ACCESSIBILITY AND UTILIZATION OF INFORMATION COMMUNICATION TECHNOLOGY INFRASTRUCTURE ON TEACHING AND LEARNING OF ENGINEERING COURSES IN POLYTECHNICS IN KENYA

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ABSTRACT

Information Communication Technology (ICT) has brought about a paradigm shift in the educational and training system by providing new alternatives to the conventional classroom teaching and learning. This paper is a report of a study that was undertaken in the year 2020 on accessibility and the utilization of ICT infrastructure in teaching and learning of Engineering courses in national polytechnics in Kenya. The study was anchored on the Technology, Organization, and Environment (TOE) model by Tornatzky and Fleischer (1990). The study employed the Mixed Methods research approach and the descriptive survey research design. Stratified, simple random sampling and purposive sampling methods were used to select a sample of 48 trainers and 12 administrators from the departments of Mechanical, Electrical and Electronic, Automotive and Civil Engineering in 3 national polytechnics in Kenya. The data was collected using questionnaires, interview and observation schedules. The findings revealed that there was limited access of internet within the institutions. The institutions lacked adequate computers that trainers could use for teaching and learning since over 80% of the trainers used their own personal computers. It was found out that 54.8% of the trainers' accessed internet through their personal phones. Most of the classrooms lacked the required equipment such as the projectors, power sockets and Wi-Fi hotspots to facilitate ICT use during the training sessions. In addition, only 40% of the classes had interactive whiteboards. The utilization of ICT for teaching and learning Engineering courses was significantly low at an average of 26% for theory lessons and 14% for practical lessons. The study concluded that there were limitations on accessibility and utilization of ICT infrastructure in teaching and learning of Engineering courses in national polytechnics in Kenya. The study informs curriculum review and implementation for Engineering courses.

Keywords: Accessibility and utilization of ICT infrastructure; Engineering courses; teaching and learning; digital technology.

INTRODUCTION

The up-and-coming of Information and Communication Technologies (ICTs) have considerably altered the mode we subsist, gain knowledge, and work, and to large extent the way we function. The twin phenomenon of globalization and innovative technology has had remarkable economic and social influence. This has shaped latest opportunities as well as contemporary challenges, if applied appropriately.

The skills divergence between the knowledge workforce and unskilled-low-knowledge workforce has widened the gap in workplace arrangement. These transformations have created considerable challenges to Technical Vocational Education and Training (TVET) and brought about new opportunities for transformative innovation in this new situation where human capital has become the most critical element in achieving a competitive advantage. TVET in which engineering is a segment part can now aim to reach its full potential, as enhanced by the application of ICT.

The availability of ICT infrastructure influences the adoption and integration of ICT in teaching and learning. A study conducted by Yildirim (2007) concluded that the access by trainers to ICT resources is one effective way of enhancing pedagogical use of technology in teaching and learning. ICT provides teaching tools that are more effective in the learning process on the basis of virtual platform. Virtual laboratories aid the trainees when they are carrying out practical activities. According to UNESCO (2000), virtual laboratories are defined as a workplace for remote collaboration and experimentation aimed at doing similar activities, reporting and disseminating the results. The application of computer and its software in teaching and learning allows the trainees to collaborate. It also provides an opportunity to set up virtual laboratories to display the outcome of experiments and also to learn complex procedures.

Information Communication Technology infrastructure is equipment meant to transmit or maneuver information or diversity processes and these requires computer and its accessories.

The introduction of this interactive technology has brought about a paradigm shift in pedagogy making it constructivist and collaborative. According to Kotsik (2009) the 21st century studies on integration of ICT into TVET could be realized if focus is on-strategic readiness, the robust between ICTs and current teaching and learning practice, and the availability of ICT based infrastructure. ICT integration in TVET complements the traditional knowledge transfer in engineering and science courses as it provides a means of simulating the processes or analyzing the sections. This offers trainees individual learning which is capable of providing instantaneous practical learning experiences comparable to real life situations. ICT integration or instructional technology refers to the use of electronic technology and media to deliver support and enhance teaching, learning and assessment. The working party of researchers Smith et al (2006) noted that the preparation of electronic notes for classroom use is difficult, time consuming plus the required skills are tactful and hard to learn. The researchers concluded that the use of interactive boards enhance whole class teaching, less group work and a faster base but reduced student responses.

