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# Influence of Infrastructure on Implementation of E-Learning in Technical Vocational Education and Training Institutions in Uasin Gishu County, Kenya

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## Abstract

Worldwide e-learning has emerged as a leading channel of learning but its implementation in Kenya has not been successful. Studies have noted infrastructural challenges in implementation of e-learning, an aspect the present study sought to address. The study determined infrastructural factors that influence implementation of e-learning in TVET institutions in Uasin Gishu County. The study established the extent to which the following factors affect the effective implementation: the availability of good bandwidth; quick response time in uploading and retrieving content; fast processors; high performance features on the servers; accessibility of learning management system and the availability of electronic learning equipment. The study was guided by Roger's theory of Diffusion of innovation and adopted an explanatory research design with a target population of 94 electrical and electronic engineering trainers and 6 HoDs of electrical and electronic engineering departments from public TVET institutions from Uasin Gishu County. Data was collected by use of questionnaire, observation and interview schedule. The piloting of the tools was done in Kitale National Polytechnic to test for reliability and validity. Quantitative data was analyzed by use of both inferential and descriptive statistics using SPSS version 25 while qualitative data using themes and sub-themes. The inferential statistics used included: simple and multiple regression, Pearson's correlation and Analysis of Variance (ANOVA) while descriptive statistics included mean, standard deviation and frequencies. From the findings, the coefficient of determination (R square) of .449 indicated that the model explained only 44.9% of the variation or change in implementation of e-learning. The study findings indicate that infrastructure ($t = 2.589$, $P < .05$), significantly influence the implementation of e-learning in TVET institutions in Uasin Gishu County and it is therefore important for TVET institutions to consider strengthening the infrastructure requirements for e-learning.

**Keywords:** Infrastructure, implementation, e-learning.



## INTRODUCTION

The advancement in digital technologies has influenced the transformation and growth of Technical and Vocational Education and Training institutions (TVET) globally (Latchem, 2017). This can be credited to information, communication, and technology (ICT), which encourages creativity and innovation providing new chances for boosting learning in education and training making it more flexible, approachable, and gratifying. Despite the benefits of embracing e-learning, its implementation and delivery have not been smooth as it has had to overcome a number of national, organizational, technological, and social issues that jeopardize the success of its execution (Kibuku, Ochieng & Wausi, 2020). Darby (2020) argues that despite the effort and expense made, teachers and staff rarely use technology and e-learning systems in the envisioned way since they are frequently underutilized hence leaving the stakeholders discontented with implementation of e-learning initiatives in higher learning institutions and TVET institutions.

According to Rajput (2019), e-learning is the expression broadly used to describe instructional content or learning experience delivered or enabled by electronic technologies. E-learning is also defined as the utilization of electronic technologies to access educational curriculum outside of a traditional classroom

(Turkyilmaz, Hariri & Jahangiri, 2019), and includes sharing knowledge through various channels such as e-books, CDs, webinars and more. It has revolutionized the conventional method of chalk and board style of learning imparted to the students. It embraces use of computers, mobile phones, computer networks, internet connections, and other less expensive methods of connection to send learning instructions to students who are located in remote places from a central site. E-learning plays an important role in offering of quality education and improvement in enrolment of students in various courses and programmes (Reich, *et al*., 2020), hence important for TVET institutions to adopt. Through e-learning, the transfer of skills and knowledge is done simultaneously and at different periods to the learners. According to Karmakar (2000) e-learning creates opportunities for organizations in the following ways: save time, cost, and effort; satisfy educational needs from remote areas; provide self-learning opportunities that have a positive impact on the learning process and provide a mechanism for collaborative learning. On the contrary, traditional modes of delivery are restrictive in accessibility of learning resources by the students.

According to Tarus, Gichoya and Muumbo (2015) developing one complete e-learning course requires a longer period of time as well as resources such as computers and reliable internet connectivity affecting e-learning implementation. In addition to successfully use technology in classes, students and teachers need to possess a positive attitude to the use of technology, E-learning skills, relevant e-content, operational e-learning policies, affordable and adequate Internet bandwidth, ICT and e-learning infrastructure are critical components necessary for successful implementation of e-learning. To achieve successful implementation of e-learning, the institutions have to invest financially and technologically in strategies that improve the quality of learning. As the world adopts new technologies at a fast rate, e-learning implementation is expanding at an unprecedented rate in all parts of the world (Ali, 2020). In the US, online enrolments have continued to grow at rates far in excess of the total higher education student population, same applies to Korea, Malaysia, and Denmark that have recorded significant increases in adoption of e-learning (Haleman & Yamat, 2021). According to Rytkonen and Rasmussen, (2010), UC/LIFE is one of Denmark's top e-learning universities with approximately 95% of the teachers using ICT to communicate with their students and to plan their teaching. Majority of TVET institutions in developing nations still use traditional teaching and learning delivery techniques that need both the learner and the teacher to be physically present in the classroom (Obwoge & Kwamboka, 2016), with the learner merely a recipient of the information while the teacher primarily the source. A dynamic educational and working environment requires deviation from the norm and improvement in the use of internet in teaching and learning which is largely limited in TVET classes.

