



(RESEARCH ARTICLE)



ESSENTIAL DIGITAL COMPETENCIES AND THEIR EFFECT ON EFFECTIVE IMPLEMENTATION OF KENYA'S COMPETENCY-BASED CURRICULUM AMONG EARLY CHILDHOOD DEVELOPMENT TEACHERS

Constance Malesi Amusala ¹, Paul Oduor Oyile ^{2,*}, Anselemo Peters Ikoha ², and Yuvalier Anjao ¹

¹ Department of Educational Foundations, Psychology and Management, Kaimosi Friends University, Kaimosi, Kenya.

² Department of Information Technology, Kibabii University, Bungoma, Kenya.

* Corresponding Author

ORCID Details

Paul Oduor Oyile: <https://orcid.org/0000-0003-1654-3600>

Anselemo Peters Ikoha: <https://orcid.org/0009-0002-9500-8058>

World Journal of Advanced Engineering Technology and Sciences, 2026, 20(03), 044–050

Publication history: Received on 02 August 2026; revised on 10 September 2026; accepted on 13 September 2026

Article DOI: <https://doi.org/10.30574/wjaets.2026.20.3.0423>

Copyright © 2026 Author(s) retain the copyright of this article. This article is published under the terms of the Creative Commons Attribution License 4.0

ABSTRACT

Digital competency frameworks for teachers have proliferated internationally, yet Kenya lacks a standalone, empirically grounded competency benchmark for early childhood development teachers implementing the competency-based curriculum at Pre-Primary Two. This paper reports findings from a ten-month convergent mixed-methods study conducted across six Kenyan counties, examining the essential digital competencies of early childhood development teachers and testing their relationship with effective curriculum implementation. Data were drawn from 51 teachers who completed a structured questionnaire following school-level focus group discussions, and from 16 school heads interviewed individually. Tests of normality confirmed non-normal distributions, justifying Spearman's rho as the correlation measure. A moderate, positive, and statistically significant correlation was found between essential digital competencies and effective curriculum implementation ($\rho = .567, p < .001$). Principal component analysis extracted two competency sub-constructs, Foundational Digital Competency and Pedagogical and Safety Competency, together explaining 69.95 percent of variance, and a single, unidimensional implementation outcome construct explaining 72.9 percent of variance. Basic device operation confidence was the weakest recorded competency, at 47.1 percent agreement, despite 88.2 percent of schools relying primarily on smartphones. Qualitative data from focus groups and interviews converged on the same conclusion as the statistical analysis: competency, not infrastructure, is the decisive determinant of effective digital integration. The paper concludes that teacher competency development should be the primary strategic lever for improving digital delivery of the curriculum at Pre-Primary Two.

Keywords: Digital Competency; Early Childhood Development; Competency-Based Curriculum; Teacher Professional Development; Kenya

1 INTRODUCTION

Kenya's Competency-Based Curriculum embeds digital literacy as a core competency from Pre-Primary Two onwards [1]. International frameworks, including UNESCO's ICT Competency Framework for Teachers [2], the European Digital Competence Framework for Educators [3], and the International Society for Technology in Education Standards [4], identify broad competency domains expected of teachers using technology in the classroom. These frameworks, however, were developed primarily for general education contexts and are not calibrated to the specific developmental demands of early childhood teaching or to the resource realities of low-connectivity settings such as much of rural Kenya.

The absence of a standalone, measurable digital competency framework for Kenyan early childhood development teachers weakens both policy implementation and monitoring [5]. Before such a framework can be constructed, the essential competencies actually required for effective classroom practice must be empirically identified, and their relationship with implementation outcomes must be tested directly rather than assumed from international precedent. This is the gap the present paper addresses.

This paper reports the second objective of a larger study developing the Digital Competency Framework for Early Childhood Development Teachers in Kenya. The specific objective addressed here was to analyse the essential digital competencies required for effective Pre-Primary Two instruction under the curriculum, and to establish their relationship with effective implementation. A companion paper reports the study's first objective, examining the digital integration challenges facing the same teacher sample, while a third output reports the development of the resulting weighted competency framework.

2 LITERATURE REVIEW

This section reviews the theoretical and empirical literature bearing on essential digital competencies for early childhood teaching, situating the present study within existing scholarship on teacher competency frameworks and technology integration.

