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Academic Staff andStudents' Participation in Science and Technology Programmes in Public Universities, Kenya

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ABSTRACT:*This paper argues that despite the government commitment to the implementation of admission policies like targeting enrolment of 50% of all students in science and technology related courses and significantly expanding them, 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 examine the relationship between academic staff and students' participation in these Programmes. The study employed descriptive survey design to target 31 public Universities, 237 lecturers teaching Veterinary and Manufacturing Engineering Programmes, 107 Heads of Departments (HoDs) and 31 Academic Registrars. Purposive sampling technique was employed to select three Public Universities, 12 HoDs, 24 lecturers, and three Academic Registrars who participated in the study. Interview schedules were administered to lecturers, HoDs and the Academic Registrars while structured observations 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, and bar graphs. It was established that 69% of the academic staff had their highest qualifications of Masters, only 25.2% were in the rank of Senior Lecturer and above, acute shortage of facilities extremely undermined the mode of delivery and the lecturer-student ratio was 1:18.It recommends that Universities should establish structures for supporting lecturers to move away from transmission–based lectures to problem-based learning, strengthen staff development programmes, scholarships and provision of lecturers' book and research allowances and payment of non-practising allowance in order to respond to the challenge of attracting, motivating and retaining staff.*

KEYWORDS -*Academic staff, Participation, Public University, Science and Technology Programmes.*

I. INTRODUCTION

Global development agenda greatly focuses on science and technology education as one of the prioritized sector components (Kirimi, 2015; Filippetti & Savona, 2017). However, the need to recruit more teachers in science and technology areas is an issue which faces many countries in Europe, particularly secondary schools. Lack of science and technology teachers is reported in Hungary, Switzerland, France and Latvia (Kearney, 2016). In Africa, the Africa Union (AU) recently crafted the continents' most ambitious and long-term development blueprint dubbed as Agenda 2063 which recognizes the role of higher education in achieving the objective of balanced teaching hard sciences in areas of agriculture, livestock, health sciences and engineering in order to develop new technology. However, the continent faces enormous challenges in implementing this agenda. For instance, in 2016, there were a paltry 1.28% engineers in Africa (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 science and technology funding and declining quality of science and technology education at all levels of education, thus primary, secondary, tertiary and vocational (Africa Capacity Building Foundation, 2016). In Ghana, there is inadequate number of lecturers and technicians, making learning largely passive with few practicals. These largely compromise quality (Sam-Amoah *et al*, 2016; Atuahene & Owusu-Ansah, 2013).In Namibia, the capacity of enrolment into Vocational Education and Training (VET) remained insufficient at 26.3% by 2014/2015 academic year. The low numbers were majorly attributed to the system lacking the capacity due to few numbers of tutors. This made access to be

a challenge for graduates from secondary school education. Furthermore, those who had entered the system struggled to complete their training, owing to difficulties in quality (UNESCO, 2016).

In Kenya, chronic shortage of sufficiently qualified faculty with capacity to teach science and technology related programmes of sufficient quality to meet recognized standards and lack of teaching and learning resources have contributed to inefficient implementation of science based curricula. Polytechnics and Institutes of Technology institutions lack adequately trained teaching staff. Consequently, effective training for a modern economy is compromised (UNESCO, 2010; Mango, 2015). Such trend equally leads to poor learning outcomes where learners don't get desired level of skills leading to wastage of precious years and dashes the high hopes of families who had incurred huge debts (Schendel & McCowan, 2015). Despite efforts by the government to expand science and technology programmes, the level of enrolment and participation at Bachelor level remains as low as 29%. 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 examine the relationship between academic staff and students' participation in Science and Technology Programmes at Bachelor Level, in Public Universities, Kenya.

