



Teacher ICT Competence as a Lever for Classroom Digital Transformation: Evidence from Public Junior Schools in Kakamega County, Kenya

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Abstract: *The transition to technology-enhanced teaching under Kenya's Competency-Based Curriculum places renewed demands on teachers' ability to select, operate, and pedagogically integrate digital technologies. This paper examined the effect of teachers' level of ICT training and skills on their use of digital technologies in teaching and learning in public junior secondary schools in Kakamega County. The study adopted a convergent parallel mixed-methods design. Data were obtained from 332 JS teachers who responded to a target of 346 questionnaires, complemented by interviews with 11 Sub-County Directors of Education and observations in 78 schools. A factor-based ICT training and skills index had a mean of 3.954, indicating moderately high competence, while the technology-use index had a mean of 3.30, indicating moderate use. Teachers were strongest in confidence, general digital knowledge, internet browsing and information search, but weaker in software installation, troubleshooting, digital-content creation and learning-management systems. Pearson correlation showed a positive moderate relationship between ICT training and technology use ($r = .467, p < .001$). In Model 1, ICT training and skills significantly predicted technology use ($B = .412, t = 9.60, p < .001; R^2 = .218$). After controls were introduced, the detailed regression table reported a positive adjusted coefficient of $B = .382$ ($\beta = .440, p < .001$), with $R^2 = .446$ and adjusted $R^2 = .423$. The null hypothesis was rejected. The paper concludes that teacher competence is an important enabling condition for classroom technology use, but advanced practical and pedagogical skills require targeted, continuous development.*

Keywords: *ICT competence; Teacher training; Digital technology use; Junior schools; Kakamega County*

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1. Introduction

The integration of information and communication technology (ICT) into education has shifted from being an optional enhancement to an important component of contemporary teaching and learning. International policy discourse positions teacher competence as central to meaningful technology integration because digital tools alter how teachers access content, design learning experiences, communicate with learners and assess progress (UNESCO, 2018). The COVID-19 disruption

further exposed the importance of teachers' digital readiness, while also demonstrating that technology adoption is uneven where professional capacity and institutional conditions are weak.

Across developed education systems, sustained investment in infrastructure has generally been accompanied by teacher development and coherent implementation strategies. Experiences from Europe, North America and parts of Asia suggest that technology becomes more educationally valuable when teachers possess the knowledge and confidence to connect digital resources

with curriculum goals rather than merely substitute digital tools for conventional materials. Literature consequently distinguishes access to devices from the competence required to use them pedagogically (Ertmer & Ottenbreit-Leftwich, 2010; Tondeur et al., 2019).

In sub-Saharan Africa, however, teacher ICT competence remains uneven. Studies show persistent gaps between basic digital literacy and advanced pedagogical or technical competence. In Ghana, for example, teacher integration is constrained by limited training, connectivity and financial resources, while studies in Tanzania report that teacher competence, self-efficacy, and institutional support shape educational technology use (Addae et al., 2024; Kafyulilo & Fisser, 2021; Raphael & Mtebe, 2017). These patterns indicate that professional development must address what teachers can actually do with technology in their disciplinary and pedagogical contexts.

Kenya has progressively embedded ICT in national education policy, including the National ICT Policy and the broader policy framework for education reform. The Kenya Education Cloud and other digital initiatives have sought to expand access to learning resources and support more learner-centred approaches (Government of the Republic of Kenya, 2019; Ministry of Education, 2021). Yet the existence of policy and digital platforms does not necessarily translate into classroom use. Research has continued to identify gaps in teacher preparation, devices, connectivity and the capacity to integrate ICT into pedagogy.

Kakamega County provides an important setting in which to interrogate the teacher-capacity dimension of this problem. Local evidence indicates that teachers in public schools may hold positive perceptions of ICT while still facing inadequate training, limited digital devices, and weak connectivity (Shikomera, 2024; Shikomera et al., 2023). The establishment of junior secondary schools under CBC from 2023 adds urgency because teachers are expected to operate in increasingly digital learning environments while many schools and teachers are still consolidating their preparedness. Against this context, the present paper asks whether teachers' ICT training and skills translate into greater use of digital technologies in teaching and learning.

1.1 Problem Statement

Kenya's policy environment strongly supports ICT-enabled education, yet classroom technology use remains uneven. In Kakamega County, evidence has pointed to inadequate teacher training and digital resources despite policy commitments to ICT integration. The problem is particularly important in public junior secondary schools because they operate within the relatively new CBC environment and depend heavily on teachers' capacity to convert available digital resources into pedagogically

useful practices. Existing Kenyan studies have largely focused on primary or conventional secondary education, while studies elsewhere have often treated teacher ICT competence as one factor among many without isolating its contribution in JS settings. The unresolved question is therefore not simply whether teachers possess ICT skills, but whether differences in their training and skills are reflected in differences in actual use of digital technologies for lesson preparation, delivery, learner evaluation and class management. This paper addresses the specific empirical gap in Kakamega County.

1.2 Aim of the study

The aim was to assess the effect of teachers' level of ICT training and skills on their use of digital technologies in teaching and learning in public junior secondary schools in Kakamega County, Kenya.

2. Literature review

The literature was reviewed to establish theoretical logic and empirical evidence linking teacher ICT competence with classroom technology use. Particular attention was given to the capability teachers need to process digital information, translate technological knowledge into pedagogical practice, and overcome practical barriers that may weaken the conversion of training into sustained use.

2.1 Theoretical framework

The paper is anchored in Galbraith's Theory of Organizational Information Processing (OIPT). The theory argues that organizational performance depends on the fitness of information-processing needs and information-processing capabilities (Galbraith, 1973, 2005). In school, technology-enhanced pedagogy increases information-processing demands because teachers must locate, evaluate, organize, and communicate digital information while coordinating instructional decisions. Teacher ICT training and skills constitute a human-capital component of the school's information-processing capability. When competence is adequate, teachers are better positioned to reduce uncertainty and manage digital tasks; when competence is weak, information-processing bottlenecks may constrain technology use. The theory therefore predicts a positive relationship between teacher ICT capability and digital technology use. It is particularly relevant to this paper because it frames training not as an isolated professional benefit but as an organizational capacity that enables schools to respond to the information demands of contemporary teaching.

2.2 Empirical literature review

Buabeng-Andoh (2012) synthesized evidence on teacher ICT adoption and emphasized that teacher characteristics, access conditions and organizational factors jointly shape

integration. Review is important because it challenges a purely hardware-centred explanation of technology use and highlights the role of teacher competence. However, much of the evidence concerned primary and secondary education generally, leaving a contextual gap for Kenya's newer JS sector.

Ertmer and Ottenbreit-Leftwich (2010) argued that teacher technology change is shaped by the interaction of knowledge, confidence, beliefs and school culture. Their distinction between first-order barriers, such as infrastructure and training, and second-order barriers, such as beliefs and confidence, suggests that professional development is necessary but must be connected to teachers' wider working conditions. The present study extends this logic by empirically estimating the contribution of teacher ICT training and skills while controlling for teacher and school characteristics.

Scherer et al. (2019), using a meta-analytic approach to the Technology Acceptance Model, showed that teacher-related factors are important correlates of educational technology adoption. The study supports the proposition that teachers' knowledge and confidence are not peripheral to technology use. Nevertheless, meta-analytic evidence necessarily combines different educational systems and technological environments. The Kakamega study contributes context-specific evidence from public JS teachers operating within Kenya's CBC transition.

Tondeur et al. (2019) emphasized the role of teacher educators and professional preparation in shaping future technology integration. Their work indicates that teachers' exposure to technology during professional preparation can influence later classroom practice. Related evidence in Tanzania by Kafyulilo and Fisser (2021), as reported in the thesis, found a strong relationship between teacher ICT competence and technology use. The variation between contexts suggests that the strength of the training-use relationship may depend on the availability of infrastructure and support.

Kenyan evidence reinforces the concern about uneven teacher preparedness. Obonyo's (2013) study in Kisumu County identified lack of ICT training among the major barriers to integration, while Barasa et al. (2020) documented teacher competency concerns in ICT integration in Bungoma County. Shikomera (2024) similarly reported that Kakamega teachers could have positive perceptions of ICT but still face training and connectivity constraints. These studies establish the relevance of teacher capacity but do not provide the same JSS-specific multivariate estimate of its contribution to technology use.

Falloon (2020) argued for progression from digital literacy toward broader digital competence, including the capacity to create, evaluate and use digital resources pedagogically.

This distinction is particularly important in the current study because teachers may be comfortable with basic internet use while remaining less confident with content creation, learning-management systems, software installation or troubleshooting. The literature therefore supports targeted professional development, but a remaining gap concerns the magnitude of the relationship between a composite measure of teacher ICT training and skills and teachers' actual use of digital technologies in Kenya's public JSS context.

3. Methodology

3.1 Study design

The study adopted a convergent parallel mixed-methods design, integrating a cross-sectional survey for the quantitative component with an exploratory qualitative component. Quantitative and qualitative evidence were collected concurrently and integrated to provide breadth, depth and triangulation. The cross-sectional survey was appropriate for examining relationships among institutional preparedness dimensions and teacher use of digital technologies without manipulating conditions, while interviews and observations provided contextual evidence on implementation, resources and school practices (Creswell & Creswell, 2018; Field, 2018).

3.2 Study location and population

The study was conducted in Kakamega County, Western Kenya. The county has 13 sub-counties and 907 registered public primary schools hosting junior secondary classes under the Competency Based Curriculum. The target population comprised 5,046 JSS teachers and 13 Sub-County Directors of Education. Teachers were selected because they are directly responsible for classroom teaching and are primary users and beneficiaries of ICT training and institutional support; Sub-County Directors provided institutional-level perspectives.

3.3 Sample and sampling

A multi-stage sampling procedure was used. The 13 sub-counties formed strata; schools and teachers were then selected using simple random procedures, while Sub-County Directors were purposively selected because of their oversight responsibilities. Using the thesis sampling procedure, the initial Yamane calculation and finite-population correction produced a final target of 346 teachers, distributed across approximately 58 schools, plus 13 Sub-County Directors, yielding a planned sample of 359 respondents.

3.4 Instruments

Data were collected using a Junior School Teachers Questionnaire, a semi-structured Key Informant Interview

Guide for Sub-County Directors of Education, and an Observation Guide. The questionnaire measured teacher ICT training and skills, ICT infrastructure, administrative ICT support, teacher use of digital technologies, and demographic/control variables. The observation guide documented the availability, condition and functionality of ICT resources and visible evidence of technology use.

3.5 Pilot study

A pilot study involving approximately 35 teachers (10% of the targeted 346 teachers) from about six public junior secondary schools in neighbouring Vihiga County was conducted. Vihiga was selected to reduce pre-exposure effects while retaining comparable demographic, socioeconomic, and educational characteristics. The pilot assessed clarity, relevance, comprehensiveness, completion time, data-collection procedures, and preliminary reliability and validity; feedback was used to refine the instruments.

3.6 Validity and Reliability

Content validity was assessed by three experts in educational research and ICT integration at MMUST, with a minimum content-validity threshold of 0.80 used. Construct validity was strengthened through alignment of questionnaire sections with the conceptual framework and factor-analytic assessment. Internal consistency reliability was evaluated using Cronbach's alpha. The study reported alpha coefficients of 0.976 for teacher ICT training and skills (13 items), all exceeding the .70 threshold (DeVellis, 2017).

3.7 Data analysis

Quantitative data were coded and analyzed in SPSS. Frequencies, percentages, means, and standard deviations summarized the data. Exploratory factor analysis using principal components analysis was used to construct parsimonious indices; KMO and Bartlett's test assessed factorability. Pearson correlation assessed bivariate

relationships. Multiple linear regression was then used in two models: Model 1 contained the objective-specific predictor, while Model 2 added gender, age, highest educational level, teaching experience, teaching subject and JS enrolment. Statistical significance was assessed at $p < .05$. Diagnostic assessment considered linearity, homoscedasticity, residual behaviour, influential cases and autocorrelation. Qualitative data from interviews, open-ended responses and observations were thematically analyzed and used to triangulate quantitative results (Field, 2018; Patton, 2015).

