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Kenyan teachers' experiences of an online professional development program across rural, peri-urban, and urban settings

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Abstract

The present study investigated Kenyan primary school teachers' learning and experiences with an online blended teacher professional development (TPD) program targeting early literacy instruction across three contexts rural, peri-urban, and urban environments. In addition, examination of resources and the physical environment available to teachers in each of these contexts was compared for a subsample of the schools. Overall, following the TPD, teachers demonstrated gains in domain knowledge and confidence teaching literacy content and they perceived working with technology positively. These outcomes did not differ as a function of context. Examination of resources and physical environments of classrooms highlighted a significant lack of resources both in general and in particular with respect to enhancing literacy, with these shortfalls evident across all three contexts.

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1. Introduction

Literacy is a foundational skill that is tied to both an individual's educational achievement and future job success (McCracken & Murray, 2009; Stromquist, 2006) and more broadly to a country's economic growth especially in developing nations (Cameron & Cameron, 2005). Recently, Kenya's adult literacy rates reached an all-time high of close to 83% (World Bank Group, 2024) but still 17% of the adult population struggles with literacy. At the same time, reports indicate that fewer than 50% of all Kenyan school students met minimum proficiency requirements in English literacy (The World Bank, 2022). Given English is the language of instruction after Grade 3, such low literacy rates among young learners raise concerns regarding the future for student success and, potentially, the country's economic success. Although these overarching statistics point to areas of challenge, a closer examination reveals that some geographic areas within Kenya experience more barriers and challenges than others. Recent research highlights discrepancies between rural and urban school environments with poorer outcomes in rural than urban environments (Mbagaya, 2021; Muyaka, 2019; Nganaga & Kambutu, 2017). Understanding why these challenges exist provides an opportunity to address inequities and promote achievement for all groups. The present study contributes to extant literature regarding early literacy in Kenya in three broad ways. First, the present study extends existing research findings to examine rural and urban contexts as well as peri-urban contexts (i.e., non-suburban, underdeveloped communities on the outskirts of urban environments). Second, the study compares teacher outcomes when provided with early literacy training across these three contexts. Third, the study examines the physical classroom environments across the three contexts. Together, these elements provide a more informative understanding of factors that may impact literacy education in Kenya with regard to teacher performance and classroom resources.

The government of Kenya has been instrumental in launching initiatives to enhance education and literacy. Recognizing challenges within the existing educational system, the Kenyan government instituted Free Primary Education, the Digital Literacy Program (DLP), the Teacher Professional Development Requirements Program, and the Basic Education Curriculum Framework (BECF) to enhance educational outcomes for teachers and school-aged children. These initiatives have resulted in both benefits and challenges. In terms of positive outcomes, following the launch of the Free Primary Education initiative there was a significant increase in primary school enrolments with numbers increasing from to 4,903,529 children in 2002 before the initiative to 7,813,500 children in 2022 (World Bank Group, 2024b). The Digital Literacy Programme (DLP), introduced in 2013 was instituted to provide the infrastructure to support instruction using technologies and devices, including laptops, tablets, projectors, internet, and other associated tools. Phase 1 of the DLP targeted young students up to grade three (Keya-Shikuku, 2021; Ogolla, 2018) and by 2019, 75,000 public primary school teachers were trained to be ready to use these technologies as instructional tools (Ministry of Information Communications and the Digital Economy, 2019). The teacher professional development (TPD) requirements program was introduced to ensure teachers received ongoing training to help them adapt and stay up-to-date with global education trends and standards (Kenya Education Management Institute, 2022). The Basic Education Curriculum Framework (BECF) was incorporated to redesign how education was being delivered in Kenya with a shift from teacher-centred instruction, including the use of rote repetition, to student-centred instruction as well as a focus on core skills such as critical thinking and problem solving, communication and collaboration, and digital literacy as identified by the Competency Based Curriculum (CBC) (Kenya Institute of Curriculum Development, 2019).

Introduction of these initiatives however also introduced new challenges. For example, the significant increase in primary school enrolments required the formation of teacher training centres to meet the burgeoning primary classroom demands. However, even this increased number of educators has not relieved lower performance outcomes in rural areas (Muyaka, 2019). Although the roll-out of the DLP has had successes in some areas, many rural parts of Kenya do not have the capacity or resources to utilize technologies. Researchers and educators identify the need for a more complete electrification plan to enable computers and related technologies to operate and subsequently for devices to be made available to teachers and students (Nganaga & Kambutu, 2017). Although the teacher development program recognizes the need for ongoing teacher learning, the reality is that many teachers, especially those in rural areas, face barriers

accessing professional development training. For example, rural teachers typically need to travel long distances to attend in-person courses and they often need to take personal leaves of absence to attend training courses (Mulkeen & Chen, 2008). These barriers can negatively impact teachers financially, as well as disrupting ongoing teaching and family obligations. Although much of the focus on urban versus rural environments focuses on challenges faced by rural teachers, teachers in urban schools also face challenges, especially in terms of large student-to-teacher ratios. Although urban schools typically have more resources, larger class sizes often exceed available resources, which impede teaching and learning.

