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Teachers' Digital Literacy and Teaching Quality: Examining the Mediating Role of Instructional Flexibility

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ABSTRACT

This study examined the mediating role of instructional flexibility (IF) on the relationship between digital literacy (DL) and teaching quality (TQ) in Junior High Schools in Ghana. A quantitative cross-sectional survey of 220 teachers from Junior High Schools was employed. A questionnaire was developed to measure digital literacy, instructional flexibility, and teaching quality. DL significantly predicted TQ ($\beta = 0.273$, $p < 0.001$). Further, DL predicted IF ($\beta = 0.462$, $p < 0.001$). IF significantly predicted TQ ($\beta = 0.379$, $p < 0.001$). IF also significantly mediated DL and TQ partially ($\beta = 0.179$, $p < 0.001$). Findings highlighted implications for teacher professional development, specifically that professional development programs should train teachers on digital skills and pedagogical flexibility to use technology instructionally. This study highlighted the emerging evidence from Ghana that digital literacy enhances teaching quality, specifically by increasing a teacher's pedagogical flexibility.

Keywords: Digital literacy, Instructional flexibility, Teaching quality, Teachers.

INTRODUCTION

The use of digital tools in teaching is gaining importance, especially in Ghana and across the African continent, due to the improvement in the quality of education. To help reduce the digital divide and promote equal access to quality education, Ghana's education policies place strong emphasis on integrating information and communication technology (ICT) into teaching and learning (Abedi, 2024; Ofosu-Asare, 2024). In practice, however, many teachers face challenges such as poor infrastructure, limited access to digital devices, and few opportunities for sustained professional development, particularly those in rural and underserved communities (Ofosu-Asare, 2024; Quaicoe & Pata, 2020). Ghanaian teachers do not always use digital tools in their teaching, even though research has shown that many teachers report their digital literacy as above average (Quaicoe & Pata, 2020). The COVID-19 pandemic further exposed these realities, thereby prompting renewed investment in digital skills training and technological infrastructure to promote more inclusive education systems (Adarkwah, 2021; Nyarkoh, 2025). In view of these developments, it is worth noting that possessing digital skills alone is not enough to guarantee improvements in teaching quality. An important factor that helps in explaining this gap is instructional flexibility.

A teacher's ability to modify methods and materials for the teaching and learning process is referred to as instructional flexibility. This adjustment is important as it helps to connect digital literacy to effective teaching. Studies have shown that when teachers have high levels of digital literacy, they can adapt their instruction, personalise learning, and consider multiple digital resources to meet students' needs (Damanik & Widodo, 2024; Kayi, 2024). A recent study found that digital teaching skills improve classroom interaction and student engagement, although there is no clarity on how it occurs in practice (Zhang & Wu, 2025). In addition, Evna and Tusyanah (2025) showed that self-efficacy plays a role in translating digital literacy into professional competence. These findings suggest that having digital skills alone is not enough; what matters most is how effectively teachers apply those skills in the classroom. However, despite this potential, there is a clear gap between what happens in class and policy expectations. A study by Abedi (2024) found that many teachers use technology when preparing lessons but do not use it effectively during instruction to promote student-centered, interactive, or constructivist learning. This is often due to rigid teaching practices and institutional structures, which can reduce the teaching quality.

Lockwood et al. (2015) believe that quality in teaching comprises many dimensions, including clarity in instructions, engagement strategies, differentiated instruction, and classroom management. In Ghana, research suggests that teaching quality is somewhat inconsistent at the junior high school level because of differences in teacher preparation, inadequate resources, and limited professional development opportunities (Asibey & Arhin, 2022). Digital literacy's potential has not been fully realised in practice, even though it helps in improving teaching quality. Therefore, it can be inferred that instructionally flexible and digitally literate teachers will offer higher-quality instruction.

In view of growing interest in digital literacy as a means of improving teaching quality, a gap remains between its potential and its use in classroom practice, especially in Ghanaian junior high schools. Studies suggest that access to digital tools and basic technical skills alone are not enough to enhance teaching quality without pedagogically informed and adaptive use (Arkorful et al., 2021; Ertmer & Ottenbreit-Leftwich, 2010). Although teachers' ability to adjust strategies, resources, and activities to meet student needs (instructional flexibility) is recognised as a key feature of effective teaching (Darling-Hammond et al., 2017), its mediating role between digital literacy and teaching quality remains underexplored.

Therefore, this study examines how digital literacy influences teaching quality in Ghanaian junior high schools, both directly and indirectly through instructional flexibility. Instructional flexibility here serves as a bridge, enabling teachers to improve learning outcomes.

Research Hypothesis

The following hypotheses were proposed:

H_1: Digital literacy has a positive and significant direct effect on teaching quality.

H_2: Digital literacy has a positive and significant direct effect on instructional flexibility.

H_3: Instructional flexibility has a positive and significant direct effect on teaching quality.

H_4: Instructional flexibility mediates the relationship between teachers' digital literacy and teaching quality.

LITERATURE REVIEW

Theoretical Review

Technological Pedagogical Content Knowledge (TPACK) and the Technology Acceptance Model (TAM) are frameworks that support this study. TPACK emphasises that effective teaching with technology is not simply about

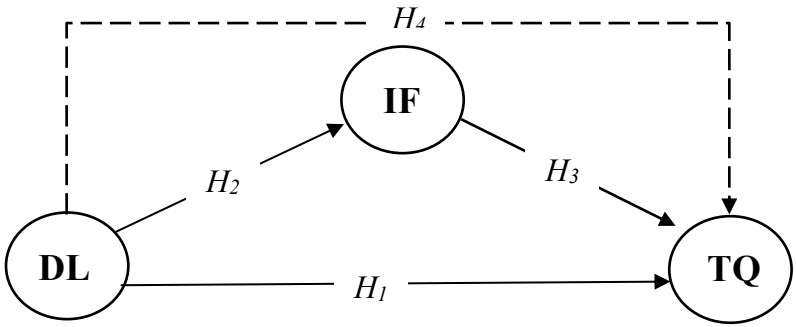
knowing how to operate digital tools; it requires the integration of content knowledge (what is being taught), pedagogical knowledge (how to teach), and technological knowledge (how to use digital tools) in a meaningful and seamless way (Mishra & Koehler, 2006; Tondeur et al., 2019). Within this framework, digital literacy is a crucial component of technological knowledge, encompassing not only the technical use of tools but also the ability to find, evaluate, and apply digital resources to enhance student learning. Evidence from Ghana indicates that, although many teachers have access to digital tools, classroom practices remain largely teacher-centred rather than facilitating constructivist or participatory learning (Abedi et al., 2024). This goes contrary to the importance of instructional flexibility, thereby hindering the effective application of TPACK in classroom instruction.

TAM complements TPACK by addressing motivational and attitudinal factors that affect the usage of technology in the classroom. How teachers perceive the ease and usefulness of technology impacts their adoption of it (Davis, 1989). Even teachers with strong digital skills may avoid using digital tools in instruction if they perceive them as difficult, unnecessary, or time-consuming. Conversely, teachers who recognise clear benefits and feel confident using technology are more likely to integrate it creatively and flexibly, supporting student-centred learning.

Conceptual Framework

The conceptual framework of this study shows how the constructs: digital literacy, instructional flexibility, and teaching quality, are studied regarding Junior High School teachers in the Kwadaso Municipality of Ghana. A conceptual framework is a structural guide that specifies how main variables operate in a study, connecting research questions to theory and existing empirical evidence (Waldt, 2020).

Figure 1
Conceptual Framework



Source: Authors' Creation, 2026

RESEARCH METHOD

Design

The research utilised a quantitative approach based on a cross-sectional survey design. Creswell (2009) states that a cross-sectional design examines relationships between variables of interest in a defined population over a single period of time. In this way, data for the current study were collected from participants over a single, fixed period.

Population, Sample Size, and Sampling Technique

The study was conducted among Junior High School teachers in the Kwadaso Municipality in the Ashanti Region of Ghana, focusing on teachers teaching Mathematics, Integrated Science, and ICT. The sample size for the study was the minimum required sample size, which was calculated using Daniel Soper's Calculator for Structural Equation Models (Soper, 2026), based on three latent variables, fourteen observed variables, an effect size of 0.25, a statistical power of 0.88, and a significance level of 0.05. This calculation produced a minimum recommendation of 220 participants. Convenience sampling was used to obtain data from teachers present at the time of data collection and who volunteered for the study. The questionnaire was printed on paper for respondents to complete without complications, and the survey cover letter was attached to each printed questionnaire. The cover letter both described the purpose of the study and the participants' eligibility, and assured confidentiality and anonymity. The demographics are shown in Table 1

Table 1
Demographics of teachers

Demographic Characteristics	Teachers	
	220	%
Gender		
Male	138	62.73
Female	82	37.27
Age		
20 – 30	144	65.45
31 – 40	69	31.36
41 – 50	7	3.19
Above 50	-	-
Qualification		
Certificate	47	21.36

Diploma	130	59.10
Bachelor's	38	17.27
Master's	5	2.27
Years of teaching		
0 – 1	36	16.36
2 – 4	93	42.27
5 – 7	72	32.73
Above 8	19	8.64
Subjects taught		
Mathematics	85	38.64
Integrated Science	70	31.82
ICT	65	29.54
School type		
Public	120	54.55
Private	100	45.45

Instruments

A questionnaire was administered to respondents, using measurement items drawn from established, valid research literature. The instrument consisted of four components. The first section (Section A) contained demographic data, as shown in Table 1. Section B was the second part, with measurement items on digital literacy, adapted from the digital competence framework (Redecker, 2017) and technological literacy indicators (Schmidt et al., 2009). Section C contained items of teaching quality developed from the Organisation for Economic Co-operation and Development (OECD) TALIS framework (OECD, 2020). The last part, titled Section D, had measurement items of instructional flexibility developed from the Teacher Adaptability Scale (Collie & Martin, 2016), the principles of differentiated instruction (Tomlinson, 2001), and the dimensions of instructional adaptation created in (Parsons et al.'s (2018) study; these are all shown in Table 5. All items were on a 5-point Likert scale (1 = strongly disagree, and 5 = strongly agree).

Convergent Validity and Reliability

The content validity of the questionnaire was verified by experts with research backgrounds aligned with the overall study. The content validity review documented that items were conceptually valid and unambiguous, thereby reflecting the study objectives, and were appropriately worded for participant comprehension. Average Variance Extracted (AVE) was used to test for convergent validity. As recommended by studies (Gyasi et al., 2024; Gyimah et al., 2026), it is achieved when AVE values exceed the 0.50 threshold. All

constructs of digital literacy, instructional flexibility, and teaching quality met this threshold and exhibited evidence of acceptable convergence. Reliability analyses were also conducted in SPSS (v.27) using Cronbach's alpha. All the measurement items met the acceptable threshold of 0.70, as recommended by Boadu et al. (2023), thereby indicating that the constructs were sufficiently reliable for the main study. This is shown in Table 2

Table 2
Reliability and Convergent Validity

Variables	Number of items	C.A	AVE
Digital Literacy (DL)	5	0.918	0.695
Instructional Flexibility (IF)	4	0.868	0.624
Teaching Quality (TQ)	5	0.928	0.724

Note: AVE = Average Variance Extracted, C.A = Cronbach's Alpha

Discriminant Validity

In checking for discriminant validity, we looked at the square root of Average Variance Extracted (√AVE) for each construct and the correlations between constructs. As stated by Asare et al. (2025), discriminant validity is established when the lowest √AVE value exceeds the highest correlation between latent variables. The smallest √AVE identified was 0.790, as shown in Table 3, and the highest inter-construct correlation found was 0.510. The data showed that discriminant validity was achieved because the √AVE was higher than the maximum correlation.

Table 3
Discriminant Validity

Variables	DL	IF	TQ
DL	***0.834***		
IF	0.510	***0.790***	
TQ	0.457	0.493	***0.851***

Note: √AVEs are in italics and bolded

RESULTS

Exploratory Factor Analysis (EFA), KMO, and Bartlett's Test

An exploratory factor analysis (EFA) was conducted to study the latent structure of the measurement items. The researcher used principal component analysis with varimax rotation to examine whether the observed variables grouped under their expected latent constructs, since this method maximizes the explained variance across each factor. According to standard recommendations (Davor et al., 2025; Owusu et al., 2022), the items with factor loadings above 0.50 were used in the analysis. The Kaiser-Meyer-Olkin (KMO) statistic was 0.915, indicating excellent sampling adequacy, whereas Bartlett's Test of Sphericity, χ^2 (91) = 2141.208, $p < .001$, confirmed that the correlations between items were adequate for factor extraction. The researcher also checked for multicollinearity and found it to be good, since the determinant of the correlation matrix was 4.410E-5. In total, the three constructs accounted for approximately 76.00% of total variance, which met the common standard of being over 50% (Marsh et al., 2020). For the detailed results, see Table 4.

Table 4
Exploratory Factor Analysis, KMO, and Bartlett's

Rotated Component Matrix			
Measurement Items	Component		
	1	2	3
DL1		0.848	
DL2		0.773	
DL3		0.863	
DL4		0.844	
DL5		0.828	
IF1			0.809
IF3			0.798
IF4			0.802
IF6			0.812
TQ2	0.857		
TQ3	0.832		
TQ4	0.854		
TQ5	0.846		

TQ6		0.847

KMO and Bartlett's Test		
Total Variance Explained		**75.56%**
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.915
Bartlett's Test of Sphericity	Approx. Chi-Square	2141.208
	df	91
	Sig.	0.000
Determinant		4.410E-5

Confirmatory Factor Analysis (CFA)

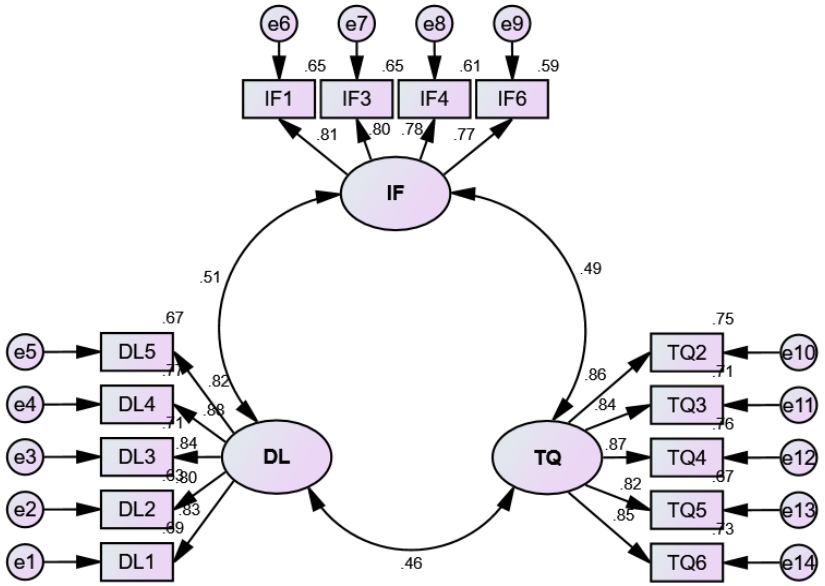
Confirmatory factor analysis examines the data to determine the degree to which it fits the proposed factor structure and provides evidence of the theoretical validity of the measurement model. Research has established that models fit the data adequately when CMIN/DF is less than 3, CFI and TLI are greater than 0.90, RMR and RMSEA are less than 0.08, and GFI is greater than 0.80 (Hair et al., 2017; Lotey et al., 2023). The proposed model met all of these thresholds, indicating good overall fit. In addition, all indicators had standardised factor loadings greater than 0.50, indicating each represented a strong indicator of the construct. The CFA is reported in Table 5

Table 5
Confirmatory Factor Analysis

Model Fitness: CMIN = 77.273; DF = 74; CMIN/DF = 1.044; TLI = 0.997; CFI = 0.996; GFI = 0.953; RMSEA = 0.014; SRMR = 0.027; PClose = 0.990		Std. Factor Loadings
Digital Literacy: CA= 0.918; CR = 0.919; AVE = 0.695		
DL1	I can use a range of digital tools to prepare lessons	0.829
DL2	I can use digital tools to assess student learning and provide feedback	0.796
DL3	I am confident in designing activities that purposefully integrate digital tools with pedagogy	0.845
DL4	I can create or adapt digital learning resources for my students.	0.879
DL5	I can evaluate the appropriateness of digital tools before integrating them into my lessons.	0.818
Instructional Flexibility: CA= 0.868; CR = 0.869; AVE = 0.624		

IF1	I modify materials or tasks during the lesson for learners with different ability levels or learning needs.	0.806
IF3	I switch between online and offline resources to meet my students' needs.	0.804
IF4	I promptly change the instructional method if a lesson plan is not engaging students	0.781
IF6	I reflect during lessons and adjust my teaching strategy if it is not meeting students' needs	0.767
Teaching Quality: CA= 0.928; CR = 0.929; AVE = 0.724		
TQ2	I clearly present lesson objectives, so students understand what I expect them to learn	0.865
TQ3	I use formative assessment during lessons to gauge student understanding	0.845
TQ4	I maintain a classroom environment that supports student engagement and learning	0.871
TQ5	I use a variety of instructional strategies to promote deep understanding of the content	0.818
TQ6	I provide timely and constructive feedback to help students improve their learning	0.855

Figure 2
Confirmatory Factor Analysis



Source: Authors' Creation, 2026

Structural Model

The structural model in the research was tested using AMOS version 23. A bias-corrected bootstrapping procedure with 5,000 resamples and a 95% confidence interval was implemented to alleviate potential estimation errors. Model fit was evaluated using fit indices as recommended by (Hu & Bentler, 1999). The results indicated sufficient fit for the structural model. A summary table of the hypothesis testing results is shown in Table 6.

Table 6
Path Summary

Direct Effects	Estimate	S.E.	C.R.	p-value
DL → TQ	0.273	0.076	3.592	***
DL → IF	0.462	0.068	6.794	***
IF → TQ	0.379	0.088	4.307	***
Indirect Effect	**Estimate**	**Lower BC**	**Upper BC**	**p-value**
DL → IF→ TQ	0.179	0.102	0.276	0.000

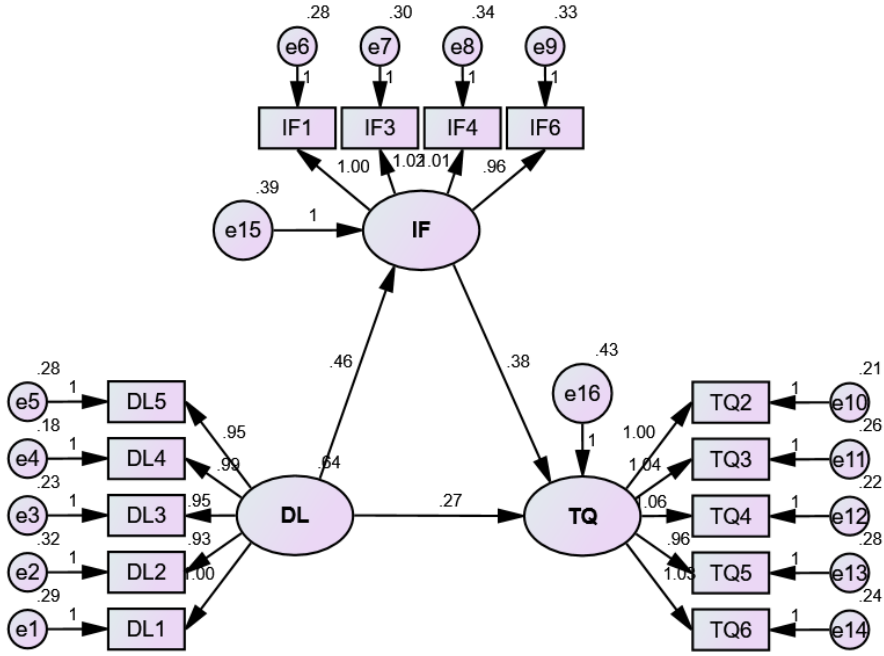
Note: *** represents p-value less than 0.01(1%) level of significance

According to the results in Table 6, digital literacy had a statistically significant direct effect on teaching quality ($\beta = 0.273$, $p < 0.001$), indicating that digitally literate teachers are likely to provide higher quality instruction. Digital literacy also had a significant effect on instructional flexibility ($\beta = 0.462$, $p < 0.001$), which suggested that teachers with high digital literacy are likely to adapt their instruction in response to classroom demands. Instructional flexibility had a statistically significant positive direct effect on teaching quality ($\beta = 0.379$, $p < 0.001$), meaning that teachers who adapt their strategies ultimately demonstrate responsive and effective teaching practices.

The mediation analysis also showed that instructional flexibility mediated the relationship between digital literacy and teaching quality significantly ($\beta = 0.179$, $p < 0.001$). This means that part of the effect of digital literacy on teaching quality is through teachers' ability to adapt, change, and arrange their instructional practices. Thus, increased digital ability improves teaching quality both directly and indirectly by supporting more flexible instructional practices, which in turn enhance overall teaching.

Figure 3

Path Analysis



Source: Authors' Creation, 2026

DISCUSSION

The findings of this study show that when teachers are digitally literate, they become more flexible in how they deliver instruction, and this, in turn, improves the quality of their teaching, thereby reaffirming the importance of digital competence. Digital literacy directly influenced teaching quality, but the effect occurred through instructional flexibility, which acted as an important mediator. This pattern indicates that digital skills become pedagogically productive when teachers flexibly adapt their instructional practice to the demands of their teaching contexts.

These findings are consistent with TPACK theory, which states that successful integration of technology happens at the intersection of technology, pedagogy, and content knowledge. Digital literacy supports the use of technology in teaching, while instructional flexibility reflects how teachers adjust their teaching methods, allowing technology to effectively improve teaching quality

(Tondeur et al., 2019). Thus, the mediation effects substantiate the idea that a teacher cannot simply possess a set of digital teaching competencies; they must also practice pedagogical flexibility in their usage of technology in multiple contexts. The Technology Acceptance Model (TAM), which posits that perceived usefulness and ease of use of technology shape intention and willingness to adopt digital tools (Davis, 1989), further supports these findings. Digitally literate teachers are more confident in using digital platforms and are likely to value technology, so they tend to use it more in their teaching. This helps them adapt lesson materials in ways that keep students engaged and support effective learning.

In the context of Ghanaian education, these findings provide significant implications. Earlier studies show that many teachers have only moderate digital skills, and the use of technology in classrooms is often limited by factors such as a lack of resources, teaching methods, and training opportunities (Ofosu-Asare, 2024; Quaicoe & Pata, 2020). In many basic schools, technology is still used in a teacher-centred way, with little focus on flexible or student-centred learning (Abedi, 2024). The recent digital competency model for the AI era also shows that teachers need to use technology in teaching, make good use of data, and use digital tools responsibly (Wang et al., 2026). However, for these skills to be useful in practice, teachers must be flexible in how they use them in different classroom situations. The current study adds to the literature that digital skills alone are not enough, as teaching quality improves most when teachers use those skills flexibly in real classroom contexts. In simple terms, it is not just about knowing how to use technology, but about using it in ways that fit the needs of the class and the learning environment.

This is therefore important for middle school teachers because at that level, students are beginning to think more independently and would need different kinds of support. In view of the findings, teacher training should focus more on the practical use of technology in the classroom. Professional development programs should therefore combine digital training with strategies that help teachers adapt their teaching to different situations. In Ghana and similar contexts, this kind of approach can help improve teaching quality, especially as classrooms become more technology-rich.

CONCLUSION

This study examined the interplay of digital literacy, instructional flexibility, and teaching quality among Junior High School teachers in Kwadaso Municipality of the Ashanti Region of Ghana. Results indicated a direct relationship between digital literacy and teaching quality. However, there was also an influence that emerged from a mediating relationship via instructional flexibility. This suggests that teachers' technological competence alone does not guarantee quality instruction. Still, teachers' ability to adapt, alter, and reorganise methods of

instruction mediates how teachers translate digital competencies into an appropriate quality of instruction. These results underscore the importance of teachers' adaptive capacities in technology-based instruction.

Instructional flexibility was also a significant predictor of quality of instruction, indicating that teachers who responded flexibly and dynamically to learners' needs, contextual opportunities and challenges, and curriculum demands created more stimulating and successful learning experiences. In the Ghanaian education system, where classrooms are more atypical than conventional, and because the infrastructure available to support teachers also varies widely, our findings emphasise the need for a professional development approach that builds on or shifts from relatively benign technical competency-building experiences to building collaborative, flexible, reflective, and context-oriented pedagogical skills. Thus, improving the quality of instruction will aid in developing teachers' digital competencies, thereby affecting their pedagogical flexibility competencies. Equipped with both sets of competencies, teachers will be better positioned to create learner-centred, innovative, and resilient classrooms that effectively harness technology as a valuable resource.

Limitations

The cross-sectional study design limits the ability to establish cause-and-effect relationships, which may affect the generalizability of the findings, especially since the researcher used convenience sampling to select the sample from a single location. Also, the self-reported data may introduce bias, thereby affecting the accuracy of the collected responses.

Recommendation for Future Research

Future research can investigate teachers from other districts or school levels in Ghana to assess the generalizability of these results. Longitudinal studies could also be useful to examine how digital literacy and instructional flexibility develop over time, especially with ongoing training. Finally, the potential for incorporating moderators, including teaching experience, geographic location of school, and institutional support, would provide more in-depth insights into when and for whom a greater or lesser enhancement of instructional quality is produced by digital literacy.

Ethical Statement: Ethical approval was given by the Mathematics Education Research Ethics Committee of Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED) under reference number AAMUSTED/IERC/2026/018. I declare that I have considered the principles and research ethics and that I am responsible for the content of this paper.

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Declarations: The author attests that there were no conflicts of interest regarding the study.

Data availability and sharing policy: Data supporting this study will be made available by the corresponding author upon request.

Consent to Participate: The study was open for voluntary participation. Before data collection began, the participants received comprehensive information concerning the purpose, methods, risks, and anticipated advantages of the research. They were also assured that their data would be kept private and that they could leave the study at any time without penalty.

Generative AI Statement

The author employed ChatGPT and Grammarly to refine the language. The author has reviewed and edited the content and accepts full responsibility for the contents of this publication.

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