According to Gupta (2002) e-learning has found application in engineering education in the delivery of hands-on activities. In this approach the environment is flexible and allows the development of course content by trainers into e-content, giving both the trainer and the trainees an opportunity to upload and download course material (interaction). The course material dealing with practical (hands-on) activities such as machining, processing and many more may be simulated for better understanding.

The use of interactive media in engineering training according to Karahoca et al (2010) has alleviated the shortage of staff and training content in the world of teaching and learning.

However, this success is only possible when trainee's computer literacy and infrastructure is adequate and up to date. The challenges of implementation of ICT can be categorized into three broad groups: insufficient infrastructure; the unavailability of power and internet connectivity as was identified by Kozma et al., (2004), the cost of initial investment and maintenance of the facilities as observed by Osin (1998) and discernment of the security of the equipment as observed by Unwin (2005). The main challenges in the adoption of ICT integration in TVET training range from the digital divide, infrastructure development, acquisition of ICT equipment, provision of software and internet connectivity to the development of policies for the utilization of equipment in teaching and learning.

PROBLEM STATEMENT

ICT has transformed the world into a technological village and Kenya as a developing country would need to keep the pace. The integration of ICT in teaching and learning of engineering courses would enhance quality education to facilitate knowledge acquisition, thus, matching the skills of the graduates with industry requirements. Saud et al (2011) highly recommended that ICT be used to promote the development of employability skills for TVET graduates. ICT provides opportunities for developing more innovative ways to span the interlude between institutional laboratories and industry practice (UNESCO, 2003). For institutions to fully integrate ICT in teaching and learning the ICT infrastructure must be accessible and the trainers must fully utilize the ICT infrastructure for quality outcomes. This study investigated the accessibility and the utilization of ICT infrastructure in teaching and learning of engineering courses in national polytechnics in Kenya.

RESEARCH OBJECTIVE

The research objective for the study delved on accessibility and the utilization of ICT infrastructure in teaching and learning of engineering courses in national polytechnics in Kenya.

THEORETICAL FRAMEWORK

The study was anchored on the constructivist learning theory and the Technology, Organization, and Environment (TOE) model by Tornatzky and Fleischer (1990). The TOE model identifies three aspects of institution's context that influence the process by which it adopts and implements a technological innovation. The TOE models emphasizes that integration of ICT is influenced by individual characteristics, both the internal and external characteristics of the organization, and the technological context which focuses on technological practices and equipment, as drivers for organizational innovativeness. Nevertheless, TOE framework additionally has a new and significant component, environment perspective. The environment context puts forward both opportunities and constraints that the institution faces as it integrates ICT; such as infrastructure and technological modernization.

RESEARCH METHODOLOGY

This study used a Mixed Method research approach which is an integration of quantitative and qualitative research. This approach provides a deeper and broader understanding of the phenomenon and ensures that study findings are grounded in participants' experience, making it suitable for this study. This is further supported by the claim that no single research methodology is essentially better than the other methodology; a combination of research methods has been

recommended in order to improve the quality of research as was observed by Benbasat et al, (1987), and Kaplan & Duchon (1988). The study adopted the descriptive survey research design

This study applied purposive sampling to select the three (3) national polytechnics in Kenya based on their geographical location, year of existence and size in terms of infrastructure and student population. According to Amin (2003) purposive sampling method is a technique used to select sample cases that have the required information with respect to the objectives of study and was beached by Orodho and Kombo, (2002) by stating that purposive sampling as the best way where the research purposely targets a group of people believed to be reliable for the study to obtain a representative sample.

The target population comprised of 60 institutional administrators and trainers in Mechanical, Electrical and Electronic, Automotive and Civil Engineering departments. A sample of 48 trainers was selected by stratified and simple random sampling methods. 12 managers were selected through purposive sampling technique. The data was collected using questionnaires, interview and observation schedule. Descriptive and inferential statistics were used to analyze the quantitative data and the qualitative data after organization and theme categorization were analyzed using both narrative and discourse techniques.

RESULTS AND DISCUSSION

This section presents the findings and discussions of the study on accessibility and utilization of ICT infrastructure for teaching and learning of Engineering courses in national polytechnics in Kenya.

Findings from the Questionnaires

The trainers were asked to identify where they normally accessed internet connectivity for preparation of teaching and learning materials. The findings indicated that most of the trainers could only access computers in the staffroom or the computer laboratory. The rest of the trainers opted to use their personal laptops.

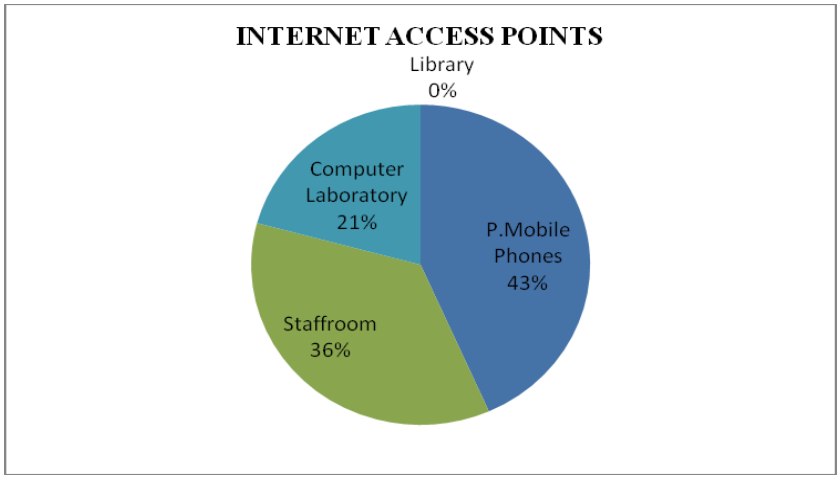

Figure 1: Pie Chart showing where internet is accessible and the capacity

The trainers accessed internet while within the precinct of the institution. The results showed that 43.4% of the trainers' accessed internet through their phones while 35.8% accessed it from the staffroom and 20.8% accessed it from the computer laboratory. It can be summarized from the results that a small numbers of trainers used institution infrastructure to access internet which implied that the national polytechnics had inadequate internet infrastructure. This inadequacy could be in terms of low internet bandwidth thus limiting the internet connectivity forcing the trainers to use their personal mobile phones.

The trainers were asked where they normally accessed computers for lesson preparation within the institution. The findings indicated that the trainers found it very challenging to access computers and had resorted to using their personal computers as the few computers available were in the computer labs.

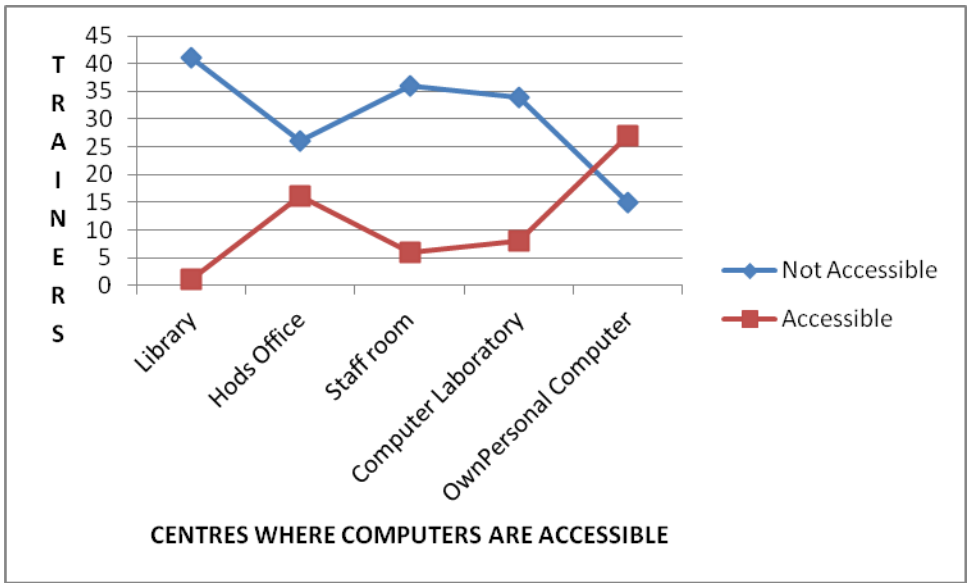

Figure 2: Locations where trainers access computers

The high percentage of trainers utilizing their personal computers was an indication that national polytechnics have inadequate number of computers that the trainers can use for the purpose of teaching and learning engineering courses.

The trainers were asked to select on how they utilized ICT infrastructure in their teaching and learning process. The options provided was whether they use infrastructure for planning, data keeping or teaching theory lessons or practical lessons. The findings are shown in Figure 3.

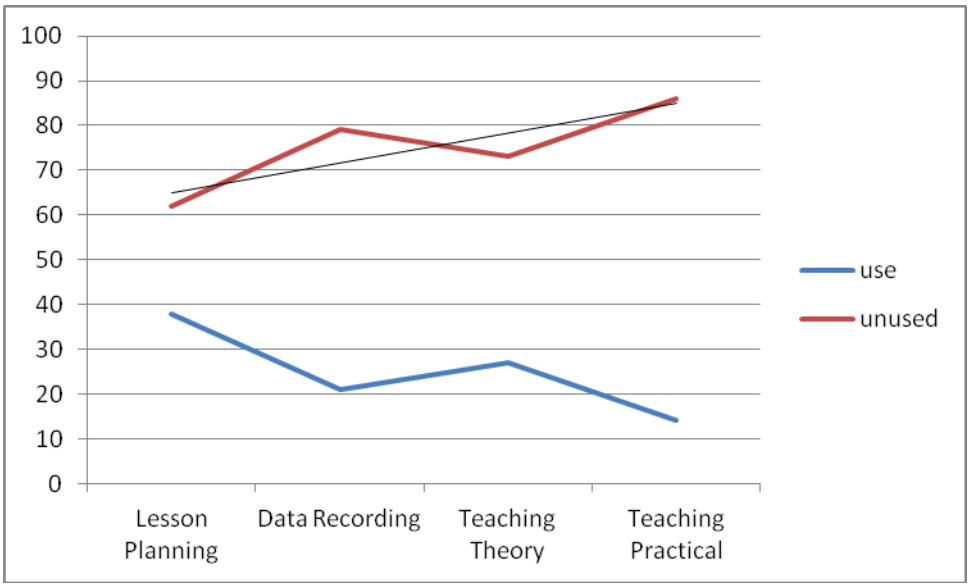

Figure 3: Various ways trainers utilized ICT in teaching and learning activities

Figure 3 shows results obtained of various ways trainers utilized ICT in teaching and learning activities. The respondents indicated that 26% were using ICT for theory lessons, 14% for teaching practical lessons, 21% for data record keeping and 38% for lesson preparation. This was an indicator of low utilization of ICT in teaching and learning in the national polytechnics. According to Galbreath (2000) the use of ICT improved quality in teaching and learning in tertiary institutions. Tasir et al (2012) observed that some level of ICT competency and confidence encouraged and motivated trainers to apply the knowledge and skills in lesson preparations, slides preparation and searching the internet. The outcome of this study depicted generally low impact of ICT integration on its application towards the implementation of TVET curriculum. The national polytechnics have not fully embraced the idea by Abuhmaid (2011) that through integration of ICT in teaching and learning, the challenges of globalization and the knowledge base economy in the world are tackled.

Findings from observations

The researcher observed 18 different lessons in engineering instruction rooms and that 10 of these observed lessons, representing 56% were carried out in the computer laboratories. The laboratories where the lessons were observed had desktop computers, printer, interactive whiteboard and software relevant to the lessons being conducted and 40 % of these lessons were purely on computer basic skills and trainers were not using the media to teach engineering concepts or skills, neither presentation of simulations nor audio visuals. There was only one workshop that was being utilized for ICT. In this particular workshop, the trainer was using an overhead projector for demonstration of a concept. The study found out that there were inadequate numbers of computers to accommodate the huge number of trainees within a given lesson.

Findings from interviews

The interviews conducted with the administrators revealed that engineering departments within the institution had an average of one computer laboratory that was being shared among them. It was also observed that most of the ICT tools could only be accessed while inside the computer

laboratories. This presented the challenge of accessing these tools an indication that learning was only confined within the computer laboratory. The lecture rooms had non-functional sockets due to vandalism. This was an indication that the lecture rooms did not have sufficient physical security.

The administrators were asked the availability ICT infrastructure for teaching and learning and the findings were that the provision of computer laboratories was for purposes of training students on the basic computer operations and were not to be used for teaching and learning. A question was posed concerning the provision of ICT infrastructure for teaching and learning and the outcome were that the special equipment was provided for demonstration on the capacity of technology and reserved for use by those who were conversant with the technology; the most knowledgeable and skillful in ICT. The administrators had no plans to equip the institutions with ICT resources for teaching and learning.

CONCLUSIONS AND RECOMMENDATIONS

The study concluded that there were limitations on accessibility and utilization of ICT infrastructure in teaching and learning of engineering courses in national polytechnics in Kenya. The study recommended that for national polytechnics to effectively integrate ICT in teaching and learning needs to design highly structured plans to enhance ICT infrastructure; provide media equipment, reliable, efficient internet connectivity and expansive to accommodate the massive users.

The study also recommended that there was need for national polytechnics to invest in ICT infrastructure for integration in teaching and learning of Engineering courses. These interventions would enhance the access of ICT infrastructure to both trainers and trainees hence increase the rate of ICT integration in teaching and learning in national polytechnics. Emphasis should be on resource mobilization, role modelling, mentorship, planning, organization, co-ordination and supervision. The trainers should be trained on ICT integration in teaching and learning and be motivated to be innovative. This would translate to quality manpower for the job market not only locally but also internationally.

REFERENCES

Abuhmaid, A. (2011). *ICT training courses for teachers professional development in Jordan.* Turkish Online Journal of Educational Technology-TOJET, 10(4), 195-210.ERICNumber:EJ946628. Retrieved September, 2019.

Amin, S. (2003). *An effective use of ICT for education and learning by drawing on worldwide knowledge, research and experience*. ICT as a change agent for education. Department of Education, University of Kashmir.

Benbasat, I., Goldstein, D. K., & Mead, M (1987). *The case research strategy in studies of information system.* MIS QUARTERLY, 11, 369-386 .http://dx.doi.org/10.2307/248684.Galbreath, J. (2000). *Knowledge management technology in education: An overview. Education Technology*, 40(5), 28-33. Information Technology underused in Education. Retrieved January 3rd ,2017 .

Gupta, A. (2002). *Content development for elearning in Engineering education.* Interactive *Educational Multimedia*, number 4, pp. 12-23.

Karahoca K. D., Duldaa, I., Karahocaa, A., Yücela, A., Gulluoglua, B., and Arifoglua, E. (2010). *Interactive E-content development for vocational and technical education*. Procedia Social and Behavioral Sciences 2 (2010) 5842–5849. Available: www.sciencedirect.com

Kaplan, B. & Duchon, D. (1988). *Combining qualitative and qualitative methods in information systems research:* A case study. Retrieved from https://www.researchgate.net/publication/236144008_combining_qualitative+and-Quantitative_Methods_In_Information_Systems_Reaerch_A_Case_Study. Retrieved on 20th May, 2018.

Kotsik, B. (2009). *ICT application in TVET*. In R. Maclean, & D, Wilson, (eds). International handbook of education for the changing world of work: Springer science plus Business media BV, pp. 1863-1877

Kozma, R., McGhee, R., Quellmalz, E., & Zalles, D. (2004). *Closing the digital divide: Evaluation of the world links program.* International Journal of Educational Development. *25*(4), 361-381.

Orodho, A. & Kombo, D. (2002). *Research methods.* Nairobi: Kenyatta University, Institute of open learning

Osin, L (1998) *Computers in Education in the Developing countries*. Retrieved from: http://www,semanticscholar.org

Saud, M. S., Shu'aibu, B., Yahaya, N., Yasin, M. A. (2011). *Effective integration of Information and Communication Technologies (ICTs) in Technical,Vocational Education And Training (TVET) toward knowledge management in the changing world of work.* African Journal of Business Management 5(16): 6668-6673.

Smith, H., & Higgins S., (2006). *Opening classroom interactions: The importance of feedback* Cambridge Journal Education, Vol. 36. No. 6 pp. 485-502. Routledge.

Tasir, Z., Abour, K. M. E. A., Halim, N. D. A., & Harun, J. (2012). *Relationship between Teachers' ICT competency, confidence level, and satisfaction toward ICT training programmes*: A case study among postgraduate students. Turkish Online journal of education technology, 11(1), 138-144. ERIC NUMBER EJ976576

Tornatzky, L. & Fleischer, M. (1990). *The process of technology innovation*, Lexington, MA, Lexington Books.

UNESCO (2000). *Report of the expert meeting on virtual laboratories*. UNESCO, Paris. Retrieved on August 1, 2018, Available from: http://unesdoc.unesco.org

UNESCO (2003): Capacity-building for teacher training institutions in Sub-Saharan Africa: Situational Analysis and proposals for action. Paris: UNESCO.

Unwin, T. (2005). *Towards a framework for the use of ICT in teacher training in Africa.* Open Learning: The Journal of Open and Distance Learning. *20*(2), 113-129.

Yildirim, S. (2007). *Factors affecting instructional leader' perception towards education media*. Retrieved from: http//books.google.co.ke