The BCEF provides the framework for understanding student-centred instructional pedagogies, however, teachers especially those in rural areas indicate a lack of teacher and learner resources that make it challenging to implement these pedagogies (Kerkhoff & Makubuya, 2021; Nganaga & Kambutu, 2017). In addition, many teachers, including those in rural and urban contexts, feel the need for further training to better understand how to implement these pedagogies (E. Wood et al., 2022). Given these known challenges, the present study provided teachers with a 12-week online blended format professional development program (TPD) that targeted early literacy and incorporated student-centred learning pedagogies and the integration of technology to support early literacy instruction.

1.1. Early Literacy Training for Teachers in Kenya

Research in Sub-Saharan Africa identifies challenges in teacher training, domain knowledge, and instructional practice for delivering effective literacy instruction (Bett, 2016; Dubeck, Jukes, & Okello, 2012; Piper, Zuilkowski, Dubeck, Jepkemei, & King, 2018; Piper, Zuilkowski, Kwayumba, & Strigel, 2016). Recent, pilot studies have documented similar challenges facing Kenyan teachers (Uribe-Banda et al., 2023). Given lower achievement outcomes in rural areas, researchers suggest that access to teacher training in early literacy instruction may be especially important for teachers in rural areas (Muyaka, 2019). The teacher professional development training offered in the present study was developed in conjunction with a team of Kenyan researchers and educators at the Aga Khan Academy in Mombasa. A blended online delivery system was adopted to make training more accessible as it combines the strengths of in-person training with the flexibility of online instruction. Team members travelled to sites to ensure all teachers could participate during in-person sessions. The TPD was comprised of a series of online modules covering the various aspects of early literacy development (i.e., alphabetics) as well as information specific to the BECF regarding student-centred teaching. All lessons were accompanied by lesson plans (and teachers worked to generate their own variations of lesson plans as part of the course), online and offline in-class activities, as well as video supports for novices to technology. In addition to the online TPD, teachers were introduced to an evidence-based early literacy software program named ABRACADABRA (shortened name is ABRA) designed to be used in conjunction with in-class instruction in early English literacy skills (Abrami, Lysenko, & Borokhovski, 2020). Previous pilot studies demonstrated learning gains and positive evaluation of the TPD (Uribe-Banda et al., 2023; E. Wood et al., 2022) and the version used in the present study reflected a revision of the previous iterations to accommodate feedback from teacher-participants.

1.2. Rural, Urban, and Peri-Urban Contexts

Key to the present study was an examination of teachers' responses to the early literacy TPD as a function of location. In particular, the present study focused on teachers in the three contexts, rural, urban and peri-urban environments. A rural setting was defined as one that was located far from a town centre. In addition, populations in rural communities were less dense and traditionally report having fewer school resources. Urban contexts included larger schools found within large town centres and where socio-economic status was more variable (from low to high income). Urban environments typically have more highly developed infrastructure and greater connectivity in terms of access to technology such as internet, cell phone, and computers which are more readily available. Urban schools typically show greater availability of school resources however, burgeoning class sizes may result in insufficient resources for each classroom. Peri-urban settings were characterized as communities where the school was found on the outskirts of the town. Although there are variations in how peri-urban environments are defined (Simon, 2008) for the present study, these communities are not characterized as suburbs of towns but rather as communities on the periphery of towns lacking access to the infrastructure typically present in towns (e.g., electricity, water, roads, sanitation). Infrastructure advances in urban areas may not extend to the peri-urban environment or may only be available sporadically. Peri-urban communities have higher and more dense populations relative to rural communities and they are of low socio-economic status.

Educational disparities between urban and rural contexts have been documented across many countries over the past several decades. Comparisons typically favour urban environments over rural ones with regard to access to education, student achievement, teacher training, available supports and school resources (e.g., (Ndijuye & Beatus, 2022; Wang, 2013; R. M. Wood, 2023; Zhao, 2022)). For example, in terms of achievement, a recent study examining school-readiness among Kenyan children found significantly higher literacy skills for children in urban environments compared to their rural peers (Mbagaya, 2021). Specifically, urban children outperformed their rural counterparts on five of six preliteracy skills, including expressive language and vocabulary, letter names and sounds and name writing. Only listening comprehension did not differ across

urban and rural children. Similarly, a study comparing literacy performance between Kenyan girls living in urban slums and girls in rural areas found higher literacy scores for the urban girls at both the grade 5/6 and 7/8 levels (Muyaka, 2019). Across studies, researchers called for higher quality education and the need for more resources to enhance the potential of marginalized rural communities. Increasing achievement in rural classrooms is especially relevant given recent statistics that rural Kenya for example, has reported increasing needs to support early education, but is experiencing declining funding. Specifically, approximately 71% of humanitarian funding has decreased since 2017 (Loughran, 2019) and this decrease in funding affects resources, infrastructure, and availability of teachers to deliver an education to Kenyan students (Loughran, 2019).

Rural teachers themselves identify the need for training to acquire competencies and greater knowledge required to teach their students (Nganaga & Kambutu, 2017). In particular, teachers identified training to improve domain knowledge, use of technology as an instructional tool, and greater awareness of instructional practices involving student-centred learning as key areas that need to be addressed. Given the challenges identified in the literature regarding urban and rural contexts, the need to develop accessible, effective, and relevant teacher professional development is both timely and necessary. The TPD introduced in the present study can address teachers' abilities to facilitate the development of foundational literacy skills which will have a long-term impact on the academic attainment of their students.

The present study extends our understanding of teacher training by comparing teachers in peri-urban environments with those in rural and urban environments. Given very limited information about educational issues in general and no available research comparing training of teachers and availability of resources in peri-urban environments to teachers in rural and urban contexts, the present study offers the potential for unique insights in understanding the context under which these teachers work.

1.3. Present Study

The present study compares teachers in rural, urban and peri-urban environments in terms of change in teacher knowledge regarding early literacy development following participation in a blended TPD program introducing content specific to alphabetics (e.g., letter sound knowledge, phonological awareness) (See (Uribe-Banda et al., 2023; E. Wood et al., 2022)) for a description of the intervention). In addition, the study compares the physical learning/teaching environments across a sample of classrooms in each of these three contexts.

As a technological tool, online professional development aims to improve the practices and pedagogy utilized by teachers. In the context of the present study within Kenya, an online TPD and the ABRA software were utilized in 8 locations that were classified as urban, peri-urban, or rural contexts. This analysis will provide a richer understanding of how the TPD is perceived by teachers in these three contexts and its associated learning outcomes.

The present study explores the following research goals:

1) To examine teacher knowledge gains before and after online TPD in rural, peri-urban, and urban environments.
2) To assess differences in attitudes towards technology among teachers in rural, peri-urban and urban environments.
3) To evaluate classroom differences and resources across rural, peri-urban, and urban contexts.

2. Methods

2.1. Participants

Participants included 211 Kenyan primary school teachers (160 females, M_{age} = 37.5 years, SD = 7.6; and 50 males, M_{age} = 36.4 years, SD = 6.5). Of these, 61 participants taught in urban schools, 58 in rural schools and 92 in peri-urban schools. Most participants had completed a university or college degree (65.9%) followed by some university or college courses (27.5%) and post graduate studies (3.4%). However, one teacher completed only late elementary school (grades 6-8) and another only high school. Teaching experience ranged from 1 to 35 years ($M_{experience}$ = 11.4 years, SD = 7.4 years). Comparisons of mean age, years of teaching experience and highest level of education as a function of gender or environment (rural, urban, or peri-urban) yielded no significant differences. In total, 59.3% of teachers reported previous experience with online courses, which did not differ as a function of environment, H (2, n = 204) = 1.406, p = 0.495). Most participants (65.5%) had previously taken specialized courses or workshops on teaching reading, 24.1% had not, 3.4% were unable to remember and 6.9% did not respond. Average class size taught was approximately 60 children (SD = 29.29) and did not differ as a function of environment, F (2, 203) = 0.551, p = 0.577.

A subset of 30 schools (11 urban, 7 rural, 12 peri-urban) was selected for further examination regarding physical characteristics of the classroom environment (i.e., content and organization of materials available to promote learning). The selection of schools was made by facilitators familiar with the region and individual schools and each selected school was deemed representative of the area and context (urban, peri-urban, or rural).

This research was reviewed and approved by the research ethics review board at Wilfrid Laurier University, Canada (Ref. # 5502). All participants were treated in accordance within the ethical guidelines of

the Canada's tri-Council and American Psychological Association and Canadian Psychological Association (APA/CPA).

2.2. Materials and Procedure

Measures for the present study included four surveys delivered throughout the duration of the 12-week study to assess teacher outcomes and experiences. In addition, a rubric was designed for this study to assess elements of the classroom physical environment based on evaluation of 360 degree of photos for the subgroup of 30 classrooms.

2.3. Surveys

Survey 1 and 2 were pre-test measures (time 1) with Survey 1 administered one week prior to the onset of the TPD and Survey 2 completed during the first in-person session on week 1. Survey 3 (mid-term survey; time 2) was completed during week 6 and Survey 4 (post-test; time 3) was completed after the 12-week program.

