Influence of Management and Utilization of Electronic Laboratory and Equipment on Skill Acquisition among Technician Trainees in TVET Institutions in Nairobi, Kenya

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Abstract

Skill training for Technical and Vocational Education and Training (TVET) graduates is very important as it prepares them to enter the world of work. Basic skills in electronics are acquired through regular laboratory practices taken by trainees. These practices must be done in a suitable environment. The purpose of this study was to investigate the influence of management and utilization of electronic laboratory and equipment on the level of skills acquisition among technician trainees in TVET institutions in Nairobi County. The study adopted mixed methods research design. The target population was four hundred and forty-nine (449) from electrical and electronics departments of eight (8) public TVET institutions in Nairobi County. Census method, purposive and convenience sampling were used to select the sample size. Data was collected using a self-administered questionnaire, interview schedules, focus group discussion and an observation checklist. Qualitative data analysis techniques involved the use of thematic analysis while quantitative data analysis involved the use of both descriptive and inferential statistics with the aid of an SPSS computer package version 26.0. The study found that effective management and utilization of electronic laboratory and equipment for skill acquisition was neglected and moderately influenced skill acquisition. The study concluded that management and utilization of electronic laboratory and equipment on the level of skill acquisition among technician trainees was not taken seriously. It was, therefore, recommended that TVET institutions with government support invest in electronic laboratory and equipment to enhance skill acquisition.

Keywords: Management; Utilization; Equipment; Skills; Trainees.

INTRODUCTION

TVET institutions play a critical role in equipping their trainees with the requisite skills in various professions to be successful in employment. For these skills to be attained, laboratories and workshops must be present with proper functioning equipment for trainees to use for practice. Ogbuanya and Oziegbunam (2012) assert that when laboratory equipment, tools, and materials are managed and utilized properly, skill acquisition is assured among trainees. This is because effective management keeps equipment in perfect working conditions for teaching and learning. Therefore, it can be argued that perfectly working equipment influences the quality of instruction positively because trainees' laboratory activities will be accomplished with ease.

There are many aspects of effective management and utilization of laboratory and equipment for skill acquisition. One is the guidance of students on the safe and proper use of equipment. Safe and proper use of equipment serves a dual purpose. It minimizes injuries to the students while at the same time minimizing breakages and damage to expensive

equipment during laboratory sessions (Nwachukwu, Bakare & Jika, 2009 cited in Ogbuanya and Oziegbunam, 2012). This underscores the importance of training and guidance in using equipment safely and properly to ensure that the equipment is always in good condition for learning purposes. Putting measures in place to safeguard laboratory equipment from loss or misuse is another critical aspect of the management and utilization of laboratory equipment. According to Muhammed (2009) cited in Ogbuanya and Oziegbunam (2012), there are a lot of laboratory equipment that have been lost as a result of poor record keeping and failing to put in place adequate measure to safeguard them in laboratories. This loss may lead to the inadequacy of laboratory training equipment which in turn affects the quality of training. Safeguarding equipment will guarantee a good student-to-equipment ratio.

Maintenance and repair of facilities and laboratory equipment is another aspect. Well-maintained facilities and equipment are appropriate for training, but in many TVET institutions, there is poor equipment and facilities repair and maintenance culture (Okwelle & Ojotule, 2018). As a result, TVET institutions are in a deplorable state (Kemevor & Kassah, 2015). Udo (2015) pointed out that facilities and equipment in schools and colleges especially in Nigeria were in a bad state and what was so disturbing was that heads of those institutions were not bothered with the state of equipment in their institutions. Acquisition of new equipment is also an aspect of management and utilization of laboratory equipment. Krivickas & Krivickas, (2007) in their study found out that laboratories with modern equipment are a good motivator for students enjoying learning skills in engineering. This demonstrates that it would be prudent that institutions to continue acquiring new equipment and they should also replace old or damaged equipment. However, as Ogbuanya & Okoli (2014) point out the acquisition of modern equipment is a challenge to most TVET institutions which the authors attribute to inadequate funds for the purchase of new equipment.

What is apparent here is that the management and utilization of electronic laboratory and equipment is a critical component that requires serious thought in skill acquisition. Mutua, Kimiti & Mulwa (2019) did a study on the adaptation of facilities for the acquisition of skills among visually impaired students in two institutions (Machakos Technical Institute for the Blind and Sikri Technical Training Institute for Deaf-Blind) and found out facilities for training were not adequate. It is in the light of this that this study sought to establish the influence of management and utilization of electronic laboratory and equipment on skill acquisition among electrical and electronic engineering technician trainees in public TVET institutions in Nairobi County, Kenya.

METHODOLOGY

The study utilized a mixed method research design. The area of study was public TVET institutions in Nairobi County, Kenya. A concurrent triangulation strategy was used. The target population comprised: eight (8) Heads of Department, fifty-one (51) electronics trainers, three hundred and seventy-four (374) final year technician trainees, eight (8) electronic experts, and eight (8) trainers in an electronics practical lesson for observation, all from electrical and electronics departments of the eight (8) public TVET institutions. The total sample was four hundred and forty-nine (449) participants. Census Method was employed in obtaining technician trainees and electronics trainers for survey and HODs for interviews. This is because the population was not vast (Kothari, 2004; Farooq, 2013, Bluman, 2009) and the researcher required a high degree of accuracy (Farooq, 2013). Purposive Sampling was used to select participants for focus group discussion (FGD), one (1) experienced trainer from each TVET institution with in-depth knowledge in the subject area (Cohen, Manion & Morrison, 2000). Convenience Sampling was to be used to select a trainer for observation, at least one group from each TVET institution. This method was

chosen because respondents were not readily available (Cohen, Manion & Morrison, 2000) since electronics laboratory practice was not timetabled separately in the institutions under study. Data were collected using self-administered questionnaires, observation checklist, focus group discussion, and interviews.

A pilot test was done to find out if the questionnaire provided the best measure of the concept at hand, (Muijs, 2004). A total of 19 respondents comprising trainees and trainers were randomly selected from two institutions used for the pilot study, one from Kiambu county and the other from Kajiado county. After the piloting, two electronics experts from the pilot institutions were mandated to analyze the responses to determine whether the questions were well understood by the respondents and correct any ambiguity. The reliability of the questionnaire was checked using the test-retest method to check for "consistency, stability and repeatability of results" (Twycross & Shields, 2004). The questionnaire was administered in the first round and the respondents were given numbers and a repeat was done after two months to the same pilot sample. A comparison between the first and second administrations was done to assess the consistency in the responses. The responses were also subjected to an internal consistency reliability check by calculating the coefficient alpha (α). This was done by coding the questionnaire data into the SPSS computer software and it attained a Cronbach's alpha of 0.862 which meant that it was highly reliable. Data collected, was summarized, analyzed and interpreted. Qualitative data collected were thematically analyzed. Quantitative data analysis involved the use of both descriptive and inferential statistics. The Descriptive statistics included the use of percentages and frequencies. Inferential statistics involved the use of Spearman rank correlation to determine the influence of the independent variable on the dependent variable.

RESULTS AND DISCUSSION

Laboratory Space and Equipment for Laboratory Practices

Electronic laboratory space determines how many trainees can be accommodated during lab practice. From the survey results in Table 1, it was found that both the trainees and trainers considered the laboratory space and equipment for electronic laboratory practices to be slightly spacious.

Table 1: Adequacy of laboratory space and equipment for laboratory practices

	Trainees		**Trainers**	
	Frequency	**Percent**	**Frequency**	**Percent**
Not adequate at all	84	33.3	7	20
Slightly adequate	137	54.4	19	54.3
Moderately adequate	28	11.1	8	22.9
Adequate	3	1.2	1	2.9
Very adequate	0	0	0	0
Total	**252**	**100**	**35**	**100**

Source: Questionnaire Data (2020)

From interviews, observation and focus group discussion it emerged that the laboratory space and equipment were not adequate. Participants attributed this to the high student population due to the government directive of 100% transition from secondary school to tertiary institutions. This created congestion in laboratory working areas, and many students shared equipment in the laboratories. Sessions comprised big groups that could not allow some trainees to touch the equipment for the entire session from observation. This survey results did not agree with the findings of the interviews, observation and focus group

discussion. Participants also said that some laboratories were used as normal classrooms in some institutions. These findings on electronic laboratory space are consistent with the findings of Okolie and Ogbaekirigwe (2014) in which the researchers found out that TVET institutions in Nigeria did not have enough laboratory or workshop space for training skills. Bakare, Ogbuanya and Akintonde (2017) also found out that most TVET institutions had inadequate equipment train.

Safety and Proper Use of Equipment

Safety and proper use of any equipment are paramount since it allows the equipment to be available for use when needed. Figure 1 shows that a majority of the trainees and trainers rated the guidance trainees were given on the safety and proper use of equipment to be good.

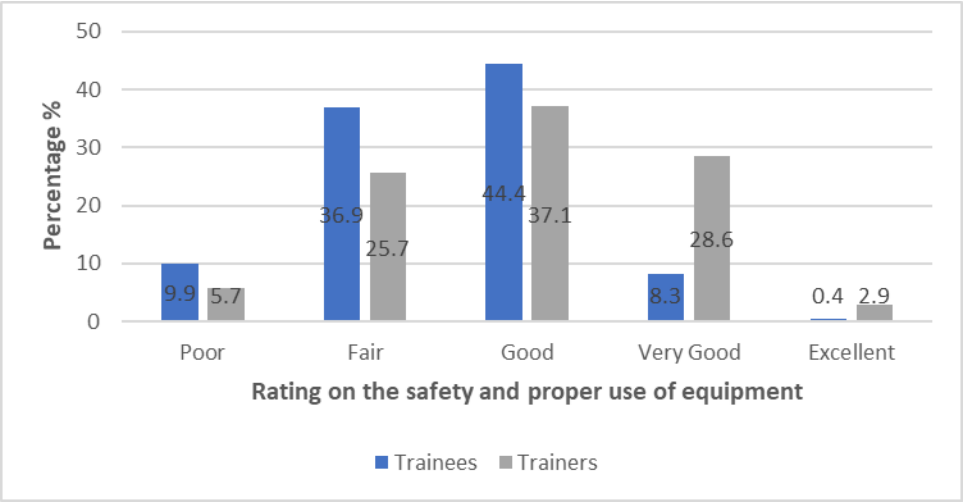

Figure 1: Rating on how well students were guided on the safety and proper use of equipment

Measures Employed to Safeguard Laboratory Equipment and Tools.

The results in Table 2, reveal that both the trainees and trainers considered the measures employed to safeguard laboratory equipment from loss to be moderately effective. This means that serious measures need to be put in place to safeguard equipment from loss.

Table 2: Rating of the measures employed to safeguard laboratory equipment

	Trainees		**Trainers**	
	Frequency	**Percent**	**Frequency**	**Percent**
Not effective	33	13.1	4	11.4
Slightly effective	73	29	2	5.7
Moderately effective	118	46.8	19	54.3
Highly effective	25	9.9	10	28.6
Very highly effective	3	1.2	0	0
Total	**252**	**100**	**35**	**100**

Source: **Questionnaire data (2020)**

FGD and observation revealed that measures put in place to safeguard equipment, and tools from getting lost or misused were not very effective. A common practice observed in most of the TVET institutions under study was the trainer asking the trainees to return equipment

after the session without confirming. However, interviews with some HODs contradicted the above information. But from observation, it seemed like the HODs were not aware of what was happening exactly in the labs.

Acquisition of Modern Electronic Laboratory Equipment

From Table 3, a majority of the trainees, indicated that acquisition of new equipment is rare while a majority of the trainers, indicated that acquisition of modern electronic laboratory equipment is somehow frequent.

Table 3: How frequently modern electronic laboratory equipment was acquired

	Trainees		Trainers	
	Frequency	**Percent**	**Frequency**	**Percent**
Rarely	135	53.6	15	42.9
Somehow frequent	90	35.7	16	45.7
Frequently	24	9.5	2	5.7
Very frequently	3	1.2	2	5.7
Total	**252**	**100**	**35**	**100**

Source: **Questionnaire data (2020)**

Findings of FGD, observation, and interview revealed that many TVET institutions did not have plans for regular acquiring of modern equipment or replacing old ones except for one institution where they had a procurement plan yearly. In the event they are bought, they were not enough to serve the number of students admitted. Respondents also indicated that sometimes equipment was bought that was not in line with the syllabus requirements. This is because, at times, management proceeded to buy equipment without involving the trainers. These findings agree with the findings of Ogbuanya and Okoli (2014) where researchers found out that the acquisition of modern equipment was a challenge to most TVET institutions which the authors attributed to a lack of funds available for the purchase of new equipment.

Repair and Maintenance of Electronic Laboratory Equipment

Regarding the repair and maintenance of electronic laboratory equipment, it was apparent that the equipment was rarely repaired and maintained. This was evident from the responses of the trainees and trainers presented in Figure 2. Data reveals that equipment was rarely repaired and maintained.

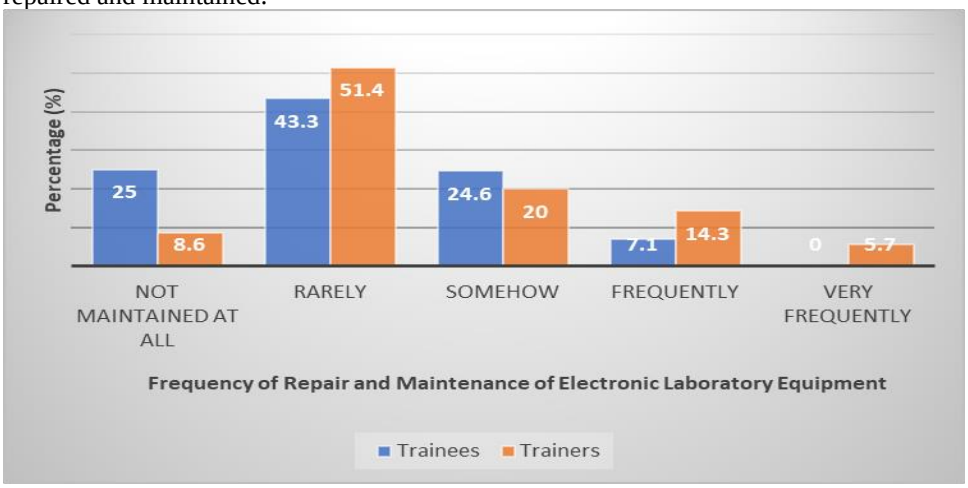

Figure 2: How frequently electronic laboratory equipment was repaired/maintained

FGD, observation, and interview revealed that equipment was rarely repaired. Many institutions visited had unrepaired heaps of equipment within the laboratory space hence reducing the space available. This also signifies that maintenance was rarely or not done at all when the equipment breaks. Respondents further revealed that repairs and maintenance were difficult because of the unavailability of spare parts. Also, the process of obtaining money in many institutions for repair and maintenance took a long time to be released. They indicated also that there was a lack of maintenance schedule, and staff to maintain the equipment. These findings agreed with Kemevor and Kassah (2015) who found that in most TVET institutions, infrastructure and training facilities were in a deplorable state which affected the acquisition of the relevant skills for the world of work.

Management and Utilization of Equipment for Skill Acquisition

Table 4 shows the responses of trainees and trainers on how the equipment was managed and utilized for skill acquisition. Both groups viewed the management and utilization of equipment, tools, and materials as moderately effective.

Table 4: Management and utilization of equipment for skill acquisition

	Trainees		**Trainers**	
	Frequency	**Percent**	**Frequency**	**Percent**
Not effective	20	7.9	2	5.7
Somehow effective	57	22.6	1	2.9
Moderately effective	133	52.8	16	45.7
Very effective	41	16.3	12	34.3
Highly effective	1	0.4	4	11.4
Total	**252**	**100.0**	**35**	**100.0**

Source: **Questionnaire data (2020)**

FGD, observation, and interview with respondents indicated that management and utilization of laboratory equipment were not proper because institutions lacked laboratory technicians who have direct responsibility for managing the laboratory resources. Most laboratories seemed not conducive to practice as they were dusty, dark, unventilated, and unorganized. Other observations were: dismantled sockets with exposed live wires in some places, old training kits and substandard facilities some storing mal-functional gadgets, equipment, and tools, evidence of improper management and utilization and a don't care attitude. This showed ineffective management and utilization of equipment, tools, and materials for skill acquisition.

Rating of Trainees' Level of Skill Attained on Various Electronic Tasks

Trainees and trainers were asked to rate the trainee level of skill attainment on a scale of 1-5, where 1 was very low and 5 very high. The data was keyed into SPSS computer software for analysis. Mean responses of trainees' and trainers' responses on the level of skill attained on various electronic tasks were computed as shown in table 5. The decision (D) on how the trainees and trainers rated trainees' skill attainment on the ability to perform various electronic tasks was given on lower and upper limits of the means as Very High 4.5 - 5.00, High 3.5 - 4.49, Moderate 2.5 - 3.49, Low 1.5 - 2.49 and Very Low 0.5 - 1.49. From table 5, the trainees rated most tasks as low low-skilled the trainers rated them as moderate. These results reveal that the trainees are not confident with the skills they have attained this far. Hence trainers need to do much to help trainees improve. However, the grand mean/standard deviation (M=2.828, SD=0.892) suggests that the skill attained in various areas were moderate.

Table 5: Mean responses of trainees and trainers on the level of skill attained on various electronic tasks.

Item No.	Area of Skill Attainment	Trainees N=252			Trainers N=35			GM	PSD	Remarks
		Mean	SD	D	Mean	SD	D			
1	Design and develop an electronic circuit	1.54	0.853	L	2.60	1.117	M	**2.072**	**0.985**	**L**
2	Read and interpret an already designed circuit	2.40	0.933	L	3.34	0.838	M	**2.874**	**0.886**	**M**
3	Identify components, materials, tools, and measuring instruments to use for the designed circuit	2.98	0.932	M	3.74	0.701	H	**3.363**	**0.816**	**M**
4	Mount the electronic circuit on a PCB, BB, and Stripboard	2.75	0.910	M	3.60	0.651	H	**3.173**	**0.780**	**M**
5	Connect measuring instruments to the circuit	2.62	0.831	M	3.06	0.906	M	**2.840**	**0.868**	**M**
6	Set measuring instruments to the required value	2.47	1.008	L	2.77	0.877	M	**2.622**	**0.942**	**M**
7	Use the instruments to measure the required values and waveforms	2.22	0.896	L	2.97	0.954	M	**2.597**	**0.925**	**M**
8	Read and record the required values and waveforms	2.88	1.034	M	3.69	0.758	H	**3.283**	**0.896**	**M**
9	Write a lab report	1.90	1.029	L	3.34	0.838	M	**2.624**	**0.934**	**M**
	Grand Mean/ Pull SD	**2.42**	**0.936**	**L**	**3.23**	**0.849**	**M**	2.828	0.892	**M**

NOTE: *SD=Standard Deviation, D=Decision, GM=Grand Mean, PSD=Pull Standard Deviation, M=Moderate, L=Low*

Influence of management and utilization of electronic laboratory and equipment on skill acquisition.

Spearman's rank correlation was run to determine whether there was an association between management and utilization of electronic laboratory and equipment and the skills acquired by technician trainees. The results were as presented below.

Table 6: Spearman's rho correlation between management and utilization of electronic laboratory equipment and the skills attained

		Skills Attained	Management and utilization of equipment
Skills Attained	Correlation Coefficient	1	.568**
	Sig. (2-tailed)	.	0
	N	287	287
Management and utilization of equipment	Correlation Coefficient	.568**	1
	Sig. (2-tailed)	0	.
	N	287	287

**. Correlation is significant at the 0.01 level (2-tailed).

From Table 6 it is evident that there was a strong positive relationship between management and utilization of electronic laboratory and equipment and skills attained by technician trainees TVET institutions in Nairobi $(r_s[287] = .568, p < .001)$. This association implies that there is a strong influence of the management and utilization of electronic laboratory and equipment on skill acquisition. Thus, if this was more effectively done, the level of skill acquisition could be influenced highly. Conversely, if there is poor management of electronic laboratory and equipment the level of skill acquisition will not be influenced much.

CONCLUSION AND RECOMMENDATIONS

The study concluded that management and utilization of electronic laboratory and equipment on the level of skill acquisition among technician trainees was not taken seriously. This is because TVET institutions lacked proper and adequate training laboratories and equipment. Also, the trainers were not serious as they handled training casually just for the sake. This impaired the delivery by trainers and learning of skills by the trainees. Given this conclusion, it is recommended that TVET institutions with the government's support invest in improving quality laboratory facilities and equipment by requesting funds to acquire modern equipment. The government and institutions provide a platform for trainers to improve their skills.

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Conflict of Interest

The authors declare no conflict of interest.

REFERENCES

Bakare, J., Ogbuanya, T. C., & Akintola, A. A. (2017) Assessment of practical skill training of technical college students in electrical and electronics trades in Osun State, Nigeria. *International Journal of Applied Engineering Research*, 12, 7501-7515.

Creswell, J. W. (2009). *Research design: qualitative, quantitative, and mixed methods* approach. Los Angeles. Sage.

Kailani, I. S. (2014). Assessment of Electrical/Electronic Laboratory Facilities in Technical Colleges in Kaduna State, Nigeria. *ATBU Journal of Science, Technology, and Education*, *2*(2), 38-48.

Kailani, I. S., Gyallesu, A. B., & Yaro, A. M. (2017). Obstacles to practical skill development among students in Kaduna Polytechnic, Nigeria. *International Journal of Pharmaceutical Sciences and Research*, 8(3), 1381.

Kemevor, K. A., & Kassah, J. K. (2015). Challenges of technical and vocational education and training and educational stakeholders in the Volta Region of Ghana. International Journal of Humanities Social Sciences and Education (IJHSSE) Volume, 2, 70-79.

Krivickas, R. V., & Krivickas, J. (2007). Laboratory instruction in engineering education. Global *Journal of Engineering Education*, *11*(2), 191-196.

Kumazhege, S. Z., & Egunsola, A. O. E. (2014). Technical Teachers' Perception of Factors Affecting Practical Skill Acquisition among Technical College Graduates in Adamawa State Nigeria. *Education Research International*, 3(3), 95-101.

Muijs, D. (2004). Doing quantitative research in education with SPSS. London: Sage Publications

Mutua, P. N., Kimiti, R., & Mulwa, D. (2019). The adaptability of facilities applied in competence-based education and training on the acquisition of employable skills among visually impaired learners in TVET institutions in Kenya. *International Journal of Education and Research Vol. 7 No. 9 September 2019*

Ogbuanya, T. C., & Okoli, S. T. (2014). workshop equipment and facilities as critical factors for sustainable skill acquisition through TVET in Nigeria. *JOINED 12 (2) 323, 326.*

Ogbuanya, T. C., & Oziegbunam, A. (2012). Effective management of electrical/electronic equipment in technical colleges in Anambra State. *Australian Journal of Basic and Applied Sciences*, *6*(13), 575-588.

Okolie, U. C., & Ogbaekirigwe, C. (2014). Entrepreneurship development through vocational education training: issues and roles in skills acquisition and manpower development in a developing economy. *Journal of Educational Policy and Entrepreneurial Research*, *1*(2), 151-157.

Okwelle, P. C., & Ojotule, D. I. (2018). Constraints to students' effectiveness in practical skills acquisition in technical colleges in Kogi State, Nigeria. *International Journal of Innovative Scientific & Engineering Technologies Research*, *6*(1), 1-9.

Udo, M. P. (2015). Techniques for improving practical skill acquisition in vocational business education (VBE) for sustainable development in Nigeria. *European Journal of Research and Reflection in Educational Sciences*, *3*(1): 27-34.

Watai, L. L., Brodersen, A. J., & Brophy, S. P. (2005). Designing effective electrical engineering *laboratories using challenge-based instruction that reflects engineering process.* Paper presented during the Proceedings 2005 American Society of Engineering Education Annual Conference and Exposition, ASEE'05.