Infrastructure is the most important aspect which influences e-Learning performance. Technical infrastructure and social infrastructure are in lower levels of importance (Keramati, Afshari-Mofrad, Amir-Ashayeri & Nili, 2011). Organizational features, ICT infrastructures, ICT availability and security are also critical issues for e-readiness assessment. Studies have considered infrastructure such as technology dimension and design dimension as an independent variable which affects e-Learning performance directly (Sun, Tsai, Finger, Chen & Yeh, 2008.

Based on previous studies and authors' experiences, infrastructures are grouped into three groups. These include: Technical, Organizational and Social (Keramati, Afshari-Mofrad, Amir-Ashayeri & Nili, 2011). Mwangi (2017) investigated ICT infrastructure preparedness for e-learning implementation in Kenyan universities and revealed that inadequate ICT infrastructure was a major challenge hindering the implementation of e-learning in Kenyan universities. The study recommended the need for enhancement of e-learning infrastructure to enable reliable access to the e-learning system by students and lecturers.

The present study findings are useful for decision making in TVETs in Kenya. The government and other stakeholders can come up with strategies and mechanisms that can enhance successful rollout for ICT infrastructure for e-learning implementation and provision of a platform through which Kenya can transform into a knowledge economy hence boosting its productivity and competitiveness in the constantly changing global market. The study used Rogers' Theory of Diffusion of Innovation to examine the relationship between factors influencing the implementation of e-learning in teaching electrical and electronics engineering courses at TVET institutes. Diffusion of Innovation (DOI) Theory, developed by E.M. Rogers in 1962 (Miller, 2015) is a theory that seeks to explain how, why, and at what rate new ideas and technology spread. According to Rogers, diffusion is the process through which an innovation is disseminated over time among the members of a social system (García-Avilés, 2020). Rogers' diffusion of innovations theory is the most appropriate for investigating the adoption of technology in educational environments (Celik, Sahin, & Aydin, 2014).

Kenya can reorient itself toward sustainable development, by adopting TVET as a tool for socioeconomic and technological change (Njeru & Mugi, 2018). The adoption of e-learning systems in delivering content to a wide variety of students is necessary given the unprecedented rate of growth in TVET enrollment and encourages teamwork, activity, and lifelong learning (Khan, Hasan, & Clement, 2012). Compared to occupational hands-on skills, ICT implementation among TVET students is more effective

in fostering cognitive learning hence there is a need for its adoption in educational institutions to change their environments to accommodate shifting educational trends and workplace expectation (Obwoge & Kwamboka, 2016). However, some educational institutions favor traditional methods of instruction over integrating ICT into the classroom. TVET places a strong emphasis on practical skills and work preparedness, which makes online learning difficult, especially for professions where hands-on experience is a poor alternative for classroom instruction (Munyi, Okinda & Wambua, 2021). Besides, extensive studies have been done on the shortcomings of e-learning in education and learners concurrently, but its implementation in TVET institutions remains indecisive. Correspondingly, researchers like Bolliger and Martin (2018) discovered that e-learning negatively impacted students' learning experiences. Therefore, the study assessed the influence of infrastructure on implementation of e-learning in TVET institutions in Uasin Gishu County.

## METHODOLOGY

The study employed an explanatory research design with a target population of all trainers in electrical and electronic engineering in all public TVET institutions. The accessible population was 94 trainers and 6 HoDs of electrical and electronic engineering from 6 public TVET institutions in Uasin Gishu County.

**Table 1: Target Population**

| Institution | Target Population |
|---|---|
| Eldoret National Polytechnic | 29 |
| Rift valley Technical Training Institute (RVTTI) | 28 |
| Kipkabus Technical | 12 |
| Koshin Technical | 9 |
| Ziwa Technical | 9 |
| Turbo Technical | 7 |
| **Total** | 94 |

The study adopted census inquiry technique that involves enumeration of all items in a population, which must be consistently defined for the purpose of study (Mugenda and Mugenda, 2012). A total of 94 trainers of electrical and electronic engineering and 6 HODs of electrical and electronic engineering department from 6 TVET institutions in Uasin Gishu County who had in-depth knowledge of factors that influence the effective implementation of e-learning in teaching electrical engineering courses in Technical and Vocational Education Training Institutions. Data was analyzed using inferential statistical analysis, which entailed organizing data for description and decision-making. The study used correlation and regression analysis in inferential statistics. Results from correlation and regression analysis was presented by use of tables. The multiple linear regression models were as follows:

$$y = \beta_0 + \beta_1 X_1 + \varepsilon \quad \text{..... Equation 3.1}$$

Where Y is implementation of e-learning, dependent variable X represented factors, $\beta_1$ is the unstandardized regression coefficient.

$\beta_0$ Represents the y intercept
Y Represents implementation of e-learning
$X_1$ Represents top management support
$\varepsilon$ Represents error term

## RESULTS AND DISCUSSION

### Descriptive Statistics of Infrastructure

Eight questionnaire items were used to examine the prevailing status of infrastructure in implementation of e-learning in TVET institutions in Uasin Gishu County.

**Table 2: Results of Descriptive Analysis of Infrastructure**

| Statements | SD | D | UD | A | SA | Mean | Std. Deviation |
|---|---|---|---|---|---|---|---|
| E-Learning courses are seamlessly accessed by students because of a good bandwidth | 3.4 | 42.5 | 4.6 | 25.3 | 24.1 | 3.24 | 1.320 |
| There is a quick response time in uploading and retrieving content | 10.3 | 24.1 | 0.0 | 49.4 | 16.1 | 3.37 | 1.295 |
| Fast processing requests are facilitated by available core processors | 2.3 | 19.5 | 8.0 | 46.0 | 24.1 | 3.70 | 1.111 |
| There is high performance feature for learning based on the servers | 3.4 | 42.5 | 4.6 | 25.3 | 24.1 | 3.24 | 1.320 |
| The learning Management System platform can be effectively accessed | 10.3 | 24.1 | 0.0 | 49.4 | 16.1 | 3.37 | 1.295 |
| Knowledge sharing and interaction is promoted by the available e-learning tools | 0.0 | 0.0 | 11.5 | 37.9 | 50.6 | 4.39 | .688 |
| Electronic learning equipment provided by the institution are sufficient | 2.3 | 18.4 | 8.0 | 47.1 | 24.1 | 3.72 | 1.096 |
| Uninterruptible Power Supply (UPS) is available | 10.3 | 24.1 | 0.0 | 49.4 | 16.1 | 3.37 | 1.295 |
| **AVERAGE MEAN** | | | | | | **3.55** | **0.849** |

**Source: Field data, 2022**

The general perception of the trainers of electrical and electronic engineering is that there is infrastructure for the implementation of e-learning in TVET institutions in Uasin Gishu County based on the overall of (Mean=3.55; SD=0.849). Despite this, there is a need for provision of more efficient and effective infrastructure for the implementation of e-learning. The study findings concur with Nyongesa, Mabele, and Murunga (2022) who noted that there is need for improvement of digital infrastructure in TVET institutions to promote e-learning and Bastola, Ameenb, and Isaacc, (2019) who established that digital infrastructure is very critical in implementation of effective e-learning.

**Descriptive Statistics for Implementation of E-Learning in TVET institutions**

Six questionnaire items were used to examine the prevailing status of Implementation of E-learning in TVET institutions in Uasin Gishu County.

**Table 3: Results for Descriptive Analysis of Implementation of e-Learning in TVET institutions**

| Statements | SD | D | UD | A | SA | Mean | Std. Deviation |
|---|---|---|---|---|---|---|---|
| Data of electronic teaching materials are used to build most of the lessons | 0.0 | 2.3 | 29.9 | 59.8 | 8.0 | 3.74 | .637 |
| I always use e-teaching | 2.3 | 36.8 | 11.5 | 31.0 | 18.4 | 3.26 | 1.205 |
| Newly acquired knowledge online is effectively applied | 4.6 | 9.2 | 29.9 | 40.2 | 16.1 | 3.54 | 1.021 |
| Specific tasks as learnt through e-platforms are performed by learners | 3.4 | 6.9 | 57.5 | 29.9 | 2.3 | 3.21 | .749 |
| Learners are engaged with the learning material during the learning process | 0.0 | 36.8 | 13.8 | 31.0 | 18.4 | 3.31 | 1.154 |
| The platforms are easy to use | 10.3 | 25.3 | 0.0 | 48.3 | 16.1 | 3.34 | 1.301 |
| **AVERAGE MEAN** | | | | | | **3.40** | **.631** |

**Source: Field data, 2022**

The general perception of the respondents is that there is implementation of e-learning (M=3.40 SD=.631). This is an index of effective application of e-learning in electrical engineering if the majority of the trainers find it easy to use.

**Table 4: Influence of institutional management support on implementation of e-learning in TVET institutions**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 1 | .670[a] | .449 | .442 | .471 | 1.597 |

a. Predictors: (Constant), Infrastructure
b. Dependent Variable: Implementation of e-learning

The coefficient of determination (R square) of 0.449 indicated that the model explained only 44.9 % of the variation or change in the dependent variable with the remainder of 55.1 % explained by other factors other than infrastructure. Adjustment of the R square did not change the results substantially, having reduced the explanatory behavior of infrastructure on implementation of e-learning to 44.2%.

**Table 5: ANOVA**

| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 15.373 | 1 | 15.373 | 69.252 | .000[b] |
| | Residual | 18.869 | 85 | .222 | | |
| | Total | 34.242 | 86 | | | |

a. Dependent Variable: Implementation of e-learning
b. Predictors: (Constant), Infrastructure

Results shown in Table 5 reveal that the F-statistic was highly significant (F= 69.252 p<0.05), this shows that the model was valid. The model significantly improved the ability to predict implementation of e-learning. The regression model as a whole was useful in explaining the ability of infrastructure to predict the implementation of e-learning.

**Table 6: Regression Coefficients of Implementation of e-learning as explained by Infrastructure**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Tolerance | VIF |
| 1 | (Constant) | 1.925 | .180 | | 10.683 | .000 | | |
| | Infrastructure | .533 | .046 | .691 | 11.705 | .000 | 1.000 | 1.000 |

a. Dependent Variable: Implementation of e-learning

Table 6 shows the estimates of β values and gives an individual contribution of a predictor to the model. The β value shows the relationship between implementation of e-learning with the predictor. The positive β value indicates a positive relationship between the predictors and the outcome. The β value for Implementation of e-learning (.691) was positive. The positive β values indicate the direction of relationship between predictor and outcome. From the results (Table 4.18) the model was then specified as: -

**$y= \beta_1 X_1+\varepsilon$…… Equation 4.2**

**Implementation of e-learning** = .670 Infrastructure + $\varepsilon$

From Table 6, the coefficient of the variable indicates the amount of change one could expect in implementation of e-learning given a one-unit change in infrastructure based on the standardized coefficients. Result reveals standardized regression coefficient for infrastructure (β=0.670), implies that an increase of 1 standard deviation in infrastructure is likely to result in 0.670 standard deviations increase in implementation of e-learning. T-test was used to identify whether the predictor was making a significant contribution to the model. When the t-test associated with β value is significant then the predictor is making a significant contribution to the model. The results show that infrastructure is (t =8.322, P<.05). In this regard the research question was answered that infrastructure significantly influences implementation of e-learning in TVET institutions in Uasin Gishu County.

These findings are supported by Mulwa and Kyalo, (2011), Keramati *et al*., (2011), Mwangi (2017); Kiget, Wanyembi and Peters (2014) who established a positive and significant influence on implementation of e-learning in teaching electrical and electronic engineering. The findings are based on the diffusion of Innovation theory because adoption of technology for e-learning by TVET institutions would be optimal and enhanced through infrastructure to positively impact on teaching electrical and electronic engineering. The e-learning infrastructure includes Learning Management System (LMS), electronic devices, communication applications, and internet accessibility (Garad, Al-Ansi, & Qamari, 2021). Effective e-learning infrastructure allows students and lecturers to interact quickly and easily for effective learning. Infrastructure (connectivity, sources of energy and e-equipment) have a significant influence on readiness to adopt e-learning (Mulwa & Kyalo, 2011). However, descriptive analysis indicates that the respondents were undecided on the goodness of the bandwidth to help users' access e-Learning courses seamlessly and performance of servers for learning, calling for improvement of the adequacy of infrastructure for effective implementation of e-learning in electrical and electronic engineering.

## CONCLUSION

Infrastructure has a positive and significant influence on implementation of e-learning in teaching electrical and electronics engineering.

## RECOMMENDATIONS

Based on the findings and conclusion of this study, the following recommendations are made:

i. There is need for provision of high-capacity bandwidth to sufficiently cater for the students and trainers to access e-Learning courses seamlessly.
ii. Lecture rooms where theory lessons are carried out should be made ICT compliant with adequate power sockets, projector screen and properly secured to install ICT facilities.
iii. The institutions should improve on their e-learning software and hardware requirements in terms of relevance and adequacy for effective implementation of e-learning in electrical and electronic engineering.

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