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Original Article

Teacher Digital Skills and Teaching of Mathematics Subject in Lower Primary

Karakacha Lilian Akello[1], Betty J. Cheruiyot, PhD[1] & Nelly C. Andiema, PhD[1]*

[1] University of Eldoret, P. O. Box 1125-30100, Eldoret, Kenya.
[*] Author for Correspondence ORCID ID; https://orcid.org/0009-0007-8325-7205; Email: karakachalilian9@gmail.com

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ABSTRACT

In the current digital age, teacher competency in the use of digital technology is essential. Therefore, this paper aimed to examine teachers' digital skills and teaching and learning of mathematics activities in lower primary schools in Kanduyi Sub-County. The study adopted a mixed-methods approach, guided by a descriptive survey research design. The target population comprised 92 public primary school head teachers and 631 Grade 1–3 teachers. Using Yamane's formula, a sample of 23 head teachers and 235 teachers was drawn through simple random sampling. Data collection tools included structured questionnaires and interviews. Qualitative data were analysed thematically in line with the study objectives and presented narratively, while quantitative data were processed using descriptive and inferential statistics with the aid of the Statistical Package for Social Sciences (SPSS Version 24). Data were analysed using frequencies, percentages, means, standard deviations, and correlation analysis. The study found that the level of teacher digital literacy skills on the Teaching of Mathematics in lower primary was at an average level (mean=3.29). Most teachers had higher capabilities to share information on mathematics activities through various digital platforms. However, research findings showed that most teachers in Kanduyi Sub-County lower primary school classes had lower literacy skills in using spreadsheets (for example, Ms Excel). The result revealed that the capacity of teachers to conduct digital classes was at a moderate level in most schools. Correlation statistics showed the existence of an average degree of correlation between teachers' digital literacy skills and mathematics learning activities in lower primary school. The paper recommends that there is a need for school management to consider sponsoring teachers to undergo continuous professional development training on digital literacy skills to enable them to acquire the necessary skills on how to operate and use the devices in classroom learning.

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INTRODUCTION

Education has evolved significantly in the digital age, prompting a transformation in how teachers deliver content and engage learners in instructional activities (Mensah, 2017). Within this transformation, teachers' digital literacy skills have emerged as a critical factor in strengthening mathematics instruction at the lower primary level, thereby enhancing pedagogical effectiveness and improving learners' academic outcomes (Bright et al., 2024). In countries such as the United States, Great Britain, Germany, and Spain, digital literacy is increasingly embedded within educational systems, enriching teaching strategies and fostering learner engagement (Mukeshimana & Andala, 2024). According to Madridejos (2024), such integration is essential for cultivating critical thinking and problem-solving skills, particularly in mathematics. Similarly, the Organisation for Economic Co-operation and Development (OECD, 2021) reports that teachers with advanced digital literacy competencies are more likely to adopt innovative and interactive approaches in mathematics instruction. Collectively, these global trends underscore the growing consensus that technology plays a central role in effective mathematics teaching (Bright et al., 2024).

Despite these advancements in developed countries, the integration of digital literacy in many parts of the world remains uneven. In regions such as South America, Australia, and Africa, schools continue to face substantial challenges in embedding digital literacy within the curriculum (Gumiero & Pazuch, 2024). A major barrier is the limited training and inadequate technological resources available to teachers, which constrain their ability to meaningfully integrate digital tools into mathematics instruction (Adedoyin & Soykan, 2020). Within the Kenyan context, the digital divide remains evident through unequal access to ICT infrastructure and insufficient professional development opportunities for mathematics teachers (Ashiono et al., 2018). Consequently, these disparities have hindered the effective delivery of mathematics education, particularly at the lower primary level.

More specifically, in Sub-Saharan Africa, digital literacy is increasingly recognised as a fundamental competency for addressing contemporary educational demands (Orshi, 2016). Although several African countries are advancing initiatives to integrate ICT into mathematics teaching (Agyei et al., 2024), these efforts are frequently constrained by inadequate digital infrastructure and limited teacher capacity-building programs. Nevertheless, evidence indicates that where digital literacy is effectively prioritised, improvements in learners' mathematics performance are observed (Achieng et al., 2024). In countries such as Rwanda, Tanzania, Uganda, and Kenya, initiatives aimed at strengthening teachers' digital competencies are gaining momentum (Uwineza et al., 2023). Governments have increased investments in professional development programs to enhance teachers' digital skills (OECD, 2021). However, the success of these interventions remains uneven and is largely influenced by socio-economic conditions, resource availability, and institutional support (Bazina et al., 2024). Overall, research consistently suggests that digitally competent teachers contribute positively to learners'

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mathematics achievement, especially in early grades (Kiong, 2023).

In Kenya, digital literacy is formally recognised as one of the seven core competencies under the Competency-Based Curriculum (CBC). Through the integration of information and communication technology, the CBC seeks to improve the overall quality of teaching and learning (Nyamosi, 2024). National policy frameworks, including the Basic Education Act (2013) and Sessional Paper No. 1 of 2019, reinforce the promotion of digital literacy across four pillars: education and training, ICT infrastructure and policy, digital content, and capacity development (Otieno, 2024). In alignment with these policy directions, the Ministry of Education launched the Digital Literacy Programme (DLP) to enhance digital competencies among teachers and learners in primary schools (Republic of Kenya, 2017). Beginning in 2017, ICT infrastructure including routers, teacher laptops, and learner tablets was distributed to public primary schools to support CBC implementation (Otieno, 2024; Lysenko et al., 2021). While these initiatives were intended to empower teachers to integrate technology into classroom practice, evidence suggests that many teachers still feel inadequately prepared to effectively utilise digital tools in mathematics instruction (Achieng et al., 2024).

Furthermore, the government's broader agenda of increasing participation in Science, Technology, Engineering, and Mathematics (STEM) careers places additional emphasis on digital literacy in schools (Kibet, 2025). Mathematics plays a pivotal role in achieving CBC competencies by fostering analytical thinking, logical reasoning, and data interpretation skills among learners (Lysenko et al., 2021). However, research by Kibet (2025) indicates that the integration of digital literacy in mathematics instruction, particularly in higher education institutions, remains inconsistent, with many educators continuing to rely on traditional lecture-based methods despite the availability of digital tools such as MATLAB, Desmos, and GeoGebra. Such limited utilisation of digital resources may negatively influence learner engagement and mathematics performance, highlighting the importance of strengthening teachers' digital competencies across all levels of education.

At the county level, Bungoma County reflects many of the broader national challenges related to digital literacy implementation. Many schools face inadequate technological infrastructure, and teachers require additional support to effectively apply digital skills in enhancing mathematics instruction (Mwaniki et al., 2024). Although interest in incorporating technology into mathematics teaching is growing, classroom implementation remains inconsistent (Achieng et al., 2024). Simiyu and Kisiang'ani (2024) further report that ICT devices are available in only a limited number of primary schools in Bungoma West Sub-County. These findings reveal persistent gaps in the practical integration of digital literacy in mathematics classrooms. However, empirical studies examining the relationship between teachers' digital literacy and mathematics teaching in public lower primary schools remain limited. It is within this context that the present study sought to examine the relationship between teachers' digital literacy and mathematics teaching in lower primary schools in Kanduyi Sub-County, Bungoma County, Kenya.

Purpose of the study

The purpose of this study was to determine teachers' digital literacy skills in the teaching of the Mathematics subject in lower primary schools in Kanduyi Sub-County, Bungoma County, Kenya.

LITERATURE REVIEW

Digital literacy is increasingly recognised as a crucial competency for educators, particularly in fostering innovative teaching and engaging learning experiences (Voogt & Roblin, 2012). In mathematics education, this competency extends beyond technical familiarity with devices to include the ability to integrate technology meaningfully into pedagogy and subject content.

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To understand this integration, the Technological Pedagogical Content Knowledge (TPACK) framework provides a useful theoretical lens. The TPACK model posits that effective technology integration occurs at the intersection of three knowledge domains: content knowledge (mathematics concepts), pedagogical knowledge (instructional strategies), and technological knowledge (digital tools). Thus, teachers' digital literacy is not merely a technical skill but their ability to blend technology with pedagogy and mathematical content to enhance learning.

Digital literacy refers to the competencies required to access, evaluate, create, and communicate information using digital technologies (Mensah, 2017). However, scholars argue that digital literacy in education must extend to pedagogical application (Encanto, 2022). In mathematics instruction, where conceptual understanding and procedural fluency are central (Joshi et al., 2023), teachers must strategically select digital tools that support visualisation, problem-solving, and learner interaction. Therefore, within the TPACK framework, digital literacy becomes a foundational component of technological knowledge that shapes pedagogical decisions and ultimately influences learner engagement and achievement (Ali et al., 2023).