2.1 Theoretical framework

The Technological Pedagogical Content Knowledge framework [6] provides the primary conceptual lens for this study, positing that effective technology integration requires the intersection of technological knowledge, pedagogical knowledge, and content knowledge. In the Pre-Primary Two context, this requires teachers to combine knowledge of digital tools, early childhood pedagogy, and curriculum-specific learning areas. Vygotsky's Zone of Proximal Development [7] further informs the structure of competency development itself, since structured peer mentoring and institutional support provide the scaffolding within which teacher digital competency grows over time, a principle that directly informs the competency progression pathway discussed later in this paper.

2.2 International and continental perspectives

Internationally, frameworks such as the ICT Competency Framework for Teachers [2], the European Digital Competence Framework for Educators [3], and the International Society for Technology in Education Standards [4] identify five broad competency domains relevant to early childhood teaching: the use of age-appropriate digital tools for play-based learning, digital pedagogy that fosters collaboration and creativity, professional growth through learning networks, digital assessment of learner progress, and online safety and digital wellbeing. The European framework specifically identifies digital assessment and content creation as core areas requiring progressive development, a pattern consistent with the competency gaps identified in this study.

At continental level, the Continental Education Strategy for Africa [8] and the African Union Digital Education Strategy [9] identify basic information and communication technology literacy, adaptation to low-connectivity contexts through offline and mobile-based content, and equitable access for girls and rural learners [10] as essential competencies. These continental priorities respond directly to the infrastructure realities documented in this study's companion paper, where the overwhelming majority of teachers rely on smartphones as their primary digital instructional tool.

2.3 The Kenyan context

Kenya's curriculum framework embeds digital literacy as a core competency across learning areas [1]. Pre-Primary Two teachers are expected to use simple devices for storytelling, songs, and creative play, conduct formative digital assessments capturing learner evidence for curriculum portfolios, and promote safe and ethical technology use [11]. Key literature gaps in the Kenyan context include low teacher preparedness and resource availability in rural schools [11] and the absence of a national competency benchmark specific to early childhood teaching, the gap this paper's findings directly inform.

3 METHODOLOGY

A convergent parallel mixed-methods design was employed [12], conducted across six purposefully selected Kenyan counties representing urban, peri-urban, and rural settings. Early childhood development teachers first took part in school-level focus group discussions, after which they completed a structured questionnaire; 51 teachers returned fully completed responses. Sixteen school heads participated separately in individual semi-structured interviews. The questionnaire's Section C measured essential digital competencies through eight Likert-scale items spanning device operation, content preparation, resource access, content adaptation, curriculum integration, digital assessment, continuous professional development engagement, and digital safety guidance. Section D measured effective curriculum implementation through seven items covering learner-centred activity, learning outcomes, creativity, digital assessment use, learner engagement, differentiated instruction, and teacher collaboration.

Quantitative data were analysed in IBM SPSS Statistics version 26. Scale reliability exceeded the conventional threshold of .70 for both composites. Normality was tested using the Kolmogorov-Smirnov and Shapiro-Wilk procedures; both confirmed significant departures from normality, justifying Spearman's rho as the correlation measure [13]. Construct structure was explored through principal component analysis using varimax rotation with Kaiser normalisation. Qualitative data from the focus group discussions and school head interviews were analysed thematically [14] and triangulated against the quantitative findings.

4 RESULTS

This section reports the study's findings in sequence: descriptive findings on essential digital competencies, descriptive findings on effective curriculum implementation, qualitative corroboration, construct extraction, and the relationship between competencies and effective curriculum implementation.

4.1 Descriptive findings on essential digital competencies

Table 1 presents the frequency and percentage distribution across the five response categories for each of the eight Section C items measuring essential digital competencies.

