International Research Journal of
SCIENCE, TECHNOLOGY, EDUCATION, AND MANAGEMENT
P-ISSN: 2799-063X | E-ISSN: 2799-0648

Volume 2, No. 1 | April 2022

Physical facilities on students' participation in science and technology programmes in public universities in Kenya

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A B S T R A C T

Despite the government commitment to the implementation of admission policies like targeting enrolment of 50% of all students in science and technology related courses through placement of students into these programmes 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 effects of physical facilities on students' participation in these Programmes. The study employed descriptive survey design. Purposive sampling and simple random techniques were employed to select respondents. Questionnaires, interview schedules and structured observation schedules were utilized to collect data. Qualitative data was analysed thematically and reported in form of tables, quotations and narrations while quantitative data was analysed by use of frequencies, percentages, means, pie charts and bar graphs. It was established that inadequacy of physical facilities stood at 74%. The study concludes that Universities were experiencing acute shortage of facilities to the extent that they had not reached the minimum acceptable level. Practical elements in curriculum were extremely undermined and the curriculum was highly deficient, out-dated and irrelevant with little coordination between its designs and industries. Students were majorly grounded in theory at the expense of practical industrial training and transmission pedagogy dominated lecture halls, making learning largely passive. It recommends that Universities should formulate, adopt and implement University Industry Partnership and Placement (UIPP) policy to recognize the Universities' science and technology study programmes as part of the industry chains.

A R T I C L E I N F O

Received : Sept. 24, 2021
Revised : April 6, 2022
Accepted : April 16, 2022

K E Y W O R D S

Physical facilities, Participation, Public university, Science and technology programmes

Suggested Citation (APA Style 7th Edition):

Wanyama, B.W. (2022). Physical facilities on students' participation in science and technology programmes in public universities in Kenya. *International Research Journal of Science, Technology, Education, and Management*, 2(1), 217-231. https://doi.org/10.5281/zenodo.6496878

INTRODUCTION

Global development agenda greatly focuses on science and technology education as one of the prioritized sector components (Dela Fuente, 2019; Kirimi, 2015; Filippetti & Savona, 2017). Like Shaheed Benazir Bhutto University of Pakistan introduced Computer-assisted English language learning technology for undergraduate University students. However, the programme was hampered by lack of facilities (Rajput & Shah, 2021). 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 (Africa Capacity Building Foundation, 2016). Like Lesotho, the levels of laboratory facilities are far too poor to adequately cater for students registering for chemistry at advanced level in Lesotho secondary schools (Mosotho, 2017). In Ethiopia, there is little attention on availability of physical facilities, particularly the adequacy and quality of laboratory facilities (Shibru *et al*, 2016). Nigeria's Technical Vocational Education and Training (TVET) institutions lack the tools and equipment necessary for practical education where inadequate and decaying infrastructure like workshops and laboratories are often obsolete and bearing little or no resemblance to the technologies currently used in 21st century workplace. Consequently, trainees overcrowd during classes, with most of them only observing the teacher demonstrate and have no opportunity to get hand on practice (Oviawe *et al*, 2017). The situation is not different in Ghana where there is inadequate physical infrastructure like laboratories, laboratory supplies and workshops. This situation is further compounded with inadequate number of lecturers and technicians, making learning largely passive with few practicals and limited field trips due to funding constraints. These largely compromise quality (Sam-Amoah *et al*, 2016; Atuahene & Owusu-Ansah, 2013).

In Malawi, students' enrolment in agriculture programmes at Lilongwe University of Agriculture and Natural Resources (LUANAR) had increased by 200% in 2015, although the curriculum was largely theoretical and lacking industrial orientation. Additionally, practical and laboratory sessions only contributes 10% to 30 % to the overall assessment as industrial attachments were only done once in third year of study and only for 4 weeks as opposed to 8 weeks stipulated in curriculum due to monetary limitations associated with attachments which largely compromises quality (Valeta *et al*, 2016). 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 to accommodate sufficient numbers due to low workshops capacity, poor safety issues, infrastructure constraints, and costly acquisition of equipment for trainees' practical work. 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, the government targeted expansion of public Universities through upgrading of a large number of middle-level technical colleges to University status. For instance, there were 14 new public Universities created in 2013 alone (Republic of Kenya, 2006; UNESCO, 2010; McCowan, 2018). This led to significant expansion of Science and Technology Programmes offered in public Universities at Bachelor level with Life Science and Physical Science cluster having 164 programmes; Agriculture, Forestry and Fisheries 140; Health and Welfare 92; Engineering 85; Mathematics and Statistics 44; Architecture 17; Veterinary 10; and Manufacturing seven (Mukhwana *et al*, 2016). Despite this expansion, inputs like laboratory space and workshops, as well as spare parts for equipment maintenance and repair, routine replacement and upgrading of equipment, reagents and other consumable supplies were not carried out (Sifuna, 2010; Gudo *et al*, 2011; Mukhwana *et al*, 2017; McCowan, 2018). Polytechnics and Institutes of Technology institutions lack adequately trained tutors and inadequate and obsolete physical facilities. Consequently, effective training for a modern economy is compromised (UNESCO, 2010; Mango, 2015). Moreover, lack of infrastructure, teaching and learning resources have contributed to inefficient implementation of science based curricula. This resulted in teaching too much theory, few practicals and less practice, a scenario that led to Engineering Board of Kenya (EBK) threatening to cancel engineering accreditation of some Universities in Kenya (Ochuodho, 2016; Ligami, 2018, Kiplang'at, 2018). 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 effects of physical facilities on students' participation in these Programmes.

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 infrastructure, teaching and learning resources 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 all 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 per cent (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 examine the effects of physical facilities on students' participation in Science and Technology Programmes at Bachelor Level in Public Universities in Kenya.

Research question

1. In what ways do physical facilities affect students' participation in science and technology programmes at bachelor level in public universities in Kenya?

LITERATURE REVIEW

Review of related literature covers effects of physical facilities on participation in Science and Technology Programmes. The review is cascaded from a global viewpoint to regional level and then national level. Vibhash (2013) conducted a survey at the University of Delhi (DU) regarding challenges and opportunities in higher education system in India. It established that India needed to strengthen its existing infrastructure. But it had two gaps of interest to this study. First, considering the faculty members of University of Delhi (DU) only, did not give a complete picture of the effect of infrastructure on participation in Science and Technology Programmes in India. The second gap of the survey was failure to come up with the components of infrastructure which were needed to be strengthened. But this study went further to solicit information from science and technology lecturers in three different Kenyan Public Universities in order to ascertain the effects of infrastructure, teaching and learning resources on participation. Furthermore, focus was on specific components of infrastructure which affected participation like availability of workshops, laboratory space, and spare parts of equipment, maintenance, repair, upgrading, reagents and consumables.

Fabiyi & Uzoka (2012) conducted a survey on infrastructure and teaching and learning resources in tertiary education. It found out that there was inadequacy of infrastructure which affected quality in tertiary institutions (Fabiyi & Uzoka 2012). A diagnostic study by Gadzirayi *et al* (2016) on status of Science, Technology, Engineering and Mathematics (STEM) education in Zimbabwe had similar findings, like dearth of infrastructure which supports Sciences and Mathematics, few laboratories, equipment and chemicals in schools (Gadzirayi *et al*, 2016). Another qualitative case study by Osei-Asibeyi (2015) on challenges in the implementation of Technical and Vocational Education and Training (TVET) curriculum in Ghana equally established that Ghana's TVET had inadequate tools and equipment and obsolete and broken down facilities (Osei-Asibeyi, 2015). This study identified gaps of interest in researches conducted by Fabiyi & Uzoka, 2012; Gadzirayi *et al*, 2016; and Osei-Asibeyi, 2015. The gap in the study by Fabiyi & Uzoka was that it could not produce accurate inference on participation in Science and Technology Programmes at Bachelor Level since tertiary education could involve institutions which did not offer Bachelor Degree Programmes. The gap in Gadzirayi *et al* study was that it focused on status of STEM education generally in primary and secondary schools, while that by Osei-Asibeyi had two gaps which were of interest to this study. First, the researcher focused mainly on TVET institutions and not Universities. Secondly, Osei-Asibeyi (2015) pointed out that some participants pulled out from focus groups prior to the start of interviews upon realizing that these were going to be recorded, yet this was the sole data collection instrument.

In that regard, this study was more specific and utilized statistics of students participating in Science and Technology Programmes at Bachelor Level in three Public Universities. Moreover, it used different data collection instruments, namely: self-administered questionnaire, open-ended interviews and structured observations. Equally, participants and informants were assured of the purpose of data collection, confidentiality, professional handling of data to ensure privacy and security. 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 physical facilities for teaching and learning and shortage of lecturers in Public Universities (Gudo *et al*, 2011). An evaluation study by Kaburu & Embeywa (2014) on infrastructure, teaching and learning resources in Kenya in 2014 corroborated the findings of the 2010 survey. The study further found out that Public Universities were lagging behind in e-learning facilities. The survey by Gudo *et al* and Kaburu & Embeywa on the state of infrastructure and teaching and learning resources in Universities in Kenya converge with this study. 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 infrastructure before accreditation (Republic of Kenya, 2014). Consequently, a study in 2019 with regard to effects of infrastructure, teaching and learning resources on participation in Science and Technology Programmes was necessary to ascertain the levels of these crucial aspects in Public Universities after operationalization of the Universities Act No. 42 of 2012.

The study by Kaburu & Embeywa had a limitation on the type of infrastructure. It only considered e-learning facilities as a parameter for participation in Science and Technology Programmes. It was not feasible how such a conclusion was arrived at, given that the use of e-learning platform *par se* did not lead to increased participation in these programmes. Consequently, a study on effects of physical facilities like laboratory space and workshops, rather than just e-learning facilities was carried out in order to arrive at a balanced conclusion on how these components affected participation at Bachelor Level. Mwirichia *et al* (2017) carried out a causal-comparative survey on the impact of massification on resource adequacy in Public and Private Universities in Kenya. It found out that there were inadequate resources in these institutions and that there was no statistical significant difference on the impact of massification on resource adequacy between them (Mwirichia *et al*, 2017). A descriptive survey by

Sang *et al* (2012) on challenges facing Technical Training in Kenya found out that training facilities used by TTIs were inferior to facilities used in industries and business organizations (Sang *et al*, 2012). Siocha *et al* (2017) conducted a small scale study of a County in Kenya on quality implications of learning infrastructure on performance in secondary education. The study found out that learning resources were not adequate and that this was replicated in the other teaching and learning infrastructural facilities (Siocha *et al,* 2017). Another analytical study by Mwebi & Simatwa (2013) on expansion of Private Universities in Kenya and its implications on quality and completion rate found out that the physical facilities were low for provision of quality Science and Technology education (Mwebi & Simatwa, 2013). The studies by Mwirichia *et al,* 2017; Sang *et al,* 2012; Siocha *et al*, 2017; and Mwebi & Simatwa, 2013 in Kenya had gaps that were similar to the study by Vibhash (2013) in India, thus failure to come up with the components of infrastructure which were needed to be strengthened. This study focused on specific components of infrastructure which affected participation in Science and Technology Programmes like availability of workshops, laboratory space, spare parts of equipment, maintenance, repair, upgrading, reagents and consumables, hence an accurate report on effects on infrastructure and participation in these programmes at Bachelor Level in Public Universities.

METHODS

Research design

This study adopted descriptive survey design method to examine the effects of physical facilities 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 of physical infrastructure, teaching and learning resources.

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. 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.

Respondents

Simple random sampling method was used to select students willing to complete the questionnaire. The method allows all the individuals in the defined population to have equal and independent chance of being selected, thus data that emerges can be generalized (Kombo & Trump, 2006). The selection of students to respond to issues of infrastructure was based on the fact that they were the ones participating hence understood the level of infrastructure, teaching and learning resources available. Opinions of the lecturers were sought since they were the ones teaching, hence they understood the challenges they faced in terms of physical facilities 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 students	3179	355	11.1	Simple random
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	3554	394		

Data collection

Primary data was collected using three tools, namely: Self-administered questionnaire, open-ended interview and structured observations. These tools generated both qualitative and quantitative data.

Administering the questionnaire

The researcher liaised with the HoDs to get teaching timetables in the three target Universities to select lecture sessions during which the researcher, with the help of two research assistants, administered the questionnaire.

Open-ended interviews

The researcher made a pre-visit to the lecturers, HoDs and Academic Registrars to book an appointment with each one of them on a specific date, time and venue for the interview. During such times, the researcher introduced himself and explained the study's expectations to each of the respondents who had voluntarily accepted to participate. A follow-up through phone call was done to confirm the date and time before the actual interview was done. The researcher assured them of confidentiality of the information given. The interviews were conducted with the help of research assistants and data was recorded both manually and electronically.

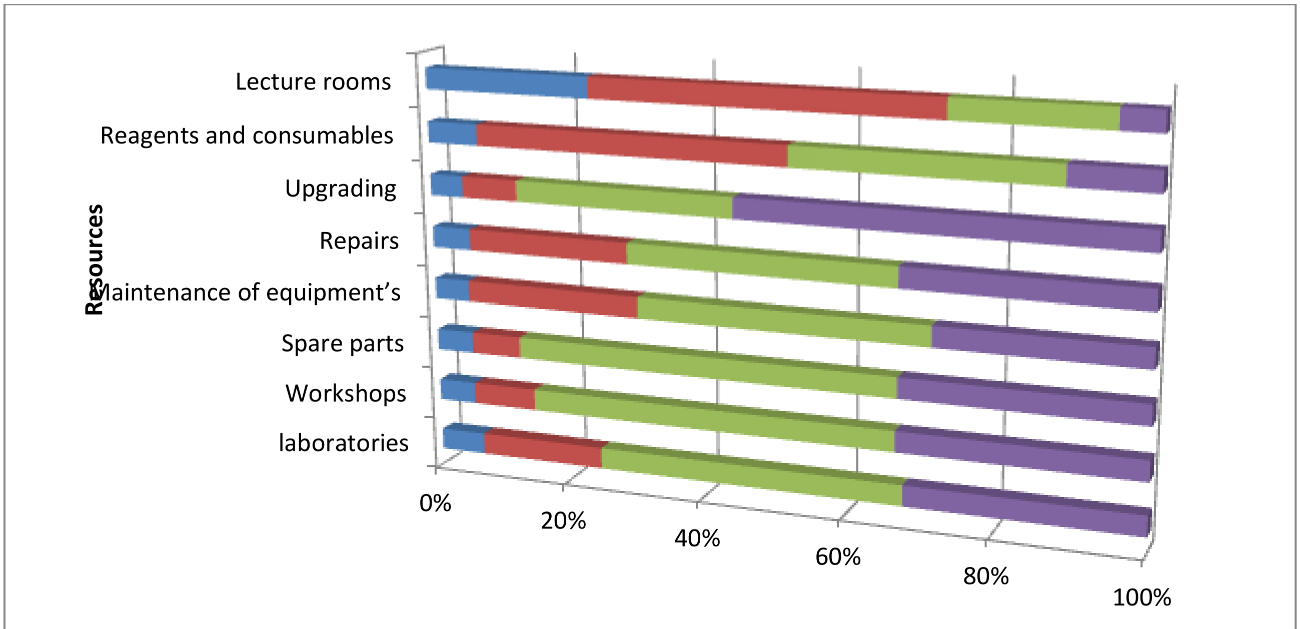
Data analysis

This study utilized mixed method analysis to examine the effects of infrastructure on students' participation in Science and Technology Programmes. The statistical data was transformed into frequencies, percentages, means, pie charts 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.

Ethical consideration

In this study, three ethical issues of informed consent, voluntary participation and confidentiality were observed. On informed consent and voluntary participation, the respondents were given a copy of the research permit and adequate information on the aim of the research. In addition, the respondents were free to withdraw their participation. To ensure anonymity, the data collection tools did not contain identification details of the respondents.

RESULTS AND DISCUSSION



	laboratories	Workshops	Spare parts	Maintenance of equipment's	Repairs	Upgrading	Reagents and consumables	Lecture rooms
Very adequate %	6.5	5.4	5.4	5.1	5.6	4.8	7.3	24.2
Adequate %	18.3	9.3	7.3	25.6	23.7	8.2	44.8	48.7
Inadequate %	43.1	52.1	54.4	40.8	37.7	31.5	36.1	21.4
Very inadequate %	32.1	33.2	33	28.5	33	55.5	11.8	5.6

Figure 1. Students' perceptions about adequacy/inadequacy of physical infrastructure
Source: Data obtained from students' respondents' during field inquiry, 2019

Figure 1 above shows that the most lacking resource were spare parts, followed by upgrading, workshops, laboratories, repairs and maintenance. Lecture rooms and reagents were the only adequate resources. In this connection, a student respondent wrote the following response to an open ended question in a questionnaire:

> *We have inadequate reagents and chemicals, inadequate live animals and dead carcasses, no veterinary clinic that can serve the students and the community. We lack exposure in diagnosis and surgery and do not know how to even suture wounds and handle cases apart from theory*. (Female, Student)

Lecturers and HoDs, perceptions of the extent of availability of physical facilities are depicted in Table 2 below:

Table 2. Lecturers and HoDs perceptions of the extent of availability of physical facilities

Adequacy/inadequacy of Physical Facilities	Frequency	Per cent
Inadequate reagents and consumables	28	93.3
Inadequate spare parts	27	90
Inadequate upgrading	26	86.7
Inadequate workshops	24	80
Inadequate laboratories	23	76.6
Inadequate repairs	22	73.3
Lack of maintenance of equipment	21	70
Inadequate lecture rooms/halls	19	63.3

Table 2 above indicates that reagents and consumables were the most inadequate at 93.3% followed by spare parts at 90%, upgrading at 86.7%, workshops 80%, and laboratories at 76.6%. Other inadequate resources were repairs at 73.3%, maintenance of equipment at 70% and lecture rooms at 63.3%. Averagely, physical infrastructure inadequacy stood at 79.2%. In this connection, one lecturer lamented:

> *Our laboratories are inadequately equipped, while the workshops available lack space. Most of them have broken down machines and tools that have been left unrepaired for several years. For instance, we only have three lathe machines of which two are stalled. Materials needed for practical lessons are not supplied at all or in few cases where they are made available, they either supply at wrong time or even wrong material. It's quite despicable that we have 6th year students on campus, yet our programmes run for five academic years. They were supposed to have cleared their programmes in the last academic year, but they are still around due to lack of materials for their 5th year projects*. (Male, HoD)

Another HoD during the interview supported the views that:

> *Our laboratories are poorly equipped for conducting practicals in areas like anatomy and physiology. We have been conducting them from UoN since they have modern facilities like ultra-sound scanning machine and advanced surgery rooms. However, they suddenly increased their charges which became difficult to pay and now we have opted for Agriculture Development Corporation, Kitale and Kenya Society for the Protection and Care of Animals, Naivasha*. (Female, HoD)

In summary, the inadequacy of infrastructure averaged 74%, painting a picture of woefully inadequate laboratories and workshops. The tools and equipment available were few, deteriorated or obsolete, leading to congestion in the laboratories and workshops. Also, the equipment lacked resemblance with the current equipment in the industry. The research concludes that the practical elements are considerably undermined due to inadequacy of physical facilities, thus throwing quality in jeopardy. These findings were similar to Gudo *et al* (2011) who had established that there was shortage of physical facilities in Public Universities. Mwebi and Simatwa (2013) and Dela Fuente (2021) found out that the quality of physical facilities were significant to quality education. Moreover, Gadzirayi *et al.* (2016) in Zimbabwe established that there was dearth of infrastructure to support Sciences and Mathematics, while Osei-Asibeyi (2015) in Ghana pointed out that TVET had inadequate tools, equipment and obsolete and broken down facilities. Lecturers, HoDs and Academic Registrars views on Science and Technology curriculum was sort. On the aspect of curriculum, all the 39 (100%) Lecturers, HoDs and Academic Registrars respondents indicated that the process of curriculum design and development was left to individual Universities. In this connection, one HoD explained that:

> *Faculty committees ought to systematically and comprehensively review curriculum after every complete cycle of five years based on feedback from various stakeholders including students, alumni, industry players/employers, lecturers, community, government through regulatory bodies, using trends and international standards to ensure training programmes are responsive to the needs of the society*. (Male, HoD)

Whether this procedure was being followed especially coordination with industry players, the findings are presented in Figure 2:

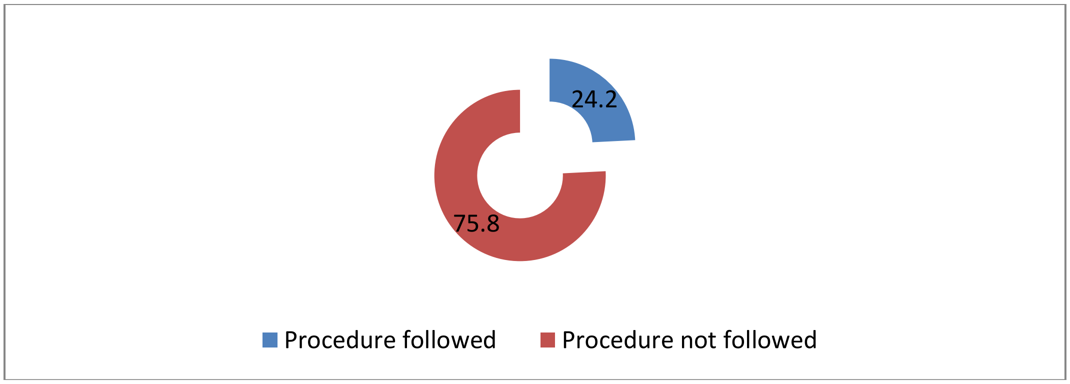


Figure 2. Lecturers, HoDs and Academic Registrars' frequency on whether there was coordination with industrial players in curriculum review and design
Source: Data obtained from respondents during field inquiry, 2019

Figure 2 above shows that 75.8% indicated that the procedure was not followed while 24.2% had the view that the procedure was followed. In this connection, one lecturer had the following to say:

> *The School of Engineering needs to review its current curriculum so that it reflects and suits the needs of modern industry. There is also need to examine the possibilities of supplying some latest machinery to the School of Engineering laboratories that will help learners in skills development and capacity development*. (Female, Lecturer)

Another lecturer decried:

> *We are offering surface irrigation in Kenya as if it is a new concept. The truth of the matter is that it's an old age concept in a country like Israel. The use of tractors for field operations is also old school as people have embraced greenhouse farming and the use of drones during field practices like application of fertilizers, herbicides and pesticides. This makes it difficult for our curriculum to cope up with international trends and standards*. (Male, Lecturer)

This finding showed that majority at 75.8% was not adhering to the laid down procedures for curriculum review, implying that the curriculum was highly deficient and, in some cases, out-dated and irrelevant. On the aspect of University-Industry Partnerships, all 39(100%) Lecturers, HoDs and Registrars (Academic) respondents revealed that Universities were attempting to link with industries through industrial attachments. In that regard, one HoD confirmed:

> *All engineering students proceed for industrial attachment in 2nd, 3rd, and 4th years of study for 8weeks each as stipulated in curriculum. The first attachment in the*

> *second year is internal while those in the third and fourth years undertake attachments externally in industries*. (Male, HoD)

Another HoD explained that:

> *Students from 1st year to 4th year always proceed for a two month field attachment. Further, they are required to undertake a successful one year internship programme after fifth year under supervision of a registered Veterinary Surgeon and pass pre-registration examination organized by the Kenya Veterinary Board*. (Female, HoD)

One HoD stated:

> *We have mooted various partnerships with industry players with the aim of delivering hands-on industrial skills, linked to market demands to our students. For example, we have partnered with Safaricom Ltd where students receive hands-on training at the facilities of the company and they undergo 12 weeks of external industry based learning*. (Male, HoD)

The findings revealed that all sampled Universities attempted to link with industries through industrial attachments. On the question of ease of securing industrial attachment, the findings are shown in Figure 3:

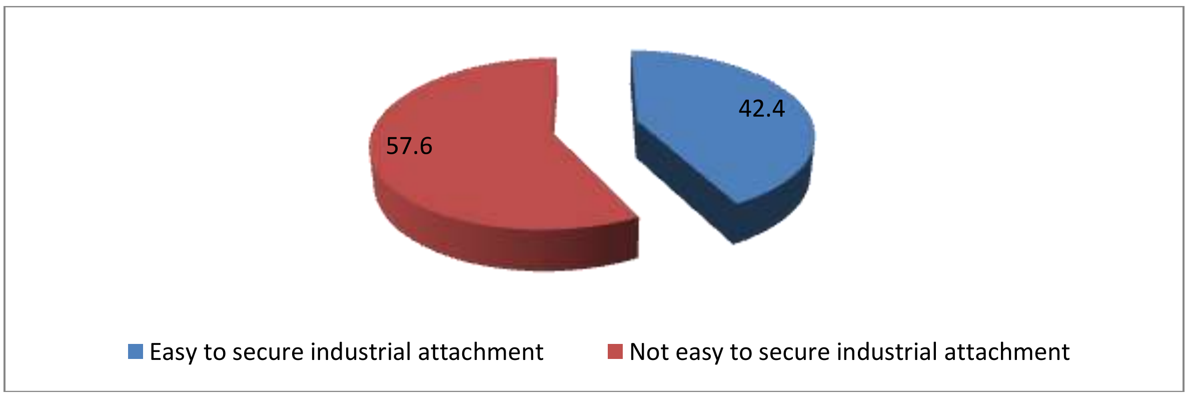


Figure 3. Lecturers, HoDs and Academic Registrars' responses' frequency on whether securing industrial attachment is easy or not
Source: Data obtained from respondents during field inquiry, 2019

Figure 3 above shows that 42.4% of the respondents held views that securing industrial attachment was easy. But 57.6% thought that it wasn't.

In this connection, one lecturer explained:

> *It's not easy to find attachment places for students because of limited vacancies. Admittedly, they want to undertake their attachments in certain industries with the hope of securing employment in the same industry after graduating hence the attachment period is also rightfully used for networking and given that many institutions are sending learners for attachment in the same industries limits the vacancies. In most cases, it takes the lecturer's personal initiative to get them places for attachment*. (Male, Lecturer)

Another lecturer lamented:

> *Kenya has a huge shortage of engineers yet the country aspires to attain Vision 2030. What is funny is that our engineering graduates are jobless amidst shortage of engineers and yet the industry tells us that they want engineers. Although Engineering programmes remain popular among students, they are bound to discover that there is no reason to pursue them when they cannot get jobs in the industry. If we don't do something, to avert the current trend of theoretical training of engineers, it's just a matter of time and we shall start losing engineering students to religion and history because they won't find value in our programmes. The solution is with academia-industry linkage and partnerships*. (Male, Lecturer)

This research established that 57.6% of students did not easily secure attachment opportunities in industries they wished to proceed to. Also, the attachment duration varied from one University to another where some institutions proceeded for 8 weeks per year while others went for 12 weeks. The picture that emerged was that most Universities grounded their students mostly in theory with limited exposure to practical industrial training. These findings corroborated with the study by Valeta *et al.* (2016) in Malawi which found out that the curriculum at Lilongwe University of Agriculture and Natural Resources (LUANAR) was largely theoretical and lacking industrial orientation. The industrial attachments were only done once in third year of study and for only 4 weeks, as opposed to 8 weeks stipulated in the curriculum, due to monetary limitations associated with attachments. On field/ industrial visits, all lecturers and HoDs 36 (100%) concurred that field trips were supposed to be incorporated into the curriculum. In this connection, one HoD explained:

> *Our programmes lay a heavy emphasis on the practical application of theoretical knowledge achieved through extensive industrial visits. We normally visit industries like Kibos Sugar and Allied Industries Limited Companies which have the advantage of single stop learning in a number of areas as it operates other subsidiary companies within the same area*. (Male, HoD)

Another HoD stated:

> *We have established partnerships with KQ and Safaricom Ltd and other stakeholders in the field of Aerospace and Aviation and our Engineering students have been receiving hands-on training at the facilities through academic group visits*. (Male, HoD)

305(87%) of student respondents revealed few or total lack of field trips in their respective schools/faculties. In this connection, a student respondent wrote the following to an open ended question in a questionnaire:

> *We need our own faculty bus in order for us to undertake academic trips because this University has few buses that cannot serve the entire University. Some University buses were auctioned for non-payment of debts*. (Male, Student)

Lecturers' and HoDs' views on the adequacy/inadequacy of field/industrial visits are presented in Figure 4:

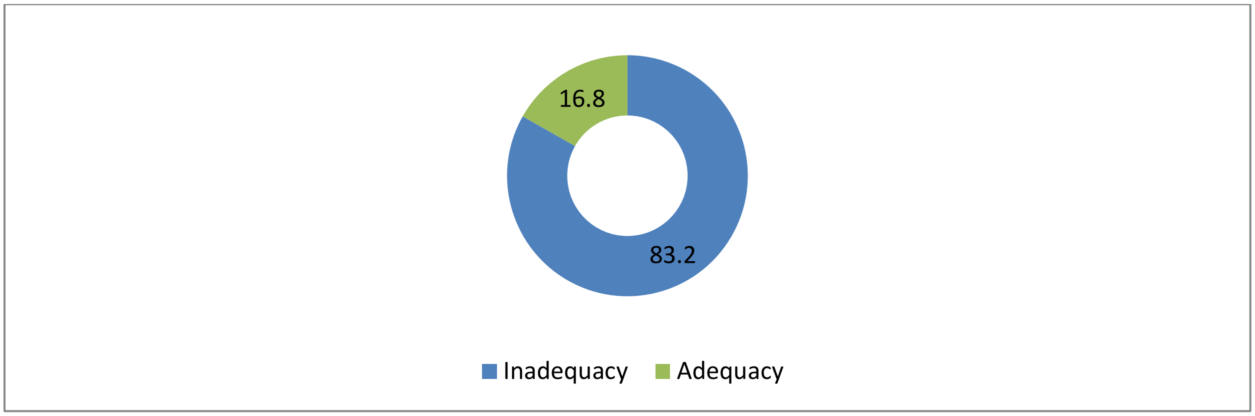


Figure 4. Lecturers' and HoDs' views on the adequacy/inadequacy of field/industrial visits
Source: Data obtained from students' respondents during field inquiry, 2019

Figure 4 above shows that majority at 83.2% held the view that field/industrial visits were inadequate while 16.8% thought that they were adequate. In that regard, a lecturer during an open ended interview indicated:

> *We no longer go for field trips because of lack of funds. For instance, I had lined up two academic trips in the last semester but none of them materialized. We completed the semester, administered examinations, marked and graded students minus field trip component*. (Male, Lecturer)

100% of the respondents concurred that Universities were making some effort to incorporate field/industrial visits in the curriculum. Nevertheless, 87% of student respondents and 83.2% of lecturers, HoDs making the average of 85.1% indicated inadequacy of such trips. The research concluded that Universities were not achieving the practical application of theoretical knowledge through field visits as emphasized in the curriculum and consequently cast doubt on the quality being offered in these programmes. Similarly, Sam-Amoah *et al* (2016) and Atuahene & Owusu-Ansah (2015) in Ghana found out that there were limited field trips due to funding constraints which largely compromised quality. As regards the mode of delivery, majority of the respondents indicated the use of dictation and writing notes on boards or giving out hand-outs. 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)

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)

In summary, the common teaching method was dictating notes and reading from hand-outs 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.

On students' assessment, all 36(100%) Lecturers and HoDs indicated that they followed University examinations procedures on this as stipulated in the Statutes of the University. In view of these, one lecturer had the following:

> *In Engineering Programmes, Unit assessment constitutes 30% Continuous Assessment Test and 70% final end of semester examinations. The CAT constitutes 10% practical work while 20% is sit-in theory examinations while end of semester examinations are theory examinations*. (Male, Lecturer)

Another lecturer explained:

> *For Bachelor of Veterinary Medicine, the CATs constitute 30%, final end of semester examinations 60% while oral examination constitutes 10%. An oral examination entails each student appearing before a panel of three lecturers and responding to oral random questions*. (Female, Lecturer)

In summary, out of the total 100% total marks, practical examinations ranges between 10% and 30% while theory ranges between 70% to 90%. This meant that the whole assessment is largely theoretical, which is contrary to the need for programmes in science and technology to be hands- on. These findings echoed those by Valeta *et al* (2016) in Malawi who documented that practical and laboratory sessions only contributed 10% to 30% of the overall assessment.

CONCLUSION AND RECOMMENDATION

The study concludes that Universities were experiencing acute shortage of facilities to the extent that they had not reached the minimum acceptable level. Consequently, practical elements in curriculum were extremely undermined. The curriculum was found to be highly deficient, out-dated and irrelevant as there was little coordination between its designs and industries. Hence, students were majorly grounded in theory at the expense of practical industrial training. Moreover, transmission pedagogy dominated lecture halls, making learning largely passive.

The study recommends that funding of Public Universities needs to be backed by a coherent policy which prioritizes quality and quantity in Science and Technology Programmes. Further to 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. Also, reform students' evaluation and move gradually away from dependency on examinations which mainly focus on memorization and adopt hands-on approaches in assessments. Additionally, Universities should prioritize collaborations with industry and professional practitioners in the development of curriculum in order to provide useful input regarding the skills required to perform in the job market and, at the same time, keeping abreast of new developments in industry and work place by benefiting through internships, workplace seminars and symposia. Hence, Universities should formulate, adopt and implement University Industry Partnership and Placement (UIPP) policy to recognize the Universities' science and technology study programmes as part of the industry chains.

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