Despite its importance, teacher proficiency in digital literacy varies considerably, resulting in uneven instructional outcomes (Yarkwah et al., 2024). Nurzhanova et al. (2024), in a comparative study of 209 pre-service teachers in Kazakhstan, reported generally high levels of digital literacy and technology-use skills. However, significant differences emerged by gender and academic level, with male participants and upper-grade students demonstrating higher competencies. While the authors attributed these differences to exposure and academic progression, several additional factors may explain these disparities. Gender differences may stem from socio-cultural norms that influence access to technology, confidence levels in using digital tools, or prior exposure to STEM-related experiences. Similarly, higher academic-level students may demonstrate stronger competencies due to cumulative exposure to coursework, practicum experiences, and institutional support structures. These findings raise critical questions about equity in digital literacy development and suggest that digital competence may not develop uniformly without deliberate intervention. However, the study focused exclusively on pre-service teachers in universities, leaving unanswered how digital literacy manifests among in-service primary school teachers operating within real classroom constraints, an area this study addresses.

Similarly, Gumiero and Pazuch (2024) conducted a systematic review of 42 peer-reviewed studies examining teachers' professional knowledge for teaching mathematics with digital technologies. Their analysis classified areas of teacher knowledge that are well-developed versus those requiring further exploration. While their review provides a broad synthesis of teacher knowledge domains, it largely concentrates on theoretical categorisations rather than empirical examination of how digital literacy influences actual mathematics classroom practices. From a TPACK perspective, the interaction between technological knowledge and pedagogical implementation remains underexplored, particularly in lower primary contexts.

In another study, Nepal et al. (2023) investigated how teachers' use of communication tools, collaborative practices, digital skills, and software proficiency influenced learners' communication behaviours during mathematics lessons. Using data from 466 secondary school teachers, the study found that digital skill development was generally low, yet significantly predictive of student communicative behaviour. Although the study establishes a predictive relationship, it emphasises learner communication rather than instructional quality or mathematics performance outcomes. Furthermore, its focus on secondary education limits understanding of how foundational mathematics instruction in lower primary settings may be shaped by teachers' digital literacy competencies.

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Research conducted in Ghana by Aidoo et al. (2022) examined primary school teachers' digital literacy and its implications for teaching practices. Findings indicated moderate digital literacy levels but identified infrastructural deficits and motivational barriers. Although the study found a positive correlation between digital skills and learner performance, it did not sufficiently interrogate how socio-economic disparities influence access to digital resources. From a theoretical standpoint, the absence of a guiding framework such as TPACK limits the ability to explain how technological knowledge interacts with pedagogical and content knowledge in shaping instructional practice.

Similarly, Adetayo (2023) investigated the impact of teacher training on digital resource utilisation in Nigerian mathematics classrooms. Post-training assessments revealed significant improvements in teaching effectiveness. However, the study highlighted the absence of sustained post-training support, suggesting that digital literacy development requires continuous professional development rather than one-time interventions. Additionally, the research was conducted primarily in urban settings, limiting generalizability to rural areas where infrastructural and institutional support may differ significantly. This underscores the importance of examining digital literacy within localised contexts such as Kanduyi Sub-County, where rural realities may influence the practical integration of digital tools in lower primary mathematics classrooms.

MATERIALS AND METHODS

This study employed a descriptive survey research design to collect first-hand data from respondents within their natural school environments (Creswell & Creswell, 2023). The target population comprised 92 public primary schools in Kanduyi Sub-County, including 92 head teachers and 631 lower primary teachers (Grades 1–3). Due to the large population, the sample size was determined using Yamane's (1973) formula for finite populations, resulting in 23 head teachers and 235 teachers selected through simple random sampling to ensure representativeness and minimise bias. Data were collected using a structured questionnaire for teachers and a semi-structured interview schedule for head teachers. Quantitative data were analysed using descriptive statistics (frequencies, percentages, means, and standard deviations) and inferential statistics, specifically the Karl Pearson Product–Moment Correlation Coefficient, to determine the relationship between teachers' digital literacy skills and mathematics learning activities.

Qualitative data from head teacher interviews were analysed thematically. Responses were transcribed, coded, and organised into emerging themes aligned with the study objectives, particularly digital literacy competence, instructional practices, and institutional support. To ensure validity, the research instruments were reviewed by experts for content relevance and clarity, and a pilot study was conducted outside the study area to refine the tools. Reliability of the questionnaire was established using Cronbach's alpha to assess internal consistency before the final administration of the instruments.

RESULTS AND DISCUSSIONS

The teachers were also asked to provide information on their age bracket. The outcome is presented in Table 1.

Table 1: Teachers Age Bracket

Category	Frequency	Percent
20 - 30yrs	79	35.7
31 - 40yrs	90	40.7
41 - 50yrs	36	16.3
51 yrs & above	16	7.2
Total	**221**	**100.0**

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Results show that 79 (35.7%) of teachers were aged between 20 – 30 years, 90 (40.7%) were aged between 31 – 40 years, 36 (16.3%) were aged between 41 – 50 years and only 16 (7.2%) were aged 51 years and above. It can be seen that more than 75% of teachers were aged below 40 years, and it is assumed that most of the individuals within this age group bracket have been exposed to the digital revolution. The study seeks to identify the degree to which they possess digital literacy, which is key towards mathematics learning.

The objective of the study was to determine how the teacher's level of digital literacy skills influenced the teaching of the Mathematics subject in lower primary schools in Kanduyi constituency. The study collected data from head teachers and teachers through the use of a questionnaire and an interview schedule. Out of the 18 head teachers interviewed, 9 (50.0%) rated their teacher's level of digital literacy as moderate, 5 (27.8%) as average, 2 (11.1%) as very low and 2 (11.1%) as high. For those who indicated that some of their teachers were competent in digital literacy, here is what Headteacher No. 15 said:

> *Some teachers demonstrate a good understanding and ability to use digital tools effectively. Others are still developing their skills in this area.*

For those who indicated the level of their teachers' digital literacy skills to be average, here is what Head Teacher No. 1 said:

> *Moderate, this is because they can use and access the digital devices in the classroom teaching and learning process.*

For those head teachers who indicated their teachers' level of skills to be below average, Head teacher No. 6 said that:

> *They can hardly operate digital devices on their own, requiring support from teachers or computer experts.*

The above response shows that a number of teachers in schools in Kanduyi Sub-County still have a challenge of using digital devices unless they receive support from a knowledgeable person. Viberg et al. (2023) observed that in this instance, when teachers do not have the capacity to integrate digital technology well, this means that even the learners cannot gain the knowledge and skills required to operate such devices on their own.

Further, teachers were asked to rate their level of digital literacy skills as: Very Low, Low, Moderate, High and Very High. The results are given in Table 2.

Table 2: Teachers' Digital Literacy Skills in Teaching Mathematics

Teachers digital literacy	Very low	Low	Moderate	High	Very High	Mean	Std. Dev
Handling digital tools	4 (1.8%)	13 (5.9%)	125 (56.6%)	45 (20.4%)	34 (15.4%)	3.42	0.88
Assessing digital information	2 (0.9%)	32 (14.5%)	113 (51.1%)	40 (18.1%)	34 (15.4%)	3.33	0.94
Ability to use spreadsheets/database applications	1 (0.5%)	51 (23.1%)	119 (53.8%)	33 (14.9%)	17 (7.7%)	3.06	0.84
Finding mathematical information through search engines	0 (0.0%)	4 (19.0%)	119 (53.8%)	25 (11.3%)	35 (15.8%)	3.24	0.94
Creating new information through digital devices	0 (0.0%)	25 (11.3%)	120 (50.3%)	46 (20.8%)	30 (13.6%)	3.37	0.86
Sharing information through digital devices	0 (0.0%)	31 (14.0%)	99 (44.8%)	44 (19.9%)	47 (21.3%)	3.48	0.98

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Teachers digital literacy	Very low	Low	Moderate	High	Very High	Mean	Std. Dev
Creating and conducting digital classes	0 (0.0%)	65 (29.4%)	100 (45.2%)	21 (9.5%)	35 (15.8%)	3.12	1.01
Composite score						**3.29**	**0.92**

Results show that 56.6% of teachers had an average capacity of handling digital tools, and only 35.8% of teachers were capable of handling various digital tools. The result implies that most teachers' ability to handle various digital equipment for learning is at a moderate level (mean=3.42, Std. Dev=0.88). This could be due to a lack of exposure to such tools, being used to print-based resources or a lack of interest in using the digital tools. Secondly, more than half (51.1%) of the teachers also said that their ability to assess digital information was at an average level. Only 33.5% of respondents were well-versed in the assessment of digital information. Thirdly, the study results reveal that more than half (53.8%) of teachers also showed an average level of capacity to use database applications and spreadsheets on computers.

Surprisingly, 23.1% had a low level of usage of spreadsheets, and only 22.6% of teachers appeared to be competent in using spreadsheets/database. The result shows that the level of teachers working through the database application and spreadsheet was at an average level (mean=3.03, Std Dev=0.84). Teachers' weakness in spreadsheets may stem from insufficient targeted training that focuses on practical classroom applications, as well as limited awareness of how tools like MS Excel can support lower primary mathematics instruction. Additionally, infrastructural constraints and a lack of continuous practice opportunities may further hinder their confidence and effective integration of spreadsheet applications in teaching.

Fourthly, most (53.8%) of teachers' ability to find mathematical information through internet search engines was at average, 4 (19.0%) had low capacity, and only 27.1% had a high level of capacity to conduct searches on various mathematical topics in the internet search engine. Fifthly, half (50.3%) of respondents had a moderate level of creation of new information through digital devices, 11.3% capacity was a low while 34.4% had a higher level of creating new information through the use of digital devices. The results also show that most teachers had an average (mean=3.37, Std Dev=0.86) level of skills in the creation of new information through digital devices. The results also show that 14.0% had a low level of skills in sharing information through digital devices, 44.8% had moderate capacity, 19.9% said their skills were high, and 21.3% indicated that it was very high. The descriptive results show that a considerable number of teachers (41.2%) had the capacity to share information at a high level, with 44.8% showing a moderate level of capacity.

Lastly, research findings show that 29.4% of teachers could not create or conduct digital lessons, 100 (45.2%) said that they could conduct digital lessons at a moderate level, and only a quarter (25.3%) of teachers appeared to be able to do so. This shows that the level of teachers to create and conduct digital classes online was found to be at a moderate level (mean=3.12, Std Dev=1.01). Composite statistics show that the level of teacher digital literacy skills was at an average level (mean=3.29, Std. Dev=0.92) in public primary schools in Kanduyi Sub-County, Kenya. This finding coincides with what head teachers reported, that nearly 50.0% of their teachers' level of digital literacy was at an average level. The result coincides with Otieno's (2024) research, which found that most teachers' level of competency in digital literacy skills was at a basic level in Rachuonyo South Sub-County. Similarly, Chama and Subaveerapandiyan's (2023) research from Zambia showed that most teachers possessed moderate levels of digital literacy skills.

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To examine the relationship between teachers' level of digital literacy skills and mathematics teaching in schools, respondents were asked to indicate the level of achievement of their learners (performance) in class with respect to mathematics activities which were ranked on a Likert scale of five; very low (1), low (2), moderate (3), high (4) and very high (5). Results are provided in Table 3.

Table 3: Teaching of Mathematics Subject in Lower Primary Schools

Mathematics learning	Very low	Low	Moderate	High	Very High	Mean	Std. Dev
Pupils working out mathematical problems	0 (0.0%)	17 (7.7%)	139 (62.9%)	33 (14.9%)	32 (14.5%)	3.36	0.82
Pupils' interest in mathematics learning	0 (0.0%)	46 (20.8%)	125 (56.6%)	19 (8.6%)	31 (14.0%)	3.16	0.91
Pupils' performance/scores in mathematics tasks	0 (0.0%)	59 (26.7%)	110 (49.8%)	27 (12.2%)	25 (11.3%)	3.08	0.92
Pupils' application of mathematical knowledge	0 (0.0%)	50 (22.6%)	117 (52.9%)	29 (13.1%)	25 (11.3%)	3.13	0.89
Counting & measuring using digital devices	0 (0.0%)	71 (32.1%)	102 (46.2%)	44 (19.9%)	4 (1.8%)	2.91	0.77
Ability to use digital devices to draw or sketch mathematical symbols	5 (2.3%)	92 (41.6%)	75 (33.9%)	18 (8.1%)	31 (14.0%)	2.90	1.07
Composite scores						**3.09**	**0.90**

Teachers ranked the capacity of pupils in their class to work out mathematical problems as low for 7.7%, moderate for 62.9%, high for 14.9% and very high for 14.5%. the above finding suggests that the capacity of most pupils in public primary schools in Kanduyi Sub County to work out mathematical problems was at average level (mean=3.36, Std=0.82). with respect to pupils' interest in mathematics, statistics shows 20.8% was rated as low, 56.6% of pupils had moderate interest, 8.6% rated their learners to have higher interest and 14.0% said their learners interest in mathematics learning was very high. From the result, it can be deduced that learners' interest in mathematics learning is at an average level, which is worrying, owing to the government's aims to push more students to undertake STEM courses in their future careers.

With respect to pupils' performance in mathematics tasks, 26.7% of teachers rated it as low, 110 (49.8%) indicated that it was on average, 12.2% rated their performance as high, and 11.3% said that their pupils' performance was very high. The result suggests that the performance of pupils in mathematics tasks in public primary schools in the sub-county was at an average level. On the level of pupils' application of mathematical knowledge in solving various assignments, 22.6% of teachers said it was low, 52.9% said that it was on a moderate level, 13.1% said it was high, and 11.3% said it was very high. The result also confirms that more than half of the pupils can apply mathematical knowledge being taught in the classroom to solve mathematical issues at a moderate level in the study area.

Teachers rated their pupils' ability to count and measure using digital devices as low for 32.1% of their pupils, 46.2% as moderate, 19.9% as high and 1.8% as very high. This shows that pupils' counting and ability to measure using digital devices in mathematics learning was at an average level. This could be due to their non-exposure to digital equipment and applications in their classrooms by their teachers. Lastly, research

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shows that 2.3% of pupils could not use digital devices to draw or sketch mathematical activities, 41.6% said that the ability of their pupils to perform such tasks was low, 33.9% said it was at a moderate level, 8.1% said it was high, and 14.0% indicated that it was very high. This shows that pupils' capacity to draw or sketch using digital devices in undertaking mathematics tasks is low. Composite statistics show that the level of learners' achievement in mathematics learning activities in public primary schools in Kanduyi sub-county was at an average level (3.09).

To examine the effect of teachers' level of digital literacy skills and pupils' mathematics learning, a Karl Pearson correlation analysis was computed. The result is presented in Table 4.

Table 4: Effect of Teacher Level of Digital Literacy Skills and Mathematics Teaching by Pupils

		Level of Digital Skills	Mathematics Learning Activities
Level of Digital Skills	Pearson Correlation	1	.567**
	Sig. (2-tailed)		.000
	N	221	221
Mathematics Learning Activities	Pearson Correlation	.567**	1
	Sig. (2-tailed)	.000	
	N	221	221

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

Statistics show the existence of a significant moderate positive effect (r=0.567, p=0.001) between teachers' level of digital skills and mathematics learning activities in public primary schools in Kanduyi Sub-County, Kenya. The above result suggests that an increase in teachers' level of digital literacy skills would result in a subsequent increase in mathematics learning activities by pupils in schools. The relationship appears to be at a moderate level. Therefore, for improvement in mathematics learning activities in the present times, teachers' acquisition of digital literacy skills is significant.

CONCLUSIONS AND RECOMMENDATIONS

This study examined the relationship between teachers' digital literacy skills and the teaching of mathematics in public lower primary schools in Kanduyi Sub-County, Kenya. The findings indicate that although most teachers demonstrated moderate digital competence, notable weaknesses existed in advanced applications such as spreadsheets and database tools, which are essential for interactive and data-driven mathematics instruction. Importantly, the study established a statistically significant moderate positive correlation ($r = .567$, $p < .01$) between teachers' digital literacy and mathematics learning activities. This provides empirical evidence within the Kenyan lower primary context that stronger teacher digital competencies are associated with improved learner participation, engagement, and mathematics performance.

Given this evidence, targeted interventions are necessary to strengthen teacher capacity. Professional development programs should move beyond basic ICT orientation to focus on practical classroom applications, particularly the use of spreadsheet tools such as MS Excel for creating interactive graphs, automating calculations, and tracking learner progress. Additionally, structured follow-up support and school-based mentorship systems should be implemented to ensure sustained and equitable digital integration across classrooms.

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