The two brief pre-test surveys (Survey 1 and 2) were created to reduce time demands for participants. Survey 1 assessed demographic information (e.g., age, gender, years teaching experience) and classroom information (e.g., class size), while Survey 2 assessed teacher knowledge and perceptions such as comfort with technology, alphabetics content knowledge, and confidence teaching alphabetics skills. Three measures assessed comfort with technology each using a 5-point scale. One measure comprised of 3 questions assessed comfort using technology for instruction (e.g., 'I feel comfortable planning lessons that use technology', 1 = Strongly disagree to 5 = Strongly agree). A second measure assessed comfort with seven different technologies/platforms (e.g., computers/tablets, Zoom, Internet; 1 = Very uncomfortable, 5 = Very comfortable). Participants were asked one question regarding IT support at their school (1 = lots of support, 5 = No support). In terms of assessing content/domain knowledge, four aggregated items were used to assess alphabetic content knowledge (Maximum score = 4). Items were consistent with information taught in the alphabetics module. Three multiple-choice questions assessed knowledge of phonological awareness, phonemes, and phonics, while one task involved counting the number of phonemes in words. For confidence teaching alphabetic foundations teachers rated their confidence (1 = Very confident, 5 = Not at all confident) in teaching 11 different literacy skills (e.g., rhyming, segmenting/blending, letter sounds).

Midterm survey 3 assessed the school location which was used for classification as a rural, peri-urban, or urban context. Participants were asked how frequently ABRA was used by students in the classroom (number of days/week) and average amount of time ABRA was used (5-minute increments from 5 minutes to 50 minutes or more). Teacher comfort using ABRA as an instructional tool was assessed for 6 items (e.g., 'navigating ABRA activities on my own', 'preparing a lesson using ABRA') rated on a 5-point scale (1 = Not at all comfortable, 5 = Extremely comfortable). Teachers also rated the perceived difficulty of the TPD at the point of the course using a 5-point scale (1 = Extremely difficult, 5 = Extremely easy). Consistent with Survey 2, participants again indicated their confidence teaching alphabetic foundations.

The final post-test survey 4 replicated measures assessed in earlier surveys. Specifically, teachers completed the comfort using technology for instruction (pretest 1), perceptions about IT support (Pretest 1), alphabetic content knowledge measure (Pre-test 2), confidence teaching alphabetic foundations (pre-test 2 and mid-term),, perceived challenges completing the TPD course (Midterm), frequency ABRA was used by students in the classroom (Number of days/week, midterm), average amount of time ABRA was used (midterm), and teacher comfort using ABRA as an instructional tool (midterm).

New to the final post-test was one question asking participants how many children shared a computer/tablet for the average lesson using ABRA.

2.4. Assessing the Physical Learning Environment

For each of 30 selected classrooms, facilitators on-site took a series of photographs to capture the full 360-degree view of the empty classroom. In total, 37 features were rated using a 3-point scale (1 = feature not present, 2 = feature partially present, 3 = feature fully present) with an additional category for items unable to be assessed. Some of these features were based on or adapted from the Early Language and Literacy Classroom Observation toolkit, Research Edition (ELLCO, 2002) Education Development Centre). Other features reflected measures in extant research or were unique to the present study to provide a comprehensive understanding of classroom contexts.

The features were grouped into three sections (Appendix A presents the features listed under each of the three sections). The first section assessed criteria directly related to literacy activities and skill development and was comprised of 13 features (i.e., posted alphabet, phonics and grammatical rules, vocabulary, alphabet templates/stencils/stamps, alphabet books, reading materials (age appropriate and books for children), display of children's literacy work, alphabet puzzles, word puzzles, and inviting places to read. The second section assessed 13 other skills/activities/materials some of which were indirectly related to literacy skill development. These materials included environmental print (such as directions, rules functional messages, calendar, current events board, areas for messages between teachers and students, print representative of

multicultural groups, themes posted), content area centres and visuals (pictures, diagrams, display of children's non-literacy work) as well as games, centres/thematic displays, writing implements/materials, shelves with materials for children. The third section assessed the classroom furniture/layout/facilities through 6 features (i.e., furnishings right size for children, enough seats/desks for all children, furniture in good repair, teacher area/desk, classroom allows for centres, lighting sufficient). In addition to these aggregated categories 5 individual questions assessed classroom features including whether seating was through individual table and chairs versus tables and benches, rows versus grouped seating arrangements, barren versus crowded classrooms and the presence of computers for children's use.

Inter-rater reliability for scoring of the features was completed by 2 raters. Both raters viewed and scored 5 randomly selected classrooms together to establish consistent guidelines for scoring. Subsequently, 6 schools (20%) were randomly selected for independent scoring by each of the two raters. Cohen's Kappa at .72 indicated substantial agreement. Raters resolved discrepancies by discussion. An additional 4 classrooms were rated by both raters and the remaining classrooms were scored by one of the raters.

3. Results

Two aspects of the data were assessed through 2 (time: pre- and post-TPD exposure) by 3 (context: rural, urban, peri-urban) mixed-model analyses of variance (ANOVAs) followed by analyses of the subset of data examining the physical classroom environment.

3.1. Knowledge and Confidence for Early Literacy Concepts

In terms of knowledge gains, there was a main effect for time such that performance on the aggregated alphabetic knowledge content improved from pre-intervention (M = 1 62, SD = 84) to post intervention (M = 1.98, SD = 0.862), F (1,154) = 14.60, $p < 0.001$, $\eta p^2 = 0.087$). There was no main effect for location (F (2,154) = 1.09, $p = 0.34$, $\eta p^2 = 0.014$) nor was there a significant interaction (F (2,154) = 1.32, $p = 0.27$, $\eta p^2 = 0.017$).

Analyses examining teachers' confidence ratings for the 11 aggregated teaching skills scale (rhyming, segmenting, phonics etc.) yielded a main effect for time (F (1,110 = 6.95, $p = 0.01$, $\eta p^2 = 0.059$) such that confidence across these skills increased from pre-intervention (M = 1.86, SD = 0.69) to post intervention (M =1.69, SD = 0.51) with a rating of 1 indicating very confident. The main effect for location (F (2,110) = 1.29, p = 0.28, $\eta p^2 = 0.023$) and the interaction (F (2,110) = 0.636, $p = 0.53$, $\eta p^2 = 0.011$) were not significant.

3.2. Experience with the TPD

In terms of perceived challenges completing the course, there was a main effect for time F(1,193) = 6.97, $p = 0.009$, $\eta p2 = 0.035$, such that perceived difficulty decreased from the midpoint M = 3.23 (SD=0.93) to post intervention M = 3.46 (SD=0.86).There was no main effect for location F(2,193) = 2.67, $p = 0.072$, ηp^2 = 0.027) nor was the interaction significant F(2,193) = 1.86, $p = 0.16$, $\eta p^2 = 0.019$. Mean scores reflect a rating between neither easy nor difficult and somewhat easy.

3.3. Technology

Teachers' comfort using technology was assessed through three measures. Pre-intervention mean scores for comfort using the seven technology tools approached ceiling, lowest M = 4.45, SD = 0.63 for peri-urban teachers. A ONEWAY ANOVA yielded no significant main effect across contexts (F (2,131) = 0.195, p = 0.82). A second measure assessed comfort teaching with technology through the aggregated three questions (supervising students while using technology, integrating technology into teaching practice, and planning lessons that use technology) at pre and post intervention. Again, means approached ceiling at both time points (lowest M = 4.06, SD = 1.13 for peri-urban at pre-intervention). The 2 X 3 ANOVA revealed no main effect for time (F (1,132) = 2.09, $p = 0.151$, $\eta p^2 = 0.016$) or location (F (2,132) = 0.378, $p = 0.69$, $\eta p^2 = 0.006$) nor was the interaction significant (F (2,132) = 2.47, $p = 0.075$, $\eta p^2 = .039$). After the intervention teachers were asked to rate their ease/comfort using the ABRA tool. Mean scores ranged from M = 3.86 (SD = 0.81) for peri-urban teachers to M = 4.01 (SD= 0.50) for rural teachers on the 5-point scale. A One-way ANOVA yielded no significant differences as a function of location (F (2,193) = 1.07, $p = 0.35$).

Teachers perceptions of availability of IT support decreased over time F (2,191) = 6.14, $p = 0.003$, ηp^2 = .06 from time 1 (M = 2.44, SD = 1.04) to time 3 (M =2.18, SD = 0.901; t (204) = 3.22, $p = 0.001$) and time 2 (M = 2.38, SD = 0.98) to time 3 (t (198) = 3.08, p= 0.002) but not from time 1 to time 2. However, perceptions about available IT did not differ as a function of location (F (2,192) = 2.48, p = 0.25,) nor was there a significant interaction (F (4,384) = 0.370, $p = 0.83$, $\eta p^2 = 0.008$).

3.4. Use of ABRA

Participants' frequency of ABRA use with children significantly increased from the intervention midpoint (M = 1.98, SD = .997) to the end of the intervention (M =2.37, SD = 1.03 t (197) = 4.99, p<0.001), as did their

average time spent with this software in minutes from midpoint (M = 6.13 SD = 2.79) to end of study (M = 7.16, SD = 2.72, t(120) = 4.48, p<0.001).

Teachers' skill regarding the use of ABRA((Navigation, logging in/out, etc) yielded a significant main effect for time showing an increase from early intervention (M = 3.74, SD=0.74) to post intervention (M = 3.91, SD = 0.71; F(1, 166) = 13.87, p < 0.001, ηp^2 =0.08) with no main effect for location (F(2,166) = 1.35, p = 0.22) or interaction (F(2,166) = 0.196, p = 0.82).

3.5. Differences in Technology Availability

There were no significant differences in the availability of technology across geographic locations (F (2,185) = 1.06, p = 0.35). Participants across all three environments had approximately four students share a computer/tablet at a time.

3.6. The Physical Teaching Environment

Observations of the classrooms were aggregated into the three grouped categories reflecting criteria directly related to literacy skill training/activities, elements fostering other learning skills/activities and furnishings. In addition, one score was included for availability of computers/tablets (see Table 1).

Table 1. Summary of classroom features for sample schools in urban, peri-urban and rural contexts.

Observed categories	Overall schools sampled M (SD)	Urban	Peri-urban	Rural	Kruskal-Wallis comparisons
Literacy materials	17.53 (3.88)	17.91 (3.39)	17.42 (4.60)	17.14 (3.76)	H (2, n= 30) = 0.336, p = 0.845
Other instructional skills/Activities/Materials (Peripheral to literacy)	19.03 (3.54)	20.55 (2.70)	17.96 (2.94)	18.57 (5.06)	H (2, n= 30) = 4.57, p = 0.102
Furnishings	14.50 (2.16)	14.91 (0.83)	14.25 (3.33)	14.29 (0.76)	H (2, n= 30) = 2.67, p = 0.264
Availability of computers	1.20 (0.48)	1.0 (0.00)	1.42 (0.67)	1.14 (0.38)	H (2, n= 30) = 4.54, p = 0.103

Note: Maximum scores for the direct literacy and other learning materials were each = 39, furnishings was = 18.

Overall, inspection of mean scores for each of these 4 categories (see Table 1) shows that classrooms across all three contexts fell below the mid-point of the maximum score of 39 for literacy ranging from M = 17.14 (rural) to M =17.91 (urban) reflecting a score between not present and some presence. Both peri-urban and rural schools fell below the midpoint of the maximum score of 39 for other learning materials and the urban schools were just above the midpoint of the scale (M = 20.55). In terms of furnishings, all schools received mean scores well above the mid-point of maximum score of 18 (ranging from M =14.25 (peri-urban) to M =14.91 (urban). Availability of computers reflected a rating of not present for urban classrooms (M = 1.0) with scores indicating some presence in peri-urban and rural classrooms.

Given the small sample size exploratory independent-samples Kruskal-Wallis tests were conducted for each of the three grouped categories and the availability of computers. There were no statistically different outcomes as a function of context, largest H (2, n=30) =4.57, p = 0.102 for ratings of other instructional skills/activities/materials.

Upon closer inspection of individual items related to the overall literacy scales, several interesting observations were noted. First, in none of the 30 classrooms observed were there any displays of children's literacy work. However, in 10% of the classrooms some children's work was posted (albeit not related to literacy). In addition, no classrooms had alphabet or word puzzles, alphabet templates/stencils/stamps, or a designated and inviting place to encourage children to go and read.

In terms of classroom structure, 90% of classrooms were furnished with longer tables and benches for children. For the remaining 3 classrooms 2 did not have seats for children and one classroom could not be adequately judged. Despite the table and bench structure, in 56.7% of classrooms there was an attempt to group children with the remaining 36.7% of classrooms using rows only.

Centres were rare across classrooms with only 6.7% of classrooms having a centre of some type. The remaining 93% did not have centres even though 83.3% of classrooms were judged to be uncrowded and observed to have sufficient space for a centre to be present.

Teachers also had limited resources for planning, organizing and storage as only 63.3% of classrooms had a designated teacher area or space.

4. Discussion

The primary aim of the present study was to assess teacher experiences and physical environments in rural, urban and peri-urban schools for teachers who were enrolled in a teacher professional development program designed to enhance literacy instruction. Given the emphasis on the use of technology to deliver the professional development as well as the use of ABRA as an instructional tool for students, understanding teacher's comfort with technologies was an important consideration. Overall, school context (rural, urban or peri-urban) did not impact teachers' learning, confidence or experiences with the TPD or technologies used as part of this TPD, however, the environmental scan of physical resources across all three contexts identified important areas of deficit facing teachers and students.

The extant literature is clear that many Kenyan teachers need support to improve their understanding of concepts and instructional strategies related to early literacy skill development (Jukes et al., 2017; Uribe-Banda et al., 2023). The blended online TPD offered to teachers in the present study resulted in domain knowledge gains as well as self-reported increases in confidence teaching early literacy. Specifically, between the start of the TPD and its conclusion teachers' overall alphabetic foundations knowledge (e.g., phonological awareness, phonics, phonemes) improved as did confidence teaching skills such as rhyming, segmenting, and phonics. These outcomes are consistent with earlier iterations of this TPD (Uribe-Banda et al., 2023) and the present study indicates the revisions made based on teacher feedback have maintained the positive outcomes available. Of note, participation in the TPD benefitted teachers equally across the three contexts; rural, urban and peri-urban.

In terms of perceived challenges completing the course, there was a main effect for time such that perceived difficulty decreased from the midpoint onward. Although the initial session, provided teachers with direct hands-on assistance with the technology tools used in the present study, navigating the platforms used to deliver content, and interact with facilitators proved to be a challenge for some teachers. As a result, supporting videos were constructed to walk through log in and navigation across content. Providing this support may have helped to ameliorate some challenges. In addition, some teachers expressed challenges with the term used to define concepts in the alphabetics domain (e.g., phonological awareness). As the course progressed and these terms were presented, defined, and supported with concrete examples, concerns arose less frequently. Exposure and additional supports in addition to increasing familiarity may have contributed to the lowered perceived challenges over the duration of the TPD. Overall teachers rated the TPD somewhere between neutral and somewhat easy—thus providing some challenge without being overly difficult.

Consistent with recent research targeting the use of technologies as a means to reach more teachers across a larger context (Jukes et al., 2017) the present study employed technology to deliver the TPD and to provide an instructional tool to be used with children. At the outset, teachers' ratings of comfort with the various technology tools (Zoom etc) as well as using technology as an instructional tool approached ceiling ratings. Overall, familiarity and comfort with the technologies remained high throughout the TPD and there were no differences among teachers in rural, urban or peri-urban contexts. After the intervention there were also no differences in teachers' ratings regarding comfort using ABRA. However, teachers' reported skill using the ABRA software improved over the duration of the study, again with no differences across rural, urban or peri-urban contexts. This increase in reported skill coincided with increased frequency and duration of use of ABRA with their students. Together these findings support a growing comfort using the technologies associated with the TPD both as a learning tool for the teachers and as an instructional tool to benefit students.

Interestingly, the one concern regarding technology noted by teachers in all three contexts was teachers' perceptions regarding IT support. In general, mean scores indicated concerns regarding IT support at the outset of the study and these concerns increased over time. The need for technology support is critical to ensure active ongoing access to and use of technologies as well-integrated tools for both teaching and learning. As teachers progressed in the TPD and used ABRA as an instructional tool, it is likely that they became more aware of challenges using technology in the classroom and this may have heightened their awareness of the need for day-to-day IT supports. In the present study, facilitators delivering the TPD were able to support teachers throughout the program, however, the teachers are clearly identifying a resource need if ABRA or similar programs were to be offered going forward. Although the initial DLP plan accounted for enhanced infrastructure regarding technologies, in practice, more IT support within the school may be necessary for teachers to embrace technologies in their teaching.

4.1. Resources in the Physical Environment

Resources to create robust learning environments are often cited as a limitation in regards to classrooms in Kenya (Nganaga & Kambutu, 2017) ref see intro to get these). Evaluations of the physical classrooms in the present study confirm that resources continue to be a limiting factor. Specifically, outcomes suggest that limited (and in some cases absent) content/domain relevant resources were especially concerning. With respect to overall scores regarding literacy materials, schools across all three contexts, rural, urban and peri-urban fell below the mid-point suggesting only sporadic or limited presence of these items. In some cases, aspects of classrooms that could help to support and promote student literacy skills were completely absent

across all schools. For example, no schools had alphabet templates stencils or stamps, alphabet puzzles, or word puzzles available for children to see or use. Similarly, no schools set aside space to display children's literacy work. In fact, there was a general lack of acknowledgement for student's accomplishments with only 10% of schools having any display of children's work of any kind. In addition, there was a lack of environmental print (directions, rules, messages to students). This is consistent with observations noted in previous research where observers of Kenyan classrooms noted that "most of the classrooms I visited in Kenya had nothing on the walls" (Nganaga & Kambutu, 2017). Together the lack of these types of resources reduces exposure to print and limits the opportunity to highlight the importance of literacy. Research conducted in North America highlights the benefits of print exposure (Stanovich, West, & Harrison, 1995). More recent research in the United States refers to "book deserts", which refers to homogeneous high poverty neighbourhoods with few print resources, which are associated with lower levels of school readiness (Neuman & Moland, 2019). These circumstances are more pronounced in Kenya, where print resources are limited and print exposure typically occurs in school. In addition, it suggests limited acknowledgment of student-centred learning where student work and outcomes are highlighted (REF). One concern that must be addressed is whether there were resources such as paper that would allow student work to be completed. In the present study, supplies of paper were noted in many classrooms and student worksheets and other offline materials were provided as part of the TPD. Greater awareness of these resources and learning how to use these types of instructional supports to support a positive literacy environment could be integrated in future literacy TPD programs.

It was also the case that few classrooms (6.7%) had a dedicated literacy centre. Thus, children did not have an area or nook set aside where they could go to read or engage independently in literacy activities. The relative absence of centres was not necessarily because there was insufficient space across all classrooms as most (83.3) were not evaluated as crowded and thus would have enough space to accommodate a centre. Encouraging teachers to adopt principles of classroom design that promote student-centred learning in addition to the provision of information regarding student-centred pedagogies and instructional practices may need to be incorporated in future TPD.

In all but 2 classrooms, there were sufficient furnishings for children to be seated and have access to a writing surface. Furniture was in relatively good repair and appropriately sized for children. Even though bench seating was most prominent, it was clear that teachers in just over half of the classrooms had made an effort to arrange the furniture to allow for children to work collaboratively in groups. Group and shared learning experiences was identified as a key element in student-centred learning as part of the TPD. The adoption of grouped seating even when the furnishings were bulky and less easily arranged in group configurations, demonstrated that these teachers acknowledged the potential for group work as part of their teaching practice.

Technologies were relatively sporadic within the classrooms observed. In some cases this may have been due to designated computer labs or computer classrooms within some of the schools where children left their home classroom to use the computers and then returned to their home classroom). In some cases, however, the limitations reflected the absence of tablets and computers available for children (and teachers) to use at the school, as was reported anecdotally by colleagues in the schools.

Overall, our findings suggest that teachers in public schools across Kenya encounter similar challenges in accessing resources to optimize their instruction. The findings also suggest that the contents of Kenyan classrooms collectively must be improved, to provide better quality learning tools and opportunity for student advancement.

4.2. Limitations and Future Directions

The present study permitted an assessment of teacher performance in an early literacy TPD as well as an assessment of the physical classroom environment teachers worked in by the end of the TPD. The notable lack of literacy materials observed in the sampled schools suggests limited resources, consistent with previous literature. However, given some materials were made available to teachers but were not displayed, it would be useful to determine through interviews with teachers whether limited resources (paper, copying, etc.) or other factors such as intentional decisions by teachers led to the limited displays and availability of materials for children.

In addition, it was clear that some teachers had actively tried to group students, interviews with teachers who had and had not adopted these more student-centred opportunities could confirm whether the content in the TPD motivated this shift or whether more direct messaging may be necessary (perhaps from peers who had made these changes) in future TPD offerings.

5. Conclusion

While locational differences between rural, peri-urban, and urban schools were expected to play a significant role in teachers' experiences and the physical environments of classrooms, this was not the case for our sample. Teachers in all locations participated in and gained knowledge and confidence in early literacy instruction. Teachers increased their use of early literacy software as an instructional tool over the duration of

the TPD and reported greater confidence in their skill using the tool. Examination of teaching environments suggest that most schools have the requisite furniture, but much work needs to be done to promote attractive supportive learning environments in classrooms within the constraints of available resources as well as the possibility of securing greater resources to supplement classroom materials. Outcomes suggest directions for future research, especially with respect to understanding regional differences that optimize learning.

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Appendix A.

Scoring criteria for each of features observed within the three overarching categories within each classroom.

Literacy environment	**Instructional supports peripheral but can promote literacy**	**Classroom furniture**
Alphabet is visible for children	Environmental print such as directions, rules, functional messages	Classroom furnishings are the right size for the children.
Phonics rules posted (Magic-E, vowels walking, different sounds of "c" & g").	Calendar	There are enough desks/Seats for each child.
Grammatical rules posted (Sentence structure, nouns, verbs)	Current events board with daily/Weekly events.	Furniture in good repair
Vocabulary items (New words identified)	Place for teachers and children to leave messages for each other	Classroom allows for centres
Alphabet templates, stencils, and/Or stamps	Print representative of multicultural groups present in the classroom	Lighting (Natural lighting sufficient to see)
Alphabet books	Classroom is decorated with pictures, illustrations, and diagrams	Teacher area/ Desk
Reading materials (Books, magazines, and newspapers)	Games available to promote learning (Board games etc…)	
Age-appropriate reading materials	Children's work is displayed.	
Word cards with familiar words and names (On wall, at desk)	Themes are posted on the wall.	
Display of children's literacy work	Materials and activities are diverse to accommodate all children (Gender, ability).	
Alphabet puzzles	Shelves with materials for children	
Word puzzles	Writing implements (Pens, pencils, crayons, felt-tip pens, colored pencils)	
Inviting places to read	Writing materials (Many varieties of paper in all sizes, blank booklets, pads)	