Table 1: Section C, essential digital competencies (n = 51)

Statement	SD	D	N	A	SA
C1. I am confident operating basic digital devices (tablet, laptop, projector).	8 (15.7%)	9 (17.6%)	10 (19.6%)	14 (27.5%)	10 (19.6%)
C2. I can prepare simple digital learning materials (e.g., slides, audio files, images).	4 (7.8%)	8 (15.7%)	12 (23.5%)	17 (33.3%)	10 (19.6%)
C3. I can access and use online teaching resources (videos, e-books, apps).	1 (2.0%)	6 (11.8%)	12 (23.5%)	19 (37.3%)	13 (25.5%)
C4. I know how to adapt digital content to the developmental level of PP2 learners.	0 (0.0%)	6 (11.8%)	13 (25.5%)	26 (51.0%)	6 (11.8%)
C5. I can integrate digital tools into CBC lesson plans effectively.	1 (2.0%)	6 (11.8%)	9 (17.6%)	25 (49.0%)	10 (19.6%)
C6. I can assess learners' progress using digital tools or applications.	0 (0.0%)	6 (11.8%)	10 (19.6%)	22 (43.1%)	13 (25.5%)
C7. I update my digital skills regularly through workshops, peer learning, or online training.	8 (15.7%)	8 (15.7%)	10 (19.6%)	14 (27.5%)	11 (21.6%)
C8. I can guide learners to safely use digital tools and content.	0 (0.0%)	3 (5.9%)	8 (15.7%)	22 (43.1%)	18 (35.3%)

| SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree (Source: field survey, 2025)

Digital safety guidance (C8) is the strongest competency, with 78.4 percent agreeing or strongly agreeing and no respondent strongly disagreeing. Curriculum lesson integration (C5) and digital assessment application (C6) are the next strongest, both at 68.6 percent. Online resource access (C3) and content adaptation (C4) each achieved 62.8 percent agreement. Digital content creation (C2) showed 52.9 percent agreement. Continuous professional development

engagement (C7) produced 49.1 percent agreement, with 31.4 percent actively disagreeing or strongly disagreeing. Basic device operation (C1) is the weakest competency, with only 47.1 percent agreeing and 33.3 percent disagreeing or strongly disagreeing, the largest disagreement proportion recorded across all eight items. This is a striking finding given that 88.2 percent of participating schools rely primarily on smartphones as their main digital tool, indicating that the gateway competency for all other digital practice is also the least developed.

4.2 Descriptive findings on effective curriculum implementation

Table 2 presents the frequency and percentage distribution across the five response categories for each of the seven Section D items measuring effective curriculum implementation through digital tools.

Table 2: Section D, effective CBC implementation through digital tools (n = 51)

Statement	SD	D	N	A	SA
D1. I use digital tools to promote learner-centred activities aligned with CBC.	1 (2.0%)	4 (7.8%)	2 (3.9%)	32 (62.7%)	12 (23.5%)
D2. Digital tools help me effectively achieve the learning outcomes in the CBC.	2 (3.9%)	3 (5.9%)	4 (7.8%)	22 (43.1%)	20 (39.2%)
D3. The use of digital content enhances learners' creativity and problem-solving skills.	0 (0.0%)	1 (2.0%)	1 (2.0%)	24 (47.1%)	25 (49.0%)
D4. I regularly use digital assessments to track learners' progress in CBC competencies.	2 (3.9%)	8 (15.7%)	10 (19.6%)	23 (45.1%)	8 (15.7%)
D5. Integrating digital tools in teaching improves learner engagement and participation.	0 (0.0%)	2 (3.9%)	1 (2.0%)	20 (39.2%)	28 (54.9%)
D6. The digital tools I use help me differentiate instruction to meet diverse learner needs.	2 (3.9%)	2 (3.9%)	5 (9.8%)	23 (45.1%)	19 (37.3%)
D7. I collaborate with other teachers to share and develop digital materials for CBC.	2 (3.9%)	2 (3.9%)	4 (7.8%)	21 (41.2%)	22 (43.1%)

| SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree (Source: field survey, 2025)

Section D produced a strongly affirmative picture overall. Creativity and problem-solving enhancement (D3) was the most widely endorsed item in the entire study, at 96.1 percent, followed closely by learner engagement (D5) at 94.1 percent. Learner-centred activities (D1, 86.2 percent), teacher collaboration (D7, 84.3 percent), differentiated instruction (D6, 82.4 percent), and curriculum learning outcomes (D2, 82.3 percent) all achieved high endorsement. Regular use of digital assessment to track curriculum competency milestones (D4) was the weakest Section D item, at 60.8 percent, with 19.6 percent disagreeing or strongly disagreeing and a further 19.6 percent neutral, reflecting a systemic gap between portfolio assessment requirements and actual classroom practice.

