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Evaluating Teachers' Learning, Perceptions, and Cultural Differences Following Professional Development for Early Literacy Software

Évaluation de l'apprentissage, des perceptions et des différences culturelles des enseignants à la suite du développement professionnel pour les logiciels d'alphabétisation précoce

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Abstract

The present study examined the impact of professional development training on Canadian and Kenyan teachers' confidence, comfort, and perceptions of their abilities to teach early literacy skills in the primary or elementary grades. Data were collected prior to and following training on how to integrate early literacy software as part of ongoing in-class instruction. Domain and technology constructs consistent with Mishra and Koehler's (2006) technology integration model were assessed, as were perceptions related to delivery pacing. Overall, outcomes reflected more similarities than differences across the two groups of teachers. Limitations in foundational knowledge regarding concepts specific to early literacy were evident in both groups, despite higher levels of perceived confidence in Kenyan teachers compared to Canadian teachers in some content areas. Perceived comfort using technology and teaching with technology were highly correlated, with no differences observed across teacher groups. Pacing was perceived to be faster for Kenyan teachers compared to Canadian teachers. Implications for professional development in this domain are discussed.

Keywords: Educational technologies; literacy; professional development; primary and elementary teachers; cross cultural comparison

Résumé

La présente étude a examiné l'impact de la formation en développement professionnel sur la confiance, l'aisance et les perceptions des enseignants canadiens et kenyans quant à leurs capacités d'enseigner les compétences de littératie précoce dans des classes au primaire. Les données ont été recueillies avant et après la formation sur la façon d'intégrer les logiciels d'alphabétisation précoce dans le cadre de l'enseignement en classe. Les construits de domaine et de technologie conformes au modèle d'intégration technologique de Mishra et Koehler (2006) ont été évalués, ainsi que les perceptions liées au rythme d'enseignement. Dans l'ensemble, les résultats reflètent plus de similitudes que de différences entre les deux groupes d'enseignants. Les limites des connaissances fondamentales concernant les concepts spécifiques à l'alphabétisation précoce étaient évidentes dans les deux groupes, malgré des niveaux de confiance perçus plus élevés chez les enseignants kenyans que chez les enseignants canadiens dans certains domaines. L'aisance perçue dans l'utilisation de la technologie et l'enseignement avec la technologie étaient fortement corrélés, et aucune différence n'a été observée entre les groupes d'enseignants. Le rythme est perçu comme étant plus rapide chez les enseignants kenyans que chez les enseignants canadiens. Les implications pour le développement professionnel dans ce domaine sont discutées.

Mots-clés : Technologies éducatives ; alphabétisation ; développement professionnel ; enseignants au primaire ; comparaison interculturelle

Introduction

Literacy is a foundational skill linked to social and economic success and personal well-being (Gott & Lesgold, 2000). However, millions of children worldwide are at risk for failing to acquire the level of literacy needed to experience these benefits (United Nations Educational, Scientific and Cultural Organization Institute for Statistics, 2017; World Bank, 2018). As a result, researchers, educators, and governments around the world are devoting attention to identifying and implementing instructional practices needed to promote literacy skill acquisition in young learners. In Kenya, for example, government initiatives such as the Digital Literacy Program introduced in 2013 and the competency-based curriculum (CBC, 2018) were initiated to enhance early literacy instruction. Student success, however, is highly dependent on the quality of teacher instruction provided (Basma & Savage, 2018; Chen et al., 2012; Wolff et al., 2010). In order to provide the highest quality of instruction, teachers must take into account theoretical, pedagogical, methodological, and philosophical changes in instructional design, changes in subject content, advancements in and integration of technology, and student learning needs (Basma & Savage 2018; Kalinowski et al., 2019; Koehler & Mishra, 2009; Nganga & Kambutu, 2017; Sheridan & Wen, 2020). Meeting these demands can be challenging especially in contexts where teacher training and available resources are more limited. For example, recent research investigating literacy instruction in Kenya and other areas in Sub-Saharan Africa identifies challenges in teacher training, subject knowledge, and instructional practices as concerns in attaining effective evidence-based literacy instruction (Bett, 2016; Bold et al., 2017; Dubeck et al., 2012). In-service professional

development (PD) opportunities provide a venue for teachers to enhance their professional practice (Bett, 2016; Ko et al., 2006; Wolf, 2018). The present study examined the impact of PD on teachers' confidence, comfort, and their perceptions of their abilities to teach early literacy skills prior to and following training regarding how to integrate early literacy software as part of ongoing in-class instruction. The PD workshops introduced web-based software (called ABRACADABRA) and corresponding instructional practices to teachers in two instructionally and culturally diverse contexts: Canada and Kenya. This comparison allowed for greater understanding of teacher experiences and generalizability for this kind of PD.

Instructional Pedagogy

Teachers play a pivotal role in providing the foundational skills that allow children in the early primary and elementary grades to learn to read (Binks-Cantrell et al., 2012). Even when teachers have limited specialized training in early reading instruction, they can draw upon external resources, such as well-designed software (e.g., ABRACADABRA), to enhance their in-class instruction and, in particular, support early language and literacy skill development (Wozney et al., 2006).

Effective Literacy Instruction

The National Reading Panel (2000) identified five skills that children must master to be able to read proficiently. These include phonemic awareness, phonics, fluency, vocabulary, and comprehension of text. More recently, the National Early Literacy Panel (Lonigan et al., 2008) identified six variables related to early literacy development: alphabet knowledge, phonological awareness, rapid naming of symbols (i.e., letters, numbers) and objects, writing, and phonological memory. Both panels discussed the importance of targeting alphabetic knowledge and phonological awareness, as well as variables related to reading fluency, vocabulary, and reading comprehension.Although both panels were based in the United States their findings have been adopted by researchers and educators in other English-speaking countries. Overall, early literacy acquisition begins with the development of preliteracy skills with phonological awareness being a key skill, which leads to the development of word reading skills, and culminates with text comprehension (Anthony & Lonigan, 2004; Vibulpatanavong & Evans, 2019). Additionally, concepts of print and grapheme-phoneme relationships are essential components of early literacy development (Grant et al., 2012).

Technology as a Support for Literacy Instruction

ABRACADABRA (A Balanced Reading Approach for Children Always Designed to Achieve Best Results for All: ABRA for short) is a freely available web-based literacy tool that was developed by a multidisciplinary team of educational researchers, policy makers, school administrators, language arts consultants and teachers from countries around the world (Abrami et al., 2010). Educational software as an instructional tool must be attractive, compelling and most importantly, grounded in theory and effective instructional practice. A multitude of studies have demonstrated ABRA's

effectiveness in improving and developing early literacy skills in children across varying grades from kindergarten to Grade 2 (e.g., Abrami et al., 2020; Arciuli & Bailey, 2019). This research included learners acquiring English as a second language, and learners with exceptionalities (Bailey et al, 2017; Savage et al., 2013; Wolgemuth et al., 2013). ABRA comprises 33 interactive literacy activities which are separated into four modules: reading comprehension, writing, fluency, and alphabetics (which includes phonological awareness and word reading). Given the strong design and evidence-based outcomes associated with ABRA, in the present study, teachers were provided hands-on professional development training workshops to introduce them to ABRA's program components, structure and navigation, as well as reviewing how the program features map onto fundamental aspects of literacy instruction.

The Role of Teacher Professional Development

Professional development (PD) offers opportunities for teachers to engage in ongoing learning, to connect with peers, and to enhance professional skills. PD influences teacher knowledge, beliefs, attitudes, and pedagogical methods (Callaghan, et al., 2018; Wolf, 2018). This positive influence on teacher knowledge and practice can enhance student learning (Koh et al., 2006).

Recent research has documented the need for instructional interventions for teachers to enhance knowledge and practice for teaching early literacy skills (Bold et al., 2017). This need has been identified in both higher- and lower-income countries (World Bank, 2018). For example, scholars and educators in Africa have identified training limitations and contextual variables (e.g., large classrooms and limited resources) that impