

Research Article

Impact of Integration of Modern Digital Technology Platforms in Teaching and Learning at the Technical and Vocational Education and Training (TVETs) in Kenya

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Abstract

Provision of quality education is one of the cornerstones of the United Nations' sustainable development goals. Attempts at increasing the quality of education has embraced the use of modern technologies including the technology platforms. In the 21st century, learners at the Technical and Vocational Education and Training (TVETs) need quality education, which may be enhanced by integrating modern digital technology platforms in teaching and learning. However, there is less research outputs in this realm. The aim of the study was to determine the impact of integration of modern digital technology platforms in teaching and learning at the TVETs in Kenya. The study relied on both the descriptive and explanatory research designs. The target populations were 367,925 students and 7645 tutors/trainers distributed among 2,287 registered and licensed TVETs in Kenya. A samples size of 245 students and similar number of tutors/trainers were selected in 96 TVETs. Data were collected through questionnaires. Data were analyzed using descriptive statistics and multiple linear regression model. The study established that the overall mean access to modern digital technology platforms was 42.3% for the students and 46.1% for the tutors, which suggest low access to these modern digital technology platforms. Moreover, 77.6% of the total variation in the learning outcomes was attributed to the modern digital technology platforms. The study concluded that modern digital technology platforms positively influence teaching and learning at the TVETs. The study recommends that tutors/trainers and tutors who were trained without ICT content should organize and undertake such courses in higher learning institutions to develop the requisite modern ICT competencies. Therefore, the study recommends that tutors/trainers without adequate digital platform knowledge should organize and undertake refresher courses in higher learning institutions to develop the requisite competencies. The study also recommends that digital knowledge should be integrated in all the subjects being taught at the TVET to help improve the quality of teaching and learning. The management of the institutions should also undertake necessary training in digital competencies to enhance their ability to implement the policy of ICT integration in curriculum within the institutions. In general digital technology should be adopted by all TVETs in their curriculum for Competency Based Education (CBET) learning outcomes.

Keywords

Modern Digital Technology Platforms, Technical and Vocational Education and Training (Tvet), Teaching and Learning, Academic Achievement, Kenya

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1. Introduction

In contemporary society, modern digital technology has been adopted to help humans in their day-to-day activities with an aim to help foster communication [1, 2]. In the process, modern digital technology has infiltrated every sphere of humans including the education sector [3]. In the past, teaching and learning relied on a number of traditional classroom methods of instructions which limited faster learning of new concepts, prompt evaluations, and more engagement [4]. In recent years, there is more integration of new technology-assisted learning tools such as laptops, dynamic visualisations, mobile devices, smartboards, tablets, and virtual laboratories which seem to have altered the modalities through which teaching and learning takes place [5, 6]. The adoption of these technologies has led to a digital revolution, which has permeated teaching and learning in various institutions including those of higher learning [7].

Indeed the adoption and use of modern digital technology has been hailed as key in improving the teaching as well as learning process in classrooms, transforming it from being passive to be more active, while increasing the engagement between the learner and tutors/trainers [8]. These modern technologies have been hailed as forms of learning support. The current upsurge in modern computer technology platforms has seen students use more of learning tools like Google classroom, Gamification, Youtube, Smart video, online textbooks, Chat GPT, Wikis, Google Docs, Google Scholar, Academia, Research Gate, among others which may enable students to undertake their assignments with much ease than in the past [9, 10]. There are also the platforms that allow for virtual meeting such as zoom, webex or Google-meet and video-conferencing [11, 12]. There is also ease of access to large number of instructional materials online such as audio files, photos, videos and e-books [13, 14].

These forms of modern digital technology platforms facilitate the interaction between students and tutors/trainers across the globe and making it easier for information to be easily disseminated [15]. This is a departure from the past where students would only interact with other fellow students in the same classroom as well as limited interaction with students within the same schools. In the process of using modern digital technology platforms, several advantages have been established like improvement in interpersonal communication, linkage between students and the industry through direct linkage via videoconference, many people can learn first hand first-hand information from other people thousands of kilometers away which would have been difficult in the past and, chances of getting better ways of solving problems are now emerging via these platforms [16, 17]. Moreover, it has been postulated that it is easier for tutors/trainers to transfer knowledge through the use of modern digital technology platforms into classrooms [18]. This appears to have occurred in most of the tertiary institutions such as the Technical and Vocational Education and Training (TVETs).

The TVETs confer learners with technical, professional and entrepreneurial expertise [19]. The practical proficiency and job-related behaviors for the students which can help them gain necessary proficiencies is guaranteed by a well designed and implemented TVET system. The TVET sector in Kenya currently operates university TVETs, national polytechnics, technical teacher training colleges (TTTC) and several technical training Institutes [20] coordinated by the Ministry of Education [21]. In Kenya, the technical and vocational training was structured to offer opportunities to the learners to develop attitudes and values to acquire knowledge and usable skills so that they can be more useful and productive members of the community. The student enrolment in TVETs was 367,925 as of October 2023 [22, 23]. The CBET curriculum guiding TVETs was aimed at achieving the training needs for skilled manpower after finishing secondary education in Kenya.

The CBET curriculum was considered a key area of TVET which should promote the practical use of digital learning resources; ICTs, capacity building for tutors and management of the institutions. However, the current TVET curriculum is outdated and offers little room for use of modern technology. There is also the aspect of several tutors seeing technology as distractions in the classroom and therefore resisting its adoption. Besides, there are tutors who underwent training in the traditional teaching methods devoid of any modern digital technology platforms and therefore have less competence in the uptake and use of these technologies. Therefore, while modern digital technology platforms appear good on papers, there is wide variations in their adoption and use among some TEVTs, despite their potential to affect teaching and learning. Thus, the aim of the current study was to determine the impact of integration of modern digital technology platforms in teaching and learning at the TVETs in Kenya.

2. Study Methodology

2.1. Study Area

The study was conducted in Kenya among TEVTs. By June 2023, Kenya had 2,287 registered TVETs, which are categorized as public and private institutions (<https://www.statista.com/statistics/tvet-institutions-in-kenya/>). The students enrollment in TVETs was 367,925 by October 2023. The number of tutors in these institutions stood at 7645. It is estimated that up-to 80% of the institutions use one or more forms of modern digital technology platforms [22].

2.2. Research Design

This study employed both descriptive and explanatory research designs. Descriptive research design seeks to explore, analyze and find explanations for various phenomena with a view to finding explanation about populations [24]. The de-

sign applies descriptive statistics for provision of explanation about characteristics of populations [25]. Descriptive design enables researchers to gather comprehensive data systematically, facilitating a clear and accurate depiction of the subject under study. Meanwhile, explanatory research design usually analyze the cause-effect relationship between study variables [26]. Such design was relevant during investigations of cause and effect relationship between the independent variable (modern digital technology) and dependent variables (learning outcomes of students).

2.3. Target Population, Sample Size and Sampling Technique

There are two sets of target populations in the current study: the students and tutors in the TVETs. The sample was obtained from a defined number of TVETs as the unit of sampling.

The sample size for students and tutors was calculated based on the Fisher's Statistical formula for sample size [27] as: Where:

$$\text{Sample size} = \frac{(Z_{1-\alpha})^2(p)(1-p)}{d^2}$$

$Z_{1-\alpha}$ = Is standard normal variate (at 5% type 1 error) and is 1.96; $p = 0.5$ (Proportion of TVETs with modern technology, 80%); $q = (1-p) = 0.5$ (Proportion of TVETs without modern technology, 20%); d = Absolute error or precision (0.05). Therefore, the sample size for the students and tutors/trainers was calculated as:

$$\text{Sample size} = \frac{1.96^2(0.8)*0.2}{0.05^2} = 245.86 \approx 245.$$

The researchers sampled 245 students and 245 tutors.

The number of sampling units (TVETs) was calculated using the Slovincs formula [28] as:

$$n = \frac{N}{1+Ne^2} = \frac{2287}{1+2287*0.1^2} = 95.81 \approx 96.$$

Where: n = Desired sample size; N = Population; e = error variance (1%) 0.1 for population 100 to 1000. Therefore, the number of TVETs was 96.

The sampling technique used in the current study was random sampling of the TVETs since these TVETs are homogenous. To determine the number of students and tutors to be sampled from each TVET, the sample size of the students was divided by the sampling units (TVETs).

2.4. Research Instruments, Validity and Reliability

Data were collected through questionnaires. The questionnaire was administered by the researcher and three research assistants at the institutions. The questionnaire contained information on 12 modern digital technology platforms

used in TVETs, effectiveness of the modern digital technology platforms in teaching, effectiveness of modern digital technology platforms in learning and performance of the students in various TVET institutions.

Validity of the instrument was ascertained through expert judgment [29], where a prior discussion of items in the questionnaire were conducted with other researchers in the same field. Suggestions were then incorporated in the final instrument. Reliability was evaluated using the Cronbach alpha test [30]. Data for Cronbach test was collected during piloting among respondents not selected for the current study. The data was declared reliable when Cronbach's alpha coefficient was determined to be above 0.60 [31].

2.5. Ethical Considerations

The ethical consideration in the current study informed consent, honesty, objectivity, confidentiality, respect for the subjects and intellectual property rights [32]. Permits to carry out research were sourced from relevant authorization agencies and institutions.

2.6. Data Analysis and Diagnostic Tests

Collected data in the questionnaire were screened and coded to allow statistical analysis using the IBM Statistical Packages for Social Sciences (SPSS) version 28.0.1.1 software. The collected data were analysed using both descriptive and inferential statistics. Frequency distributions and percentages were used for categorical variables. To assess the effects of modern digital technology platforms on performance at the TVETs, a multiple linear regression model was employed. The use of multiple linear regression is appropriate because it accommodates several independent variables simultaneously and helps identify the strength and direction of their relationships with the dependent variable [33]. The model was described using the equation:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots \epsilon_i$$

Where:

Y_i = Performance (mean score)

X_1 = Type of modern digital platform technology adopted

X_2 = Effectiveness in teaching

X_3 = Effectiveness in learning

$\beta_1, \beta_2, \dots, \beta_3$ are the regression coefficients to be estimated. ϵ = is the error term that is normally distributed with a mean of zero and constant variance of epsilon squared (ϵ^2), and included in the model to account for other factors that are not included in the model but affected the performance.

Diagnostic tests were conducted on the regression results obtained from the analytical approach, specifically the SPSS output. These tests aimed to assess the assumptions underlying the chosen analytical model, which in this study was multiple linear regression using Ordinary Least Squares. The main diagnostic test was multicollinearity, which refers to the correla-

tion between independent variables and was assessed using the Variance Inflation Factor (VIF). The study used VIF to estimate the inflation of regression coefficient by multicollinearity. A VIF of 1 indicates no correlation, while values between 1 and 5 suggest a moderate correlation that does not require corrective measures. VIFs greater than 5 indicate severe multicollinearity, which can lead to unreliable coefficient estimates and questionable p-values (Bayman & Dexter, 2021).

$$VIF = \frac{1}{1-R^2}$$

3. Results and Discussion

This section presents the response rate and the reliability of the questionnaire as well as the major findings and discussion of the study variables.

3.1. Response Rate and Reliability of the Questionnaires

For this study, a sample size of 245 students and 245 tutors were selected to take part. From the sampled respondents, a total of 222 students questionnaires and 232 tutors questionnaires were duly filled and returned. The duly filled and returned questionnaires represented a response rate of 90.6% and 94.7% among students and tutors, respectively. A response rate of 50% is adequate for analysis and reporting; a rate of 60% is good and a response rate of 70% and over is excellent [34]. Therefore, for this study, the response rates of 90.6% and 94.7% were excellent for analysis and reporting. The overall reliability of the questionnaires were 0.79 and 0.82 among students and tutors respectively. A reliability value above 0.6 is adequate to accept the research instrument's internal consistency [35]. Therefore, the high reliability value above 0.6 showed that the questionnaires were good for analysis.

3.2. Descriptive Results of Modern Digital Technology Platform Adoption in Teaching and Learning

3.2.1. Modern Digital Technology Platforms Used in Learning at TVETs

Access to various technology platforms among students and tutors in TVETs are provided in Table 1. The results show that students and tutors accessed the various modern digital technology platforms differently. Among the platforms that were reportedly accessed by highest number of students and tutors was YouTube (86.5% and 81.5% for students: tutors), online textbooks (79.3% and 80.2% for students: tutors), and Google docs (64.9% and 66.4% for students: tutors). The other platforms that were accessed by moderate numbers of students and tutors were Gamification, and Wikis. However, google classroom, smart video, cloud technology, Google scholar, Academia, and Research Gate were accessed by fewer students and tutors. The overall mean access to modern digital technology platforms was 42.3% for the students and 46.1% for the tutors, which suggest low access to these modern digital technology platforms. Low use of digital technologies has been reported in several studies in Kenya. For example, in Nyeri and Nairobi counties, there was evidence that some tutors used digital technology platforms during teaching, albeit at very low rates [36]. Similarly, there are reports that some form of digital technology platforms was being used in curriculum to enhance quality of learning outcomes in distance learning, but this was done by few tutors [37]. There was one study that looked at the integration of digital platforms to learn mechanical and automotive engineering in the Kenyan TVETs [38], which found that there was low usage of digital platform technology in teaching. Therefore, it is clear from the current finding and from other studies that there was low usage of modern digital technology platforms for teaching.

Table 1. Access to various types of modern digital technology platforms among students and tutors in TVETs.

Modern digital platform	Students		Tutors	
	Frequency	Percent	Frequency	Percent
YouTube	192	86.5	189	81.5
Google Classroom	54	24.3	53	22.8
Smart video	74	33.3	79	34.1
Online textbooks	176	79.3	186	80.2
Gamification	122	55	105	45.3
Cloud technology	40	18	56	24.1
Chat GPT	90	40.5	85	36.6
Wikis	103	46.4	134	57.8

Modern digital platform	Students		Tutors	
	Frequency	Percent	Frequency	Percent
Google Docs	144	64.9	154	66.4
Google Scholar	45	20.3	98	42.2
Academia	67	30.2	99	42.7
Research Gate	21	9.5	45	19.4
Mean (%)		42.3		46.1

3.2.2. Effectiveness of Modern Digital Technology Platforms in Learning

Results on the effectiveness of modern digital technology platforms in teaching among tutors in TVETs are provided in Table 2. The mean rating of results on effects of modern digital technology platforms in learning indicated a high rating ($M = 4.04$, $SD = 0.44$). The highest response among students was that modern digital technology platforms makes information accessible to students ($M = 4.51$, $SD = 0.41$), modern digital technology platforms allow students explore new disciplines aiming for deeper understanding of complex ideas ($M = 4.39$, $SD = 0.39$), and modern digital technology platforms

allow 24/7 access to relevant educational information ($M = 4.21$, $SD = 0.37$). The current study converges with another study on the impacts of modern technology on undergraduate students teaching and learning in tertiary institutions conducted in Nigeria which reported that modern technology platforms allowed teachers and students an immediate feedback thus allowing them to acquire practical life skills [39]. Similar to the current findings was another study where learning platforms, gamification, and diverse teaching approaches were effective in teaching and learning [40]. A study on digital education platforms in engineering: teaching and researching conducted in Spain [41] found that digital technology platforms fostered improved teaching and learning.

Table 2. Descriptive statistics on the effects of modern digital technology platforms in learning.

Statement	Mean	Std. Dev
Modern digital technology platforms make information accessible to students	4.51	0.41
Modern digital technology platforms allow students explore new disciplines and get a deeper understanding of complex ideas	4.39	0.39
Modern digital technology platforms allow students to acquire the technical skills needed for the 21 st century	3.88	0.43
Modern digital technology platforms allow students to communicate group projects ideas	3.51	0.27
Modern digital technology platforms allow one-on-one interactions with tutors	3.73	0.27
Modern digital technology platforms allow 24/7 access to relevant educational information	4.21	0.37
Composite Mean	4.04	0.44

3.2.3. Effectives of Modern Digital Technology Platforms in Teaching

The effectiveness of modern digital technology platforms in teaching at the TVETs are as presented in Table 3.

Table 3. Descriptive statistics on the effects of modern digital platform technology in teaching/training/instruction.

Statement	Mean	Std. Dev
Modern digital technology platforms make teaching information accessible to tutors	3.81	0.51
Modern digital technology platforms allow tutors to explore new disciplines and get a deeper understanding of	3.89	0.59

Statement	Mean	Std. Dev
complex ideas		
Modern digital technology platforms allow tutors to obtain technical skills for the 21 st century	4.18	0.43
Modern digital technology platforms allow teacher and students communicate ideas	3.61	0.32
Modern digital technology platforms allow one-on-one interactions with students through online platforms	3.83	0.77
Modern digital technology platforms allow tutors to have basic understanding off issues hence easier to teach	3.61	0.53
Composite Mean	3.82	0.44

Table 3 shows that mean rating of the effects of modern digital technology platforms in teaching was moderate ($M = 3.82$; $SD = 0.44$). High rating was noted among tutors based on statements like modern digital technology platforms allow tutors to obtain technical skills for the 21st century ($M = 4.18$; $SD = 0.43$), followed by modern digital technology platforms allow tutors to explore new disciplines and get a deeper understanding of complex ideas ($M = 3.89$; $SD = 0.57$). Moderate responses were evoked among tutors with other statements like modern digital technology platforms allow teacher and students communicate ideas ($M = 3.61$; $SD = 0.32$) and modern digital technology platforms allow tutors to have basic understanding off issues hence easier to teach ($M = 3.61$; $SD = 0.53$). The analysis of effects of modern digital technology platforms in teaching reveals moderate levels, which may suggest that teachers do not feel that these methods/ platforms result in the best teaching outcomes. The current findings are in agreement with findings of [42], who studied the use of modern technology as correlates to teaching in various colleges and established that tutors did not rank modern technology platforms highly as was expected in theory. The current study findings are also in agreement with a study conducted in Nigeria on impact of modern technology for undergraduate teaching and learning in tertiary institutions [39]. This suggests that while some tutors feel they are afforded opportunities to develop their skills through modern digital technology platforms, others may perceive a lack of adequate use of these platforms to teach.

3.3. Descriptive Results of Academic Achievements of Students in TVETs

The dependent variable of this study was learning outcomes of the students in various TVET institutions. Table 4 presents the descriptive statistics regarding the learning outcomes of the students in TVETs. Table 4 on learning outcomes showed that majority of the respondents were in agreement that digital technology platforms enabled them improve in assignments ($M = 4.49$; $SD = 0.39$) followed by improvements in oral presentations ($M = 4.33$; $SD = 0.44$) and then improvement in CATs ($M = 4.21$; $SD = 0.31$). The overall analysis of learning outcomes at the TVETs reveals moderate levels of satisfaction with job learning outcome among students using digital tech-

nology platforms (overall $M = 3.44$; $SD = 0.42$). The moderate levels of learning outcomes among students suggest that while digital platforms may help to improve the academic outcomes, it cannot fully replace students' ability and degree of commitment to achieving better academic results. The current finding concurs with a study on implementing a new approach for the design of an e-learning platform in engineering education [43]. The current finding concur with a study on online education of engineering students: educational platforms and their influence on the level of academic performance [44].

Table 4. The descriptive statistics of learning outcomes of students in TVETs.

Statement	Mean	Std. Dev
Improvement in CATs	4.21	0.31
Improvement in assignments	4.49	0.39
Improvements in exams/examinations	3.44	0.34
Improvements in essay writings	3.32	0.31
Improvements in oral presentations	4.33	0.44
Improvements in class participations	3.45	0.23
Composite Mean	3.44	0.42

3.4. Regression Results on the Relationships Between Modern Digital Technology Platforms and Academic Achievements

A multivariate regression model was applied to determine the relationship between digital technology platforms and learning outcomes in TEVTs.

3.4.1. Diagnostic Test Results

The diagnostic results were tested for multicollinearity as provided in Table 5. The results show that all the variables under study had a VIF ranging between 1.061 and 2.365 and also tolerance values ranging from 0.423 to 0.943, which show that there were no potential multicollinearity symptoms.

These were the indicators that there was a low correlation among the variables under consideration.

Table 5. Estimates of Multicollinearity Statistics.

Model	Multicollinearity statistics	
	Tolerance	VIF
Modern digital technology platform adopted	0.739	1.354
Effectiveness in teaching	0.677	1.477
Effectiveness in learning	0.734	1.362

Source: Author's Computation from Survey Data (2024)

3.4.2. Econometric Model Analysis Results

The estimated results on the effects of modern digital platform technology on students' academic achievement are shown in Table 6 of results. From the results, the value of *R*-Square indicates the goodness of fit of the linear regression. *R*-square and Adjusted *R* Square values are 0.788 and 0.776 respectively, which means that 77.6% of the total variation in the dependent variable (learning outcomes) is attributed to the modern digital technology platforms while the remaining 20.9% lies within the error term in the regression model for this study.

ANOVA test was conducted to test the significance of the relationship between modern technology platforms and academic achievement by predicting the power of the model with that of an intercept-only model [45]. The results established from the ANOVA test result showing that the *P*-value is <0.01. This indicates a statistically significant relationship between academic achievement and modern digital platforms.

Table 6. Estimated results on influence of modern digital platform technology on performance.

Regression Statistics					
Model summary					
Multiple R	0.888				
R Square	0.788				
Adjusted R Square	0.776				
Observations	222				
Standard Error	1.083				
ANOVA	SS	df	MS	F	P-value
Regression	20.369	3	6.789	13.335	0.002
Residual	111.505	219	0.509		
Total	131.874	222			
	Unstandardized Coefficients		Standardized Coefficients		P-value
	Beta	Std. Error	Beta	t Stat	
(Constant)	1.533	0.679		2.258	0.026
Type of modern digital platform	0.32	0.054	0.319	0.488	0.001**
Effectiveness in teaching	0.216	0.727	0.161	0.242	0.082
Effectiveness in learning	0.177	0.061	0.131	1.467	0.045*

Legend: * = significant at 5% level, ** =significant at 1%

Source: Author's Computation from Survey Data (2024)

From the regression results in Table 6 it can be deduced that learning outcome is greatly influenced by digital technology platforms. The regression analysis revealed that types of modern digital technology platforms have the most significant positive effect on leaning outcomes, indicating that not all types of digital technology platform enhance teaching and learning. The findings also concur with the findings of a study on digital education platforms in engineering: teaching and researching [41] which found a positive association between the type of technology platform and learning outcomes. Additionally, these findings are in line with previous research on an open-source platform for using gamification and social learning methodologies in engineering education: Design and experience [46]. The current findings are also in agreement with a meta-analysis on the digital platforms and the improvement of learning outcomes [47].

4. Conclusions and Recommendations

The results of Impact of Integration of Modern digital technology platforms in Teaching and Learning at the Technical and Vocational Education and Training (TVETs) institutes in Kenya indicated high mean rating of the effects of modern digital technology platforms in learning. The multiple linear regression results show that 77.1% of the total variation in the dependent variable (students academic achievement) is accounted for by the modern digital platform technology platforms.

Therefore, the study recommends that TVET tutors who were trained without the context of modern digital technology platforms should undertake such courses in higher learning institutions to develop the requisite digital competencies. The study also recommends that modern digital technology platforms should be integrated in all subjects taught at the TVETs as this will improve the quality of learning outcomes. The management of TVET institutions should also undertake necessary training in digital competencies to enhance their ability to implement the UNICEF's policy on integration of digital technology platforms in TVETs curriculum.

Abbreviations

TVETs	Technical and Vocational Education and Training
CBET	Competency Based Education
ICT	Information and Communication Technology
TTTC	Technical Teacher Training Colleges
GPT	Generative Pre-training Transformer
VIF	Variance Inflation Factor

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Author Contributions

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Data Availability Statement

The data is available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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