart from certifying entry criteria, enrolments through SSP largely depended on affordability. This implied that the philosophical and ethical considerations in mounting these programmes aimed only at those in society who could afford. In summary, the SSP admission policy catered for students who could afford to pay the prevailing market fees. This had negatively impacted on enrolment of students who scored the minimum University entry qualifications but came from low socio-economic backgrounds. Therefore, the criteria discriminated learners since those living in poverty were the most likely to be excluded. This finding was similar to one by Gichuhi (2015), on alternative methods of financing higher education in Central Kenya, which concluded that education expenditures were major components in the consumption of households with children in school. Consequently, as the government funding reduced in higher education, it affected access especially for the poor. Moreover, it was in line with the findings of House of Lords (2012) in Britain which established that repayable tuition loans policy in higher education discouraged students from entering science and technology subjects because they were generally more expensive. Furthermore, Masaiti & Shen (2013), on cost sharing policy in Zambia's public Universities, established that the economic fee (self-sponsored stream) was so expensive that many parents had no capacity to pay.

With regard to relationship between Higher Education Loans Board (HELB) and participation in Science and Technology Programmes, student respondents were asked to indicate whether they applied for HELB loans or not, and if yes, whether they receive the loan and how much per year. With regard to loan application, the findings are presented in Figure 4:

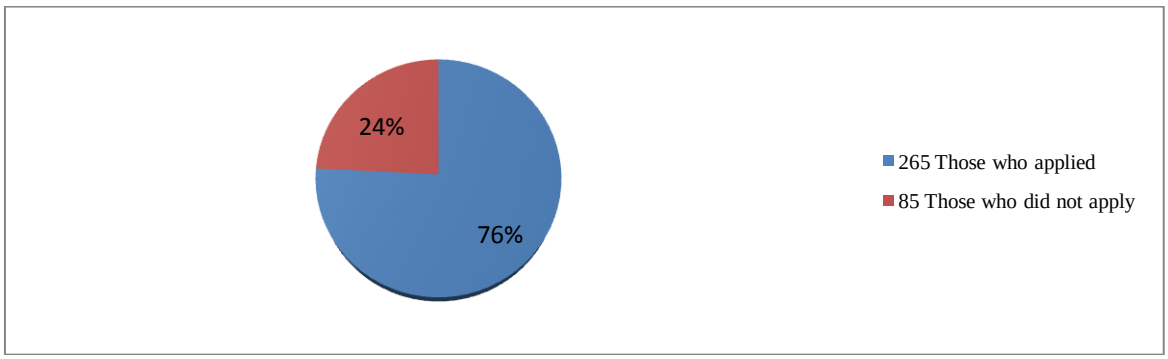

Figure 4: Student respondents' frequency on whether they applied for HELB loans or not

Figure 4 above shows that 265 (76%) of the respondents applied for HELB loans while 85 (24%) did not apply. One student respondent wrote the following answer to an open ended question in a questionnaire:

I do not apply for HELB loan because my parents afford to finance my University education without HELB loans. (Student response to open ended question in a questionnaire, October, 2019)

Another one lamented:

I only applied and received during my first year of study. But during the subsequent application, I was not considered because I lacked guarantors. Furthermore, I was also blacklisted that I gave false information thus I stopped applying in subsequent years. (Student respondent to an open ended question on a questionnaire, October, 2019)

This showed that majority of students in Science and Technology Programmes applied for the HELB loans. Those who did not apply could afford to finance their education, given that even those who missed guarantors were still participating. This implied that they had paid.

For the HELB loans, the findings are presented in Figure 5 below:

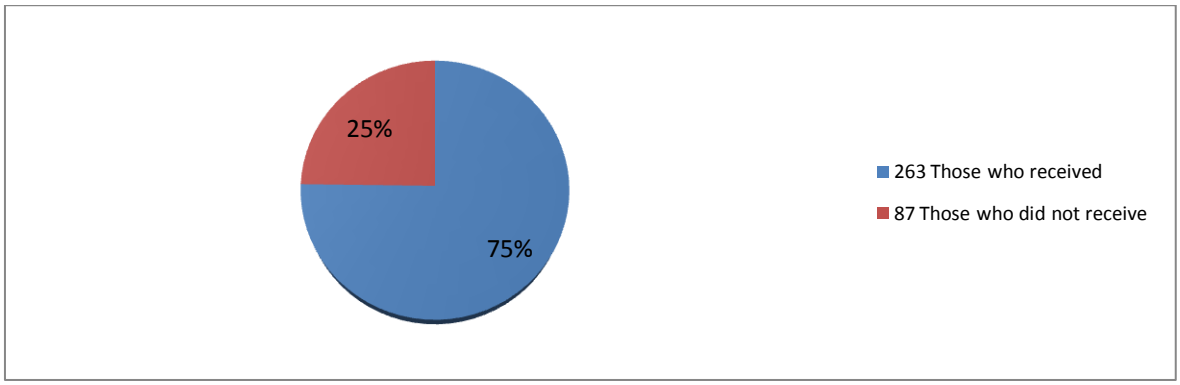

Figure 5: Students' responses' frequency on whether they received HELB loans or not.

Figure 5 above shows that 263(75%) of the HELB loan applicants received the loans while 87 (25%) of them were not successful. In this connection, a student respondent wrote the following in a questionnaire:

I was unsuccessful because during the application time, I had not attained 18 years of age hence did not have an Identification Card (ID) which is critical document for loan awarding and also applying after the set deadline. (Student respondent to open- ended question on a questionnaire, October, 2019)

This meant that majority of the applicants were successful and the few who did not, probably never met the stipulated conditions.

On the amount of HELB loans, student respondents were asked to approximate the annual amount they received. The findings are presented in Figure 6:

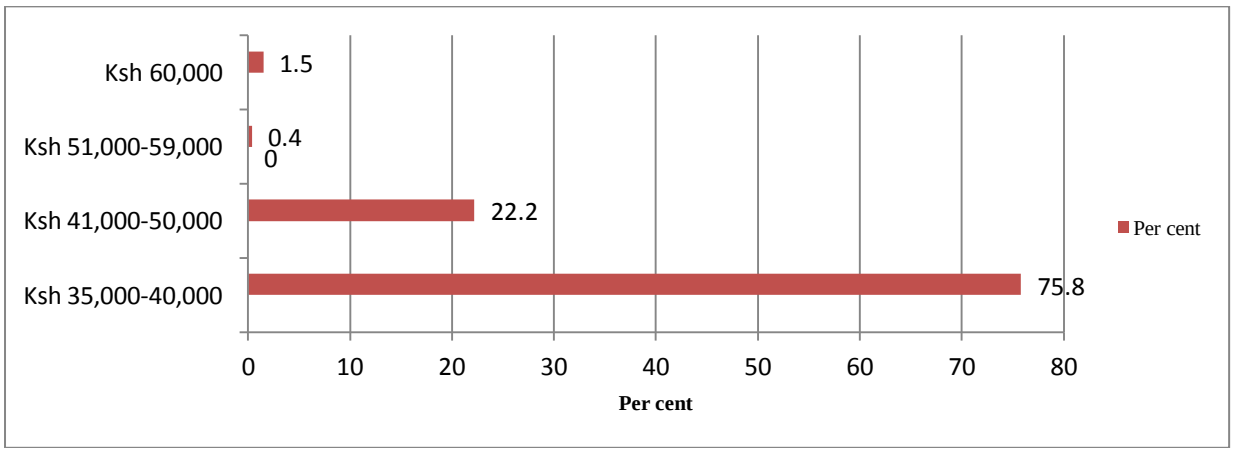

Figure 6: Approximate annual amount received from HELB

Figure 6 above indicated that 201(75.8%) of the loan recipients' received between Ksh. 35,000/= and Ksh.40, 000/=. A further 59 (22.2%) received between Ksh.41, 000/= and Ksh. 50,000/=. Only one recipient (0.4 %) got between Ksh. 51,000/= and Ksh. 59,000/= while 4 (1.5%) received above Ksh. 60,000/=. The majority got between Ksh. 35,000/= and Ksh. 40,000/=, making the mean loan awarded to be Ksh 37,500/= and cumulatively Ksh187, 500/=.

Given that it cumulatively costs Ksh.360, 860/= to pursue Veterinary Medicine, through GSP mode and Ksh. 1,480,860/= through SSP mode, and Ksh. 329,850/= to pursue Engineering Programme through GSP mode and Ksh 1, 099,850/= through SSP, then the average HELB loan awarded of Ksh. 187,500/= is equivalent to 52% of GSP Veterinary Medicine cost and 57% of GSP Engineering cost. Equally, it was equivalent to 12.5% of SSP Veterinary Medicine and 17% of SSP Engineering cost. The implication was that the amounts extended

were too small. Therefore, HELB loan was an inadequate mode of financing Science and Technology University education for majority of poor students who did not have reliable alternative financing mechanisms. Arguably, HELB loans had no relationship then with the type of programme to pursue. Subsequently, students should look for other sources of finance to bridge the gap between loan awarded and fees charged. The findings of this study are in line with those of Akumu *et al* (2017) which revealed that there was no significant relationship between HELB loan amount and the choice of programme of study by self-sponsored students in Public Universities.
Student respondents were asked to indicate the sources of their finances, and the findings are presented in Figure 7 below:

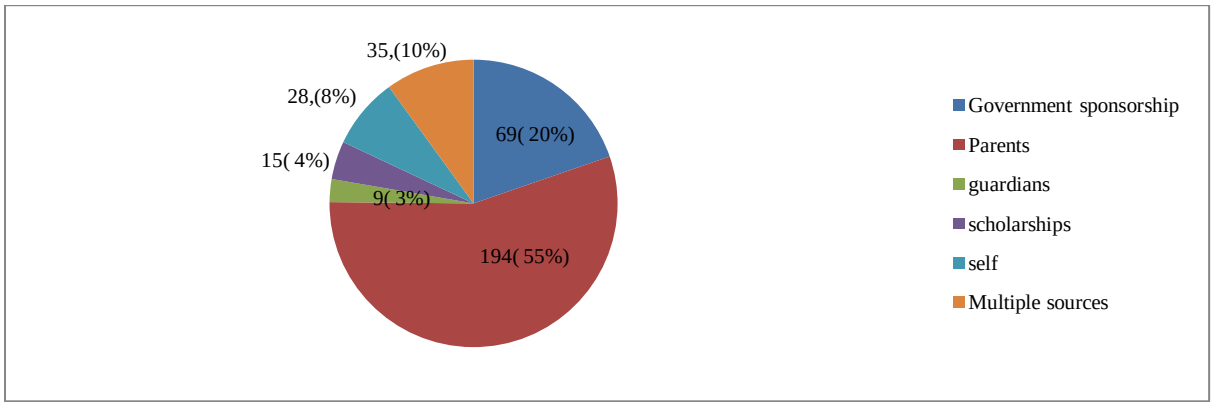

Figure 7: Sources that finance University students

Figure 7 above shows that 194 (55%) of the respondents were financed by parents, followed by 69 (20%) sponsored by government. 35 (10%) indicated multiple sources, 28 (8%) were self-financing, 15 (4%) scholarships while 9 (3%) were financed by guardians. The parents, guardians and self-financing, combined, constituted a total of 80% financing University education. This, therefore, implied that parents, guardians and students' socio-economic status played a pivotal role in financing students in Science and Technology Programmes. The findings corroborate those by Debrah (2008), on financial challenges for students at **the** University ofGhana, which established that the main source of funds which majority of students at the University depended on came from parents.

With regard to the type of secondary school attended, student respondents were asked to indicate the category of secondary school they attended. The findings are presented in Figure 8 below:

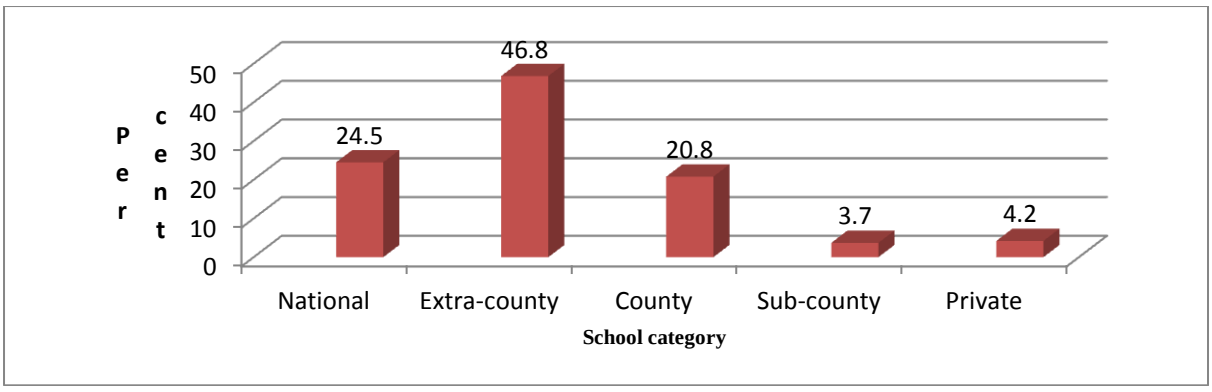

Figure 8: Categories of secondary schools attended by students pursuing Science and Technology Programmes

Figure 8 shows that 86 (24.5%) attended national schools, 164(46.8%) extra- County schools, 73(20.8%), County schools, 13(3.7%) sub-County schools and 14(4.2) private schools. Therefore, national schools and extra-County schools combined contributed the bulk of the students at 71.3% while County schools and sub-County schools contributed 24.5%.

Seemingly, enrolment into Science and Technology Programmes was heavily skewed to those who attended national and extra-County schools. Such schools charged higher fees and had better facilities, teaching and learning resources which guaranteed good performance. This implied that those who attended them largely came from middle and high socio-economic status backgrounds since they could afford. As a result, Science and Technology Programmes were increasingly becoming elitist and discriminatory against students from

disadvantaged economic backgrounds. These observations were similar to those by McCowan (2016) who established that in Brazil, chances of passing competitive examinations for one to join Science and Technology Programmes were linked to prior attendance at high quality primary and secondary schooling and fee-paying preparatory course, all of which were out of reach of most lower-income students. Caner & Okten (2013), in Turkey, established that students from low income families found it difficult to compete in competitive entrance examinations for Science and Technology Programmes with applicants from advantaged backgrounds which had more resources to spent on high quality primary and secondary schooling, private tuition and examination preparations. Moreover, Galukande *et al* (2018), in Uganda, found out that access to training for health profession was skewed to the elite and well-to-do who had attended the top ten secondary schools with infrastructure, teaching and learning resources.

With regard to parents'/guardians' highest level of education, the findings are presented in Figure 9 below:

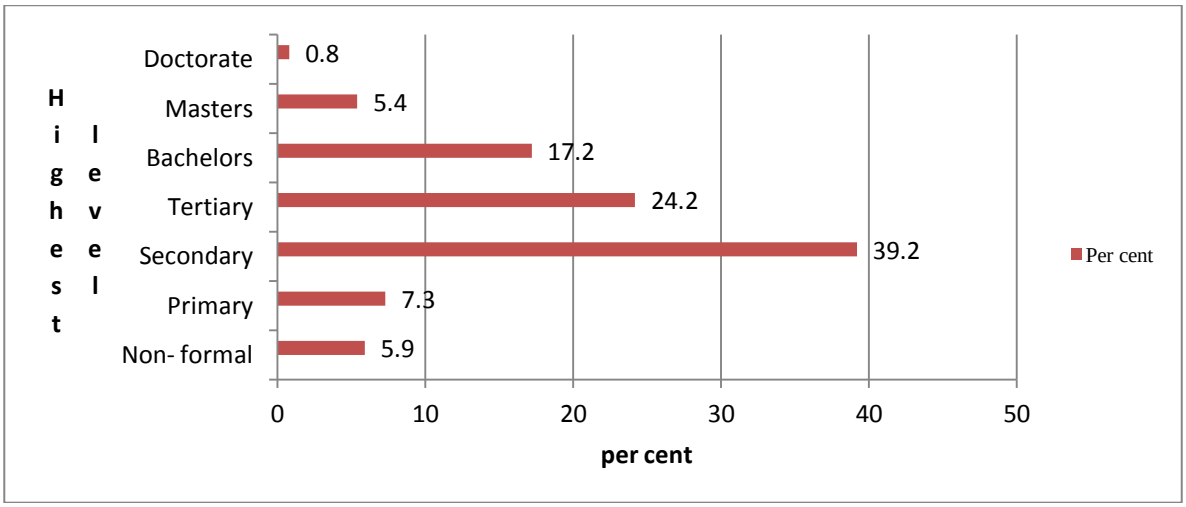

Figure 9: Students' responses' frequency about their parents'/guardians' highest level of education

Figure 9 revealed that 137 (39.2%) of parents or guardians had secondary education as the highest level of education. 88 (24.2%) had tertiary level, 60 (17.2%) had bachelors. The least represented was doctorate at 3 (0.8%), followed by masters at 19 (5.4%), non-formal at 20 (5.9%) and primary at 26 (7.3%). A total of 304 (86.8%) of the parents/guardians had secondary and above level of education. This meant that majority of the parents/guardians had good minimum level of education which indicated middle or upper socio-economic status.

On the aspect of the parents'/guardians' major sources of income, the findings are presented in Figure 10 below:

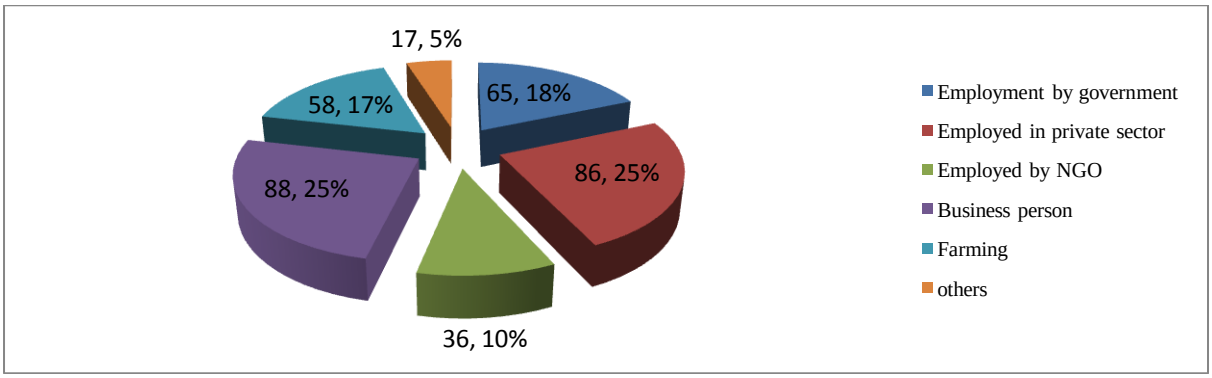

Figure 10: Students' responses' frequency about their parents'/guardians' major sources of income

Figure10 showed that 25% of respondents' parents/ guardians were business people. A further 25% were employed in the private sector, 18% employed by government, 17% were farmers while 5 % indicated 'others'. In summary, 95% of parents/guardians were in formal employment, business or farming, meaning they were in middle or upper socio-economic backgrounds.

On parents/guardians monthly income in Kenya shillings, the findings are presented in Figure 11 below:

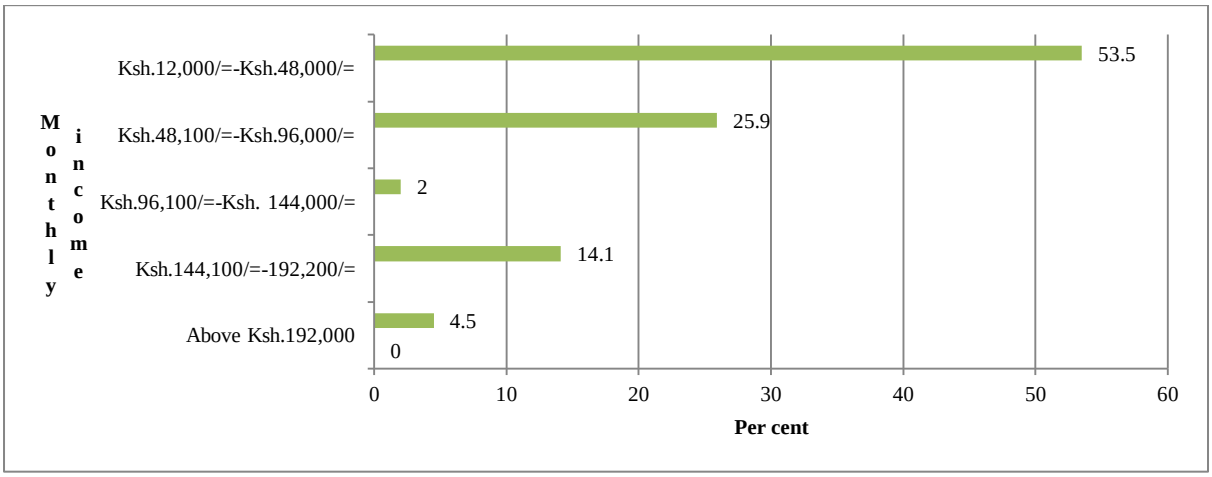

Figure 11: Parents'/guardians' monthly approximate income in Ksh

Figure 4.19 shows that 187 (53.5%) earned a monthly income of between Ksh. 12,000/= and Ksh. 48,000/=. 91 (25.9%) earned between Ksh. 48,100/= and Ksh. 96,000/=. A further 49 (14.1%) had income of between Ksh. 144,100/= and Ksh. 192,000/=. 16(4.5%) earned above Ksh. 192,000/=. Only 7 (2.0%) earned between Ksh.96, 000/= and 144,000/=. The picture that emerged showed that all the parents/guardians had a monthly income. Also, 79.4% of the respondents' parents and guardians earned between Ksh.12000/= and Ksh. 96,000/=. Arguably, this group was able to access loan facilities and make savings to fund science and technology. The amount was sufficient to finance children/wards, especially those who accessed education through GSP.

Overall, Science and Technology Programmes were populated by students from the middle and upper socio-economic levels in society. This meant that income was strongly correlated with participation where individual and household financing capacities were a major determinant. Coupled with declining public funding, majority of the masses from lower socio-economic strata might indeed continue being eliminated. Consequently, the government admission policies pay little attention to questions of poverty in favour of those who can already afford. In the long-run, greatest admission breach of discriminating learners based on social class are committed. These findings seem to imply that participation in science and technology is restricted to privileged few with underrepresentation of many groups like lower-income earners (Sifuna & Oanda, 2014; Mulongo, 2013).

VI. Conclusion

In conclusion, DUC formula had a net effect of decreasing capitation. Qualified students missed entry into Science and Technology Programmes due to punitive and restrictive GSP admission policy while SSP mode was very flexible, and targeting well-to-do in society. Overall, SSP entry mode was more expensive than GSP mode in Science and Technology Programmes. On average, the HELB loans awarded were not equivalent to the cost of both GSP and SSP entry modes per year respectively. It was further established that majority of students were financed by parents since socio-economic status largely determined participation.

VII. Recommendations

The study recommended that funding of Public Universities needs to be backed by a coherent policy which prioritizes quality and quantity in Science and Technology Programmes. At the same time, the government should adhere to timely disbursement of the funds to Universities as well as expand the financial base of HELB to enable it mobilize resources for loans to needy students. Furthermore, University Government Sponsored Programme (GSP) policy should be flexible so as to allow "get-in-get-out" arrangement for those who cannot afford to finish their studies continuously in a block. Also, it should not just target KCSE candidates who seek admission in the year succeeding examination year. The policy should provide clear avenues which promote entry through coordinated middle level education and training institutions, by accumulation of credits at certificates and diplomas, pre-University programmes, alternative and continuing education. Similarly, the policy should consider students from low socio-economic status in society.

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