II. STATEMENT OF THE PROBLEM

The attainment of global development agenda greatly focuses on science and technology education (Republic of Kenya, 2007; Nyang'au, 2016; Kivati, 2017). The Government of Kenya introduced several measures in order to increase students' participation in Science and Technology Programmes at Bachelors' level. Some of the measures included a new higher education legal framework which led to the operationalization of the Universities Act No. 42 of 2012 that called for developing acceptable levels of academic staff before accreditation (Republic of Kenya, 2014) and a policy on admission which targeted enrolment of 50% of all students in science and technology related courses by significantly expanding these programmes (UNESCO, 2010; Kenya Universities and Colleges Central Placement Services, 2014; Mukhwana *et al*, 2016). Despite implementation of these policies, participation rate from public Universities in Kenya stood below 29% (Commission for University Education, 2016), which was twenty-one percentage points behind 2010 KESSP I target of fifty percent (UNESCO, 2010).

This low numbers of students participating in Science and Technology programmes at Bachelor level constituted a major concern in this study because these were the programmes prioritized for training with the potential to spur the country's national development. Leaving out majority of the population from science and technology disciplines was going to have negative implication for attainment of an industrialized nation as envisaged in Kenya Vision 2030. Additionally, the continued low participation of students in Science and Technology Programmes meant that any benefits which could accrue from increased students' participation like viable productivity and social-economic development might be difficult to be realized. Therefore, the task of this study was to explore the gaps which existed in the stated government policies designed to guide developing the academic staff and admission to science and technology Bachelor degree programmes and their actual practice and impact during the implementation of the policies.

III. OBJECTIVE

Examine the relationship between academic staff and students' participation in Science and Technology Programmes at Bachelor Level in Public Universities in Kenya.

IV. REVIEW OF RELATED LITERATURE

Review of related literature covers relationship of academic staff and student's participation in Science and Technology Programmes. The review is cascaded from a global viewpoint to regional level and then national level. A study by Barthope (2012) on trends and issues affecting workforce planning in New Zealand University Libraries found out that technological development had impacted on workforce planning. Hence, recruitment of new staff to the library profession and relevance of the current professional qualifications were issues of great concern (Barthope, 2012). But it had one gap of interest to this study. The gap is that Barthope narrowed to workforce in University Libraries and did not go further to look at other components of workforce resources like lecturers, technicians, and laboratory assistants, their numbers and qualifications in order to ascertain how these affected participation in Science and Technology Programmes. This study focused on all these components of workforce and came up with the effects of human resources on participation.

A study by Ntim (2016) on implications for pedagogical quality, equity and assessment in Ghanaian higher education noted that in Public Universities, the ratio of academic population to student population is six times more than the required internationally accepted student–to-teacher ratio (Ntim, 2016). Matovu (2018) carried out a study on massification and quality of graduates in Uganda which also noted that Higher Education Institutions (HEIs) had less academic staff and that highly qualified academic staff (Professors and Associate Professors) moved to other parts of the world looking for greener pastures (Matovu, 2018). Etshim (2017) used multiple approaches to study collaboration between higher education and labour market in Kinshasa, Democratic Republic of Congo (DRC). The study established that the Congolese higher education system was struggling with the lack of qualified personnel (Etshim, 2017). Thomas (2014) carried out a study on academic staff views of higher education quality in Somaliland. It found out that Somaliland Universities lagged behind in terms of the qualifications of academic staff. Furthermore, most institutions employed significant number of professors with only a bachelor's qualification since those with a master's degree or higher were few (Thomas, 2014).

The four studies by Ntim, 2016; Matovu, 2018; Etshim, 2017; and Thomas, 2014 had one common gap that is, generally considering student-to-lecturer ratio, staff qualifications, and curriculum on offer without considering specific programmes. This approach could not bring out a clear picture in Science and Technology Programmes. This study focused on student-to-lecturer ratio and staff qualifications and specifically in Science and Technology Programmes. The study by Etshim (2017) had one more limitation, that is, adopting online survey, yet there was limited access to internet in DRC which made most targeted respondents fail to respond to questionnaires. The study by Thomas (2014) had two other limitations. He stated that the sample was not representative and this limited the statistical analysis of quantitative data. For instance, the largest Gollis University with 200 lecturers and which focused on engineering and science based education was not surveyed. The second limitation was inadequate feedback since English language competence was a challenge for some respondents. This study filled the gap in Etshim study by the researcher personally travelling to the target Universities to conduct interviews. The gaps in the study by Thomas were filled by sampling Technical University of Kenya (TUK), Moi University (MU) and Egerton University (EU) which had a history of offering Science and Technology Programmes since their establishment and the researcher conducted interviews and administered questionnaires which were in English language, understood by all respondents.

Gudo *et al* (2011) conducted a survey on infrastructure, teaching and learning resources in Kenya between May 2010 and November 2010 and the survey established that there was shortage of lecturers in Public Universities (Gudo *et al*, 2011). The survey by Gudo *et al* on the state of infrastructure and teaching and learning resources in Universities in Kenya converge with this study. However, the first gap in the survey conducted by Gudo *et al* is the applicability of the findings due to the time factor. The research was conducted between May 2010 and November 2010. Ten years later it may, therefore, not accurately reflect the current situations, given the new higher education legal framework which led to the operationalization of the Universities Act No. 42 of 2012 which called for developing acceptable levels of academic staff before accreditation (Republic of Kenya, 2014). Consequently, a study in 2019 with regard to effects of teaching staff on participation in Science and Technology Programmes was necessary to ascertain the levels academic staff in Public Universities after operationalization of the Universities Act No. 42 of 2012.

V. METHODOLOGY

Research Design: This study adopted descriptive survey design method toexamine the relationship of academic staff on students' participation in Science and Technology Programmes at Bachelor Level in Public Universities in Kenya. 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 access accurate data on aspects academic staff.

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. Opinions of the lecturers were sought since they were the ones teaching, hence they understood the challenges they faced in terms of student-lecturer ratios while the HoDs were directly involved in the day-to-day running of the Departments. 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 lecturers	237	24	10.1	**Purposive**
Academic Registrars in the sampled Universities	31	3	9.7	**Purposive**
Heads of Departments in sampled Universities	107	12	11.2	**Purposive**
Total	406	39		

Data Collection Instruments: The study utilized three instruments to collect data: open-ended interview, documentary reviews and structured observations.

Open-ended Interviews for Lecturers, Heads of Departments and Academic Registrars
Open-ended interviews yielded mainly crucial information on aspects of qualifications and rank of academic staff and student-lecturer ratios.

Documentary Reviews: Documentary analysis was used as a supplementary method of gathering information, especially from institutional records. Quantitative data was obtained from University admission and human personnel 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).

Structured Observations: Non-participant observations were used in collecting data on non-verbal behaviour where direct observations focused on the lecturer-student ratios during lectures while collecting data. Structured observations were preferred because they allowed for considerable flexibility in the research process and provided for complete and direct information relating to science and technology and the learning environment in an objective manner.

Data Analysis: This study utilized mixed method analysis to examine the relationship of academic staff on students' participation in Science and Technology Programmes. The statistical data was transformed into frequencies, percentages, means, and bar graphs in order to address the research question while qualitative data analysis utilized simple descriptive analysis where data was grouped and presented in form of narrations and quotations. The voices of the participants validated specific findings from the quantitative data.

VI. FINDINGS AND DISCUSSION

Regardingdistribution of academic staff by qualification in Science and Technology Programmes, the findings are presented in Fig. 1:

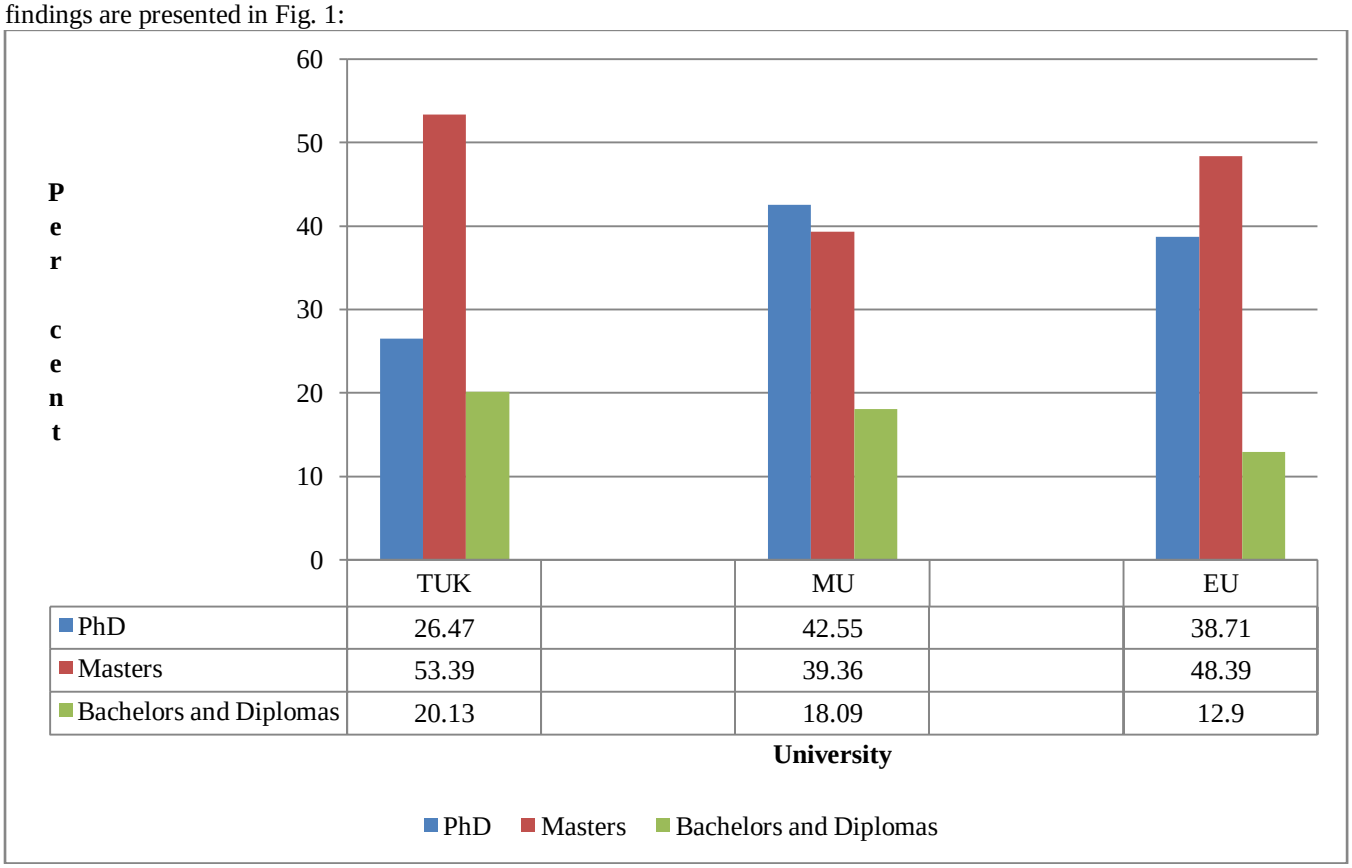


Fig. 1: Distribution of academic staff by qualifications in the School/Faculty of Engineering at Sampled Universities

Source: Researchers' compilation from official human resource records in sampled Universities

Fig. 1 above shows the distribution of academic staff by qualification in the School/Faculty of Engineering at the sampled Universities. At TUK, 53.39% had Masters' qualifications, followed distantly by PhD at 26.47%. Bachelors and Diplomas were the least represented at 20.13%. Masters and Bachelors combined, therefore, constituted the bulk of the teaching staff at 73.52%. At Moi University, 42.55% had PhDs, followed by Masters' at 39.3% and Bachelors at 18.09%. Therefore, Masters and Bachelors, combined, constituted the majority at 57.45%. For Egerton University, 48.39% had Masters, followed by PhDs at 38.7% and Bachelors at 12.9%. Masters and Bachelors, combined, constituted the bulk at 61.29%, meaning that only 38.71% had PhD qualifications in the entire Faculty.

Fig. 2 shows the distribution of academic staff by qualifications in the Faculty of Veterinary Medicine of Egerton University:

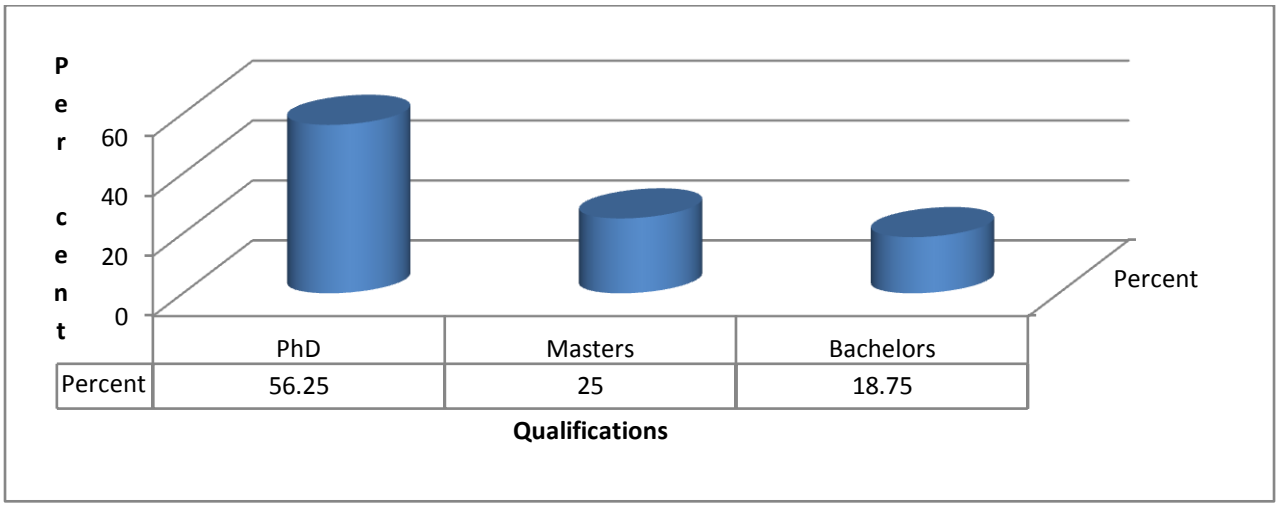


Fig. 2: Egerton University distribution of academic staff by qualifications in the Faculty of Veterinary Medicine

Source: Researchers' compilation from Egerton University official human resource records

Fig. 2 above shows that the highest number of teaching staff had PhD qualifications at 56.25%, followed by Masters at 25% while Bachelors were the least represented at 18.75%. Masters and Bachelors qualifications holders, combined, therefore, constituted 43.75% of the teaching staff.

In summary, 64.2% had Masters and Bachelors qualifications in Engineering Programmes. However, Veterinary Medicine had 56.25% with PhDs, 43.75% with Masters and Bachelors. This meant that only 35.8% in Engineering had PhD qualifications hence a dire shortage of staff with PhD qualifications contrary to Commission for University Education (CUE) PhD teaching regulations. These findings were reinforced by one lecturer who lamented that:

> We have insufficient and ill prepared staff in general. We are largely affected in areas that call for specialization. The University has no strategy to replace qualified staffs who exit service through natural attrition. Once a qualified staff exits, they just pick somebody enrolled for Masters and assign him or her teaching responsibility without even basic orientation in teaching. (Female, Lecturer, September, 2019)

One HoD pointed out that:

> We are yet to reach an ideal state as concerns staffing. Many members of the teaching staff are registered for Masters since those with PhDs are very marketable and easily find lucrative jobs elsewhere hence attracting, recruiting and retaining them is very difficult. In 2016, we advertised vacancies for teaching jobs but there were no applicants partly because PhD holders in our area want to work in Nairobi City where they can equally do consultancy work. (Male, Lecturer, September, 2019)

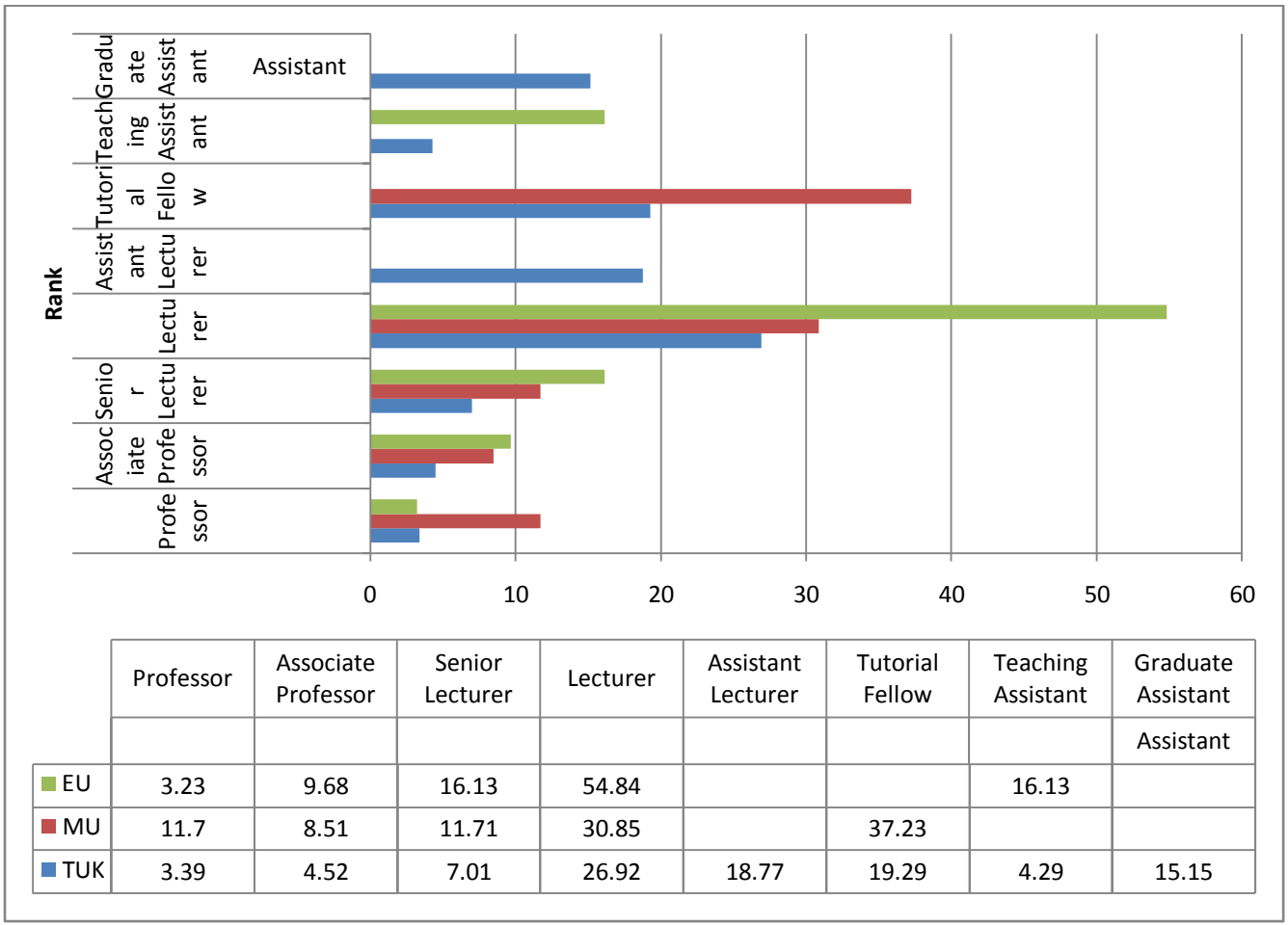
Another HoD argued:

> We have only three members of staff with PhD qualifications in our Department. I know of my two colleagues, one who went to UK while another to South Africa eight years ago for their PhD programmes but since then they have overstayed until their salaries have been stopped. I doubt if they are still pursuing their PhDs and if they will ever come. We have also embraced recruiting staff on contract and this makes exit very easy since you cannot force one to renew a contract. Our Staff Development Programme is not working either. Recently, we recruited our First Class Honours student as a Graduate Assistant with a starting salary of about Ksh. 87,000/= but even before settling, he got a job at Olkaria Geothermal Company earning close to Ksh. 400,000/= per month. I'm very sure that you will leave even if it were you. (Male, HoD, September, 2019)

These sentiments paint a picture of insufficient number of qualified candidates to fill teaching vacancies, a scenario attributed to loss of many highly qualified staff to other sectors of the economy due to unattractiveness of academic career since conditions of service in Universities fall behind those in other sectors of the economy.

Moreover, opportunities outside the country beckon some of the brightest minds with PhD qualifications. The situation is further compounded by low incentives. Hence, it's not easy to attract competent staff from abroad. In conclusion, significant proportion of teaching staff do not have the minimum academic qualification of PhD and, therefore, those with Master's degrees forms the bulk of the teaching staff, contrary to Commission for University Education (CUE) PhD requirement for teaching (Commission for University Education, 2016). These observations corresponded to Thomas (2014) on academic staff views of higher education quality in Somaliland which revealed that, most institutions employed significant number of Professors with only a Bachelor's qualification as those with Master's degree or higher were few.

On the distribution of teaching staff by rank in the Faculty/School of Engineering, the findings are presented in Fig. 3 below:



	Professor	Associate Professor	Senior Lecturer	Lecturer	Assistant Lecturer	Tutorial Fellow	Teaching Assistant	Graduate Assistant
								Assistant
EU	3.23	9.68	16.13	54.84			16.13	
MU	11.7	8.51	11.71	30.85		37.23		
TUK	3.39	4.52	7.01	26.92	18.77	19.29	4.29	15.15

Fig. 3: Distribution of teaching staff by rank in Faculty/School of Engineering.

Source: Researchers' compilation from official human resource records in sampled Universities

Fig. 3 above shows that at TUK, 26.92% were in the rank of Lecturer, 19.23%, Tutorial Fellows, 18.77% Assistant Lecturers and 15.15% Graduate Assistants. The least represented cadre was Professor at 3.39 %, followed by Teaching Assistant at 4.29%, Associate Professor 4.52% and Senior Lecturers at 7.01%. Those in the rank of Assistant Lecturer and below, combined, constituted the majority at 58.11% of the teaching staff. At Moi University, the bulk of teaching staff were in the rank of Tutorial Fellow at 37.23%, followed by Lecturers at 30.85%, and Professors tallied with Senior Lecturers at 11.7% each. The least represented cadre was Associate Professors at 8.51%. Therefore, senior staff in the rank of Professor, Associate Professor and Senior Lecturer, combined, constituted only 31.9% of the academic staff. At Egerton University, majority of

teaching staff were in the rank of Lecturer at 54.84%, followed by Senior Lecturer and Teaching Assistant tallying at 16.13%, and Associate Professor at 9.68%. The least represented cadre was Professor at 3.23%. Hence, only 29.04% of the academic staff was in the rank of Professor, Associate Professors and Senior Lecturers.

In connection to distribution of the teaching staff by rank, one lecturer commented:

> Surely, I'm a Teaching Assistant with Lecturers' load. You can imagine how difficult it can be to do my research. At the same time, I have remained a Graduate Assistant since attaining my Master's degree yet I expected to be promoted to the position of Assistant Lecturer. (Male, Lecturer, November, 2019)

One HoD explained that:

> This situation is further amplified by the fact that the staff who are supposed to be academic leaders in the rank of Senior Lecturers, Associate Professors and Professors quite often look for more lucrative opportunities in University administration, business world, research institutions and consultancy, eventually making the junior staff members take the burden of teaching in an environment lacking mentorship. (Male, HoD, September, 2019)

In summary, only 25.28% were in the rank of Professor, Associate Professor and Senior Lecturer. This meant that 74.72% were in the rank of Lecturer and below, implying that more teaching workload was passed to junior staff. This was a cause for worry as it meant that there were very few academic leaders to mentor scholars in the sector. Consequently, the anxiety that came with such a burden in a context demanding high standards of research productivity, eventually discouraged potential academicians. Furthermore, the question of accountability on promotions criteria was evident. This, certainly, demotivated trained staff and negatively impacted on quality. These findings corresponded to observations by Matovu (2018) in Uganda which established that Higher Education Institutions (HEIs) had less academic staff and those highly qualified (Professors and Associate Professors) moved to other parts of the world for greener pictures.

Based on the Commission for University Education (CUE), the recommended lecturer-student ratio should be 1: 20 for practical-based courses (Commission for University Education, 2016). Results on the lecturer student ratio in Engineering and Veterinary Medicine Programmes are shown in Table 2:

Table 2: Academic staff to student ratios in Engineering and Veterinary Medicine Programmes at Sampled Universities

University	Faculty/School	Number of teaching staff	Number of students enrolled	Ratio
TUK	Engineering	236	4756	1:20
MU	Engineering	86	741	1:9
EU	Engineering	31	769	1:25
	Veterinary	16	473	1:30
Total		**369**	**6739**	**1:18**

Source: Researchers' compilation from sampled Universities official human resource and admission records

The results in Table 2 above revealed that MU had academic staff to student ratio of 1:9 and TUK 1: 20 in the Faculty of Engineering. EU had a ratio of 1:25 and 1:30 in the Faculty of Engineering and Faculty of Veterinary Medicine respectively. Overall, the ratio was 1:18 indicating that the academic staff to student ratio was sufficient to meet recognized standards by CUE. Arguably, these impressive ratios might not be sustainable in the long run, especially if remedial measures targeting training, recruitment and retention of staff shall not be initiated. Nevertheless, these findings contrast sharply with those by Ntim (2016), in Ghanaian higher education, which observed that in Public Universities, the ratio of academic population to student population was six times more than the required internationally accepted student-to teacher ratio.

As regards the mode of delivery, majority of the informants indicated the use of dictation and writing notes on boards or giving out handouts. In that regard one HoD opined that:

> In some cases, it's difficult to undertake practicals and demonstrations due to limited laboratory facilities and little resources such as laboratory supplies or spaces. Even digital platform is difficult due to limited capacity and short of equipment in this digital platform. (Male, HoD, September, 2019)

One lecturer lamented:

> The main method of teaching is "face to face lectures" in which lecturers dictate notes and write them on board at the same time especially equations and technical terms and this method is quite tiring and boring. The students equally study from hand-outs that are given by the lecturers as soft copies or hard copies. (Female, Lecturer, October, 2019)

In summary, the common teaching method was dictating notes and reading from handouts with very few discussions, practicals and demonstrations, tutorials and seminar work. In other words, transmission pedagogy dominated lecture halls, making learning to be largely passive with too much theory, few practicals, less practice and, subsequently, raising the question of quality.

VII. CONCLUSION

The study concludes that there was non-compliance with the Commission for University Education (CUE) requirement for University teaching staff. Furthermore, there were very few academic leaders to mentor scholars in the sector. Again, Universities were experiencing acute shortage of facilities and this extremely undermined the mode of delivery. Nonetheless, the lecturer-student ratio was sufficient to meet recognized CUE standards.

VIII. RECOMMENDATIONS

The study recommends that Universities should establish structures for supporting lecturers to move away from transmission–based lectures to problem-based learning, more participatory, collaborative lecture rooms and promote use of technology so as to prepare increasingly diverse student cohorts for a borderless economy. Finally, Universities should strengthen staff development programmes, scholarships and provision of lecturers' book and research allowances and payment of non-practising allowance in order to respond to the challenge of attracting, motivating and retaining staff.

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