3.8 Ethical considerations

Participation was voluntary, informed consent was obtained, anonymity and confidentiality were protected, and data were reported in aggregate form. Participant codes were used in place of names, and identifying information was separated from the analytical data. The study followed the ethical and approval procedures described in the thesis.

4. Results and Discussion

4.1 Descriptive findings

Exploratory factor analysis of the 13 teacher ICT training and skills indicators produced a single coherent factor. KMO was .889, and Bartlett's test of sphericity was significant, $\chi^2(78) = 2,164.37$, $p < .001$, supporting factorability. The rescaled factor-based index had a mean of 3.954, interpreted as moderately high. Teachers were strongest in confidence ($M = 4.20$), knowledge and skills in using digital technologies ($M = 4.22$), engagement with digital technologies ($M = 4.21$), and information search ($M = 4.13$). Lower-rated competencies included independence in troubleshooting minor EMIS/ICT issues ($M = 3.46$), software installation ($M = 3.46$), digital-content creation ($M = 3.78$), and learning-management systems ($M = 3.81$). The aggregate coefficient of variation was 26.4%, indicating moderate variation.

Table 1: Descriptive statistics of teachers' level of ICT training and skills

Level of ICT Training and Skills	N	R	OM	Few	ED	Mean	Std. Dev.
Basic computer troubleshooting (restarting, connecting cables)	7 (2.1%)	63 (19.0%)	33 (9.9%)	91 (27.4%)	138 (41.6%)	3.87	1.205
Using office software (Word, Excel, PowerPoint)	2 (0.6%)	36 (10.8%)	63 (18.0%)	78 (23.5%)	153 (46.1%)	4.04	1.068
Using internet browsing for educational resources	7 (2.1%)	31 (9.3%)	44 (13.3%)	78 (23.5%)	172 (51.8%)	4.14	1.095
Operating interactive boards/projectors	7 (2.1%)	46 (13.9%)	47 (14.2%)	94 (28.3%)	138 (41.6%)	3.93	1.140
Using Learning Management Systems	22 (6.6%)	31 (8.3%)	79 (23.8%)	56 (16.9%)	144 (43.4%)	3.81	1.269
Creating digital content (videos, quizzes)	7 (2.1%)	62 (18.7%)	65 (19.6%)	54 (16.3%)	144 (43.4%)	3.80	1.237
Level of confidence in using digital technologies (Smartphones & mobile apps, computers & laptops	6 (1.8%)	32 (9.6%)	47 (14.2%)	50 (15.1%)	197 (59.3%)	4.20	1.116
Level of knowledge and skills in using digital technologies	1 (0.3%)	37 (11.1%)	34 (10.2%)	75 (22.6%)	185 (55.7%)	4.22	1.042
Smartphones & mobile apps	1 (0.3%)	37 (11.1%)	35 (10.5%)	76 (22.9%)	183 (55.1%)	4.21	1.043
Level of engagement with digital technologies (Smartphones & mobile apps, computers & laptops	1 (0.3%)	37 (11.1%)	35 (10.5%)	76 (22.9%)	183 (55.1%)	4.21	1.043
Level of independence in troubleshooting minor EMIS or ICT issues	5 (1.5%)	83 (25.0%)	37 (11.1%)	63 (19.0%)	144 (43.4%)	3.78	1.279
Software installation	50 (15.1%)	51 (15.4%)	54 (16.3%)	50 (15.1%)	127 (38.3%)	3.46	1.494
Search for information using digital tools such as smartphones & mobile apps, computers & laptops	16 (4.8%)	37 (11.1%)	32 (9.6%)	50 (15.1%)	197 (59.3%)	4.13	1.248
Ease of using passwords to protect and retrieve private data	1 (0.3%)	38 (11.4%)	60 (18.1%)	81 (24.4%)	152 (45.8%)	4.04	1.061

Open-ended responses reinforced the quantitative pattern. Internet research and information search were the most useful skills identified (33.7%), followed by PowerPoint presentations (26.8%). The most frequently requested further training concerned digital-content creation (29.5%) and Learning Management Systems (20.2%). This suggests that teachers are relatively comfortable with consumption-oriented digital skills but require more support for production-oriented and advanced pedagogical uses.

Pearson's correlation showed a statistically significant, positive, and moderate relationship between teacher ICT training and skills and use of digital technologies, $r = .467$, $p < .001$. The direction indicates that higher teacher ICT competence was associated with more frequent use of digital technologies in teaching and learning. The relationship was substantial but not complete, implying that training and skills are important without being sufficient on their own.

4.2 Bivariate results

Table 2: Correlation between Level of ICT Training and Skills and Use of Digital Technologies

Variable (<i>n</i> = 332)		Use of Digital Technologies	Level of ICT Training and Skills
Use of digital technologies	<i>Pearson Correlation</i> Sig. (2-tailed)	1	
Level of ICT training and skills	<i>Pearson Correlation</i> Sig. (2-tailed)	0.467** <i>p</i> <0.0001	1

4.3 Multivariate results: Multiple linear regression

Two regression models were estimated. Model 1 contained only the ICT training and skills index. Model 2 added gender, age, highest educational level, teaching experience,

teaching subject and JSS enrolment. Model 1 explained 21.8% of the variance in teachers' technology use, $F(1,330) = 92.16$, $p < .001$. The main-effect coefficient was $B = .412$, $t = 9.600$, $p < .001$, indicating that a one-unit increase in the ICT training and skills index was associated with a .412-unit increase in technology use.

Table 3: Multiple Linear Regression Results for ICT Training and Skills and Use of Digital Technologies

Variable (<i>n</i> =332)	Model 1					Model 2				
	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>p-value</i>	<i>B</i>	<i>SE</i>	β	<i>T</i>	<i>p-value</i>
Main effect										
(Constant)	1.699	0.163		10.42	$p < .0001$	2.321	0.225		10.28	$p < .0001$
ICT TS index	0.412	0.043	0.467	9.60	$p < .0001$	0.382	0.040	0.440	9.47	$p < .0001$
Controls										
Teaching exp						-0.046	0.024	-0.087	-1.88	0.062
Enrolment						-0.002	0.0007	-0.231	-3.35	0.001
Male						-				
Female						0.110	0.080	0.061	1.37	0.173
< 30 years						-				
30-40 years						-0.628	0.091	-0.338	-6.93	$p < .0001$
41-50 years						-0.883	0.256	-0.169	-3.46	0.001
Diploma						-				
Bachelor's						-0.093	0.107	-0.044	-0.87	0.386
Master's						-0.042	0.197	-0.011	-0.21	0.833
English						-				
Kiswahili						0.299	0.133	0.124	2.24	0.026
Mathematics						0.325	0.126	0.159	2.57	0.011
Integrated Science						-0.004	0.128	-0.001	-0.03	0.972
Pre-technical						0.229	0.249	0.066	0.92	0.358
Combined						0.303	0.176	0.088	1.72	0.086
<i>R</i> ²	0.218					0.446				
Adjusted <i>R</i> ²	0.216					0.423				
<i>F</i> Change	92.16					19.34				
<i>P</i>	$p < .0001$					$p < .001$				
<i>Df</i>	[1, 330]					13, 312				

After controls were introduced, the detailed regression table in the thesis reported $B = .382$, $\beta = .440$, $t = 9.47$, $p < .001$, with $R^2 = .446$ and adjusted $R^2 = .423$. Thus, holding the control variables constant, a one-unit increase in teacher ICT training and skills was associated with an estimated .382-unit increase in teachers' use of digital technologies. The control variables increased the explained variance substantially. The adjusted coefficient remained positive and statistically significant, showing that the teacher-capacity effect was not eliminated by differences in demographic and school characteristics.

For transparency, the thesis contains some inconsistent summary figures in its abstract and chapter-five narrative (for example, an adjusted B of .389 and an adjusted

variance figure of 36.2%). This manuscript uses the detailed Chapter 4 regression table as the primary source for the adjusted regression statistics and separately reports the hypothesis-test coefficient from Model 1. This preserves the distinction between the unadjusted objective-specific effect and the adjusted multivariate effect.

4.3 Diagnostic tests

The regression assumptions were examined before interpretation. For the ICT-training model, the highest Cook's distance was .212 and maximum leverage was .376, indicating no extremely influential cases. The scatterplot showed an approximately linear positive relationship with no obvious curvature or extreme outliers.

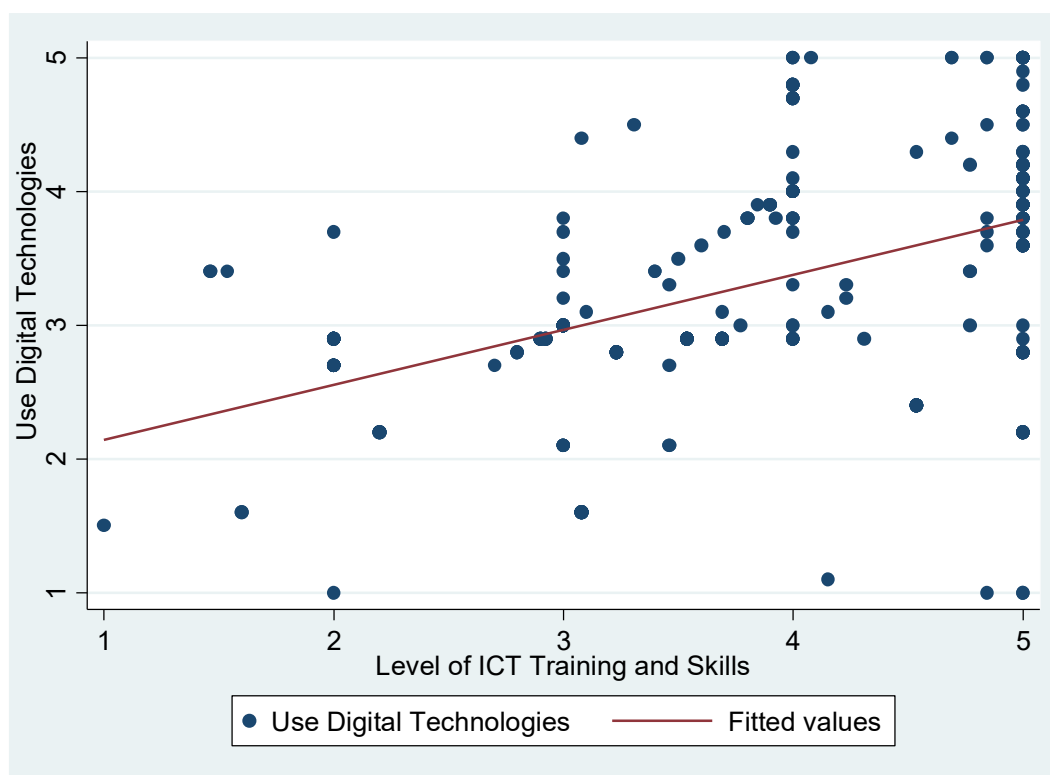


Figure 1: Scatterplot of use of digital technologies and teachers' level of ICT training and skills

Residual spread was reasonably consistent, supporting homoscedasticity, and the Durbin-Watson statistic was 1.471, supporting the absence of problematic autocorrelation.

4.5 Hypothesis test

H_{01} stated that the teacher's level of ICT training and skills has no statistically significant effect on teacher use of digital technologies in teaching and learning. The hypothesis was tested using the regression coefficient for ICT training and skills. The results showed that $B = .412$, $t = 9.600$, $p < .001$, with a 95% confidence interval. Because the p-value was below .05, H_{01} was rejected. The evidence

therefore supports a statistically significant positive effect of teacher ICT training and skills on technology use.

4.6 Discussion of findings

The finding that teachers had a moderately high ICT training and skills index ($M = 3.954$) is encouraging but should not be interpreted as evidence of complete preparedness. Teachers were highly confident and competent in basic digital activities, yet advanced skills such as software installation and troubleshooting were weaker. This pattern accords with Falloon's (2020) distinction between basic digital literacy and broader digital competence, suggesting that professional

development should move beyond operational familiarity toward pedagogical and productive competence.

The positive moderate correlation ($r = .467$) and significant regression effect show that training and skills matter for classroom technology use. The result is consistent with Scherer et al. (2019) and Tondeur et al. (2019), which position teacher knowledge, confidence and professional preparation as important determinants of adoption of technology. It also accords with the Tanzanian evidence cited in the thesis, although the present relationship is weaker than the $r = .62$ reported by Kafyulilo and Fisser (2021). One plausible interpretation is that teacher competence in Kakamega operates within institutional constraints, so improved skills do not automatically produce equivalent gains where infrastructure or support is inadequate.

The open-ended evidence strengthens quantitative interpretation. Teachers identified internet research and PowerPoint as particularly useful, while digital-content creation and Learning Management Systems were the most commonly requested areas for further training. This is precisely the transition from consumption to production that contemporary digital competence frameworks emphasize. It suggests that training programmes should be task-specific and embedded in teachers' actual curriculum work rather than organized as generic computer-literacy sessions.

The result is also consistent with Ertmer and Ottenbreit-Leftwich's (2010) argument that knowledge and confidence interact with the school environment. Training is therefore necessary but not sufficient. The moderate correlation leaves substantial variance unexplained, which is consistent with the broader thesis finding that infrastructure and administrative support are additional dimensions of institutional preparedness.

From the perspective of OIPT, the findings indicate that teacher competence forms part of the school's information-processing capability. Digital pedagogy creates information-processing demands that teachers must meet through searching, evaluating, creating and communicating information. Where training strengthens these capabilities, teachers are better able to convert available digital information into classroom practice. The positive regression coefficient is therefore theoretically coherent with the organizational-capability argument of Galbraith (2005).

The findings should be adopted as a basis for differentiated professional development because they identify specific weaknesses rather than merely demonstrating that training is generally beneficial. The priority areas, digital-content creation, Learning Management Systems, software installation and troubleshooting, are directly connected to more sustained and pedagogically meaningful technology

use. Targeting these areas while maintaining basic digital competencies offers a more defensible intervention strategy than uniform training for all teachers.

5. Conclusion and recommendations

5.1 Conclusion

The study concludes that teachers' ICT training and skills significantly and positively influence their use of digital technologies in teaching and learning in public junior secondary schools in Kakamega County. Although the overall competence index was moderately high, the profile was uneven: teachers were more proficient in basic digital activities and less proficient in advanced technical and pedagogical applications. The bivariate and multivariate evidence consistently demonstrated that higher ICT competence was associated with greater technology use, and the null hypothesis was rejected. The practical implication is that teacher capacity is a substantive component of institutional ICT preparedness, but its full effect depends on complementary infrastructure and institutional support.

5.2 Recommendations

The study made the following recommendations

1. The Ministry of Education and Teachers Service Commission should strengthen continuous, practical ICT professional development for JSS teachers, moving beyond basic digital literacy.
2. Training should prioritize digital-content creation, Learning Management Systems, software installation, troubleshooting, online assessment, and pedagogical integration of digital resources.
3. Teacher professional development should be differentiated according to identified competency gaps rather than delivered as a uniform programme.
4. Schools should institutionalize peer-supported ICT practice, including demonstrations, mentoring and collaborative development of technology-enhanced lessons.
5. Future teacher-development programmes should be implemented alongside improvements in ICT infrastructure and technical support so that newly acquired competence can be translated into sustained classroom use.

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