4.3 Qualitative corroboration

School heads across all six counties, irrespective of school type, identified the same competency priorities for effective Pre-Primary Two instruction: basic device operation, curriculum-aligned content navigation, digital content creation, and digital assessment. One head teacher described the gap between stated policy expectations and actual classroom capacity:

"My teachers know they are supposed to use digital tools for CBC, but when you ask them to show you how they make a simple presentation for a lesson, most cannot do it. What we need is someone to sit with them and show them practically, not just lecture them in a hall." (**Head Teacher, Public ECD Centre, Bungoma County**)

Focus group participants across all six counties independently identified device operation confidence and locating appropriate curriculum-aligned content as the two most critical competencies, directly corroborating the C1 and C3 questionnaire findings. Teachers described their professional development as almost entirely informal and self-directed:

"I know how to use WhatsApp and I watch videos online, but using the phone to teach is different. I do not know how to find the right content for PP2 or how to present it to the children. Nobody has shown us that." (**ECD Teacher, Public School FGD, Samburu County**)

A recurring and spontaneous theme across five of the six county focus group sessions was a direct call for a defined competency standard: teachers wanted to know precisely what a Pre-Primary Two teacher should be able to do with digital tools, rather than working from a general and unspecific policy mandate. This constitutes strong grassroots validation for the framework developed in the companion paper to this study.

4.4 Construct extraction

Principal component analysis of the eight Section C items produced a Kaiser-Meyer-Olkin measure of .841 and a significant Bartlett's test of sphericity ($p < .001$). Two components with eigenvalues above 1 were retained, jointly explaining 69.95 percent of variance.

Table 3: Principal component analysis of essential digital competencies (Source: SPSS output, 2025)

Item	Component 1 (FDC)	Component 2 (PSC)
C1. Device operation confidence	0.812	
C2. Digital content preparation	0.789	
C3. Online resource access	0.763	
C4. Content adaptation for PP2	0.741	
C5. Curriculum lesson integration		0.854
C6. Digital assessment application		0.831
C7. Continuous professional development engagement		0.714
C8. Digital safety facilitation		0.697

The first component, labelled Foundational Digital Competency, captured basic technical and content competency, with an average loading of .776. The second, labelled Pedagogical and Safety Competency, captured the pedagogical application and safety dimensions of digital competency, with an average loading of .774. A separate principal component analysis of the seven Section D items produced a single dominant component, explaining 72.9 percent of variance and labelled CBC Digital Implementation Effectiveness, with an average loading of .838, indicating that effective curriculum implementation functions as a coherent, unidimensional outcome.

4.5 Relationship between essential digital competencies and effective curriculum implementation

Table 4 presents the Spearman's rho correlation between the composite essential digital competencies score and effective CBC implementation.

Table 4: Spearman's rho, essential digital competencies and effective CBC implementation (n = 51) (Source: SPSS output, 2025)

Variable pair	Spearman's rho	N	Significance (2-tailed)
Essential digital competencies x effective CBC implementation	.567	51	$p < .001$

Table 4 shows a moderate, positive, and statistically significant correlation between essential digital competencies and effective curriculum implementation ($\rho = .567$, $p < .001$). Higher levels of digital competency are associated with more effective curriculum implementation in Pre-Primary Two classrooms. This finding corroborates the central premise of the Technological Pedagogical Content Knowledge framework [6], that the intersection of technological, pedagogical, and content knowledge is the critical determinant of effective classroom technology use, and is consistent with international evidence that progression through competency levels is associated with improved instructional outcomes [2], [3]. This correlation provides the primary empirical mandate for the weighted competency framework developed in the companion paper to this study.

5 DISCUSSION

The central finding of this paper is that teacher competency, not challenge exposure, is the decisive determinant of effective curriculum implementation through digital tools. This is corroborated at every level of the data. School heads and teachers across all six counties, when asked what would most improve digital teaching practice, named competency development rather than hardware provision. The moderate, statistically significant correlation between essential digital competencies and effective implementation stands in direct contrast to the non-significant relationship between

digital integration challenges and implementation reported in the companion paper to this study, reinforcing the conclusion that competency-building interventions yield greater returns than infrastructure investment alone.

The competency profile itself reveals a specific and actionable gap. Digital safety internalisation is strong, but basic device operation and continuous professional development engagement remain weak. Kenyan Pre-Primary Two teachers appear to have absorbed the curriculum's digital policy expectations conceptually, while lacking the practical device-handling skills and sustained professional development pathways needed to translate policy into classroom practice. This finding is particularly significant given that the overwhelming majority of schools rely on smartphones as the primary available device: basic device operation confidence functions as the gateway competency for every other competency strand, yet it is the area of greatest recorded weakness.

6 CONCLUSION AND RECOMMENDATIONS

This paper has established, for the first time with empirical Kenyan evidence, that essential digital competencies significantly and positively predict effective implementation of the competency-based curriculum among early childhood development teachers, while a companion paper found no such relationship for structural challenges. Two coherent competency sub-constructs, foundational digital competency and pedagogical and safety competency, were extracted through principal component analysis, together with a unidimensional implementation outcome construct. Basic device operation was identified as the single weakest and most consequential competency gap.

Teacher training institutions should revise pre-service early childhood programmes to include structured, hands-on digital pedagogy modules focused specifically on basic device operation and sustained continuous professional development pathways, the two areas where the field evidence confirms the greatest gap. The Ministry of Education and the Kenya Institute of Curriculum Development should adopt a competency-progressive model of professional development, moving away from one-off workshops toward structured, practice-oriented, school-based coaching. Future research should test whether a defined competency benchmark of the kind called for spontaneously by teachers in this study produces measurable gains in curriculum delivery when implemented at scale.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Acknowledgments

The authors thank the early childhood development teachers, school heads, and county education officials in Nairobi, Kisumu, Kakamega, Bungoma, Turkana, and Samburu counties who participated in the focus group discussions, interviews, and questionnaire administration. The authors also acknowledge the National Commission for Science, Technology and Innovation (NACOSTI) and the six participating county governments for granting research clearance, and IBM SPSS Statistics for the analytical tools used in this study.

Funding Source

This study was funded by the Education Sub Saharan Africa (ESSA) and the REAL Centre, University of Cambridge, under Grant reference ECDAFRICA001, with financial support from the Conrad N. Hilton Foundation and the Global Partnership for Education Knowledge and Innovation Exchange (GPE KIX).

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

This study involved human participants (early childhood development teachers and school heads). Ethical approval and research clearance were obtained from the National Commission for Science, Technology and Innovation, Kenya (NACOSTI, Ref: NC53266), together with research permits from all six participating county governments, prior to the commencement of data collection.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

REFERENCES

- [1] Kenya Institute of Curriculum Development, Basic Education Curriculum Framework. Nairobi, Kenya: KICD, 2017.

- [2] UNESCO, ICT Competency Framework for Teachers, 3rd ed. Paris, France: UNESCO, 2018.
- [3] C. Redecker, European Framework for the Digital Competence of Educators: DigCompEdu. Luxembourg: Publications Office of the European Union, 2017.
- [4] International Society for Technology in Education, ISTE Standards for Educators. Arlington, VA: ISTE, 2017.
- [5] Ministry of ICT, National ICT Policy. Nairobi, Kenya: Ministry of ICT, 2019.
- [6] P. Mishra and M. J. Koehler, "Technological pedagogical content knowledge: A framework for teacher knowledge," *Teachers College Record*, vol. 108, no. 6, pp. 1017-1054, 2006.
- [7] L. S. Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press, 1978.
- [8] African Union, Continental Education Strategy for Africa (CESA 16-25). Addis Ababa, Ethiopia: African Union, 2016.
- [9] African Union, Digital Education Strategy and Implementation Plan 2023-2028. Addis Ababa, Ethiopia: AU Commission, 2023.
- [10] UNICEF, Digital Learning for Every Child: Closing the Gap. New York, NY: UNICEF, 2021.
- [11] P. P. K. Heto, "Kenya's 2017 Basic Education Curriculum Framework: A review," ERIC, 2020.
- [12] J. W. Creswell and J. D. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 5th ed. Los Angeles, CA: SAGE Publications, 2018.
- [13] A. Field, *Discovering Statistics Using IBM SPSS Statistics*, 5th ed. London, UK: SAGE Publications, 2018.
- [14] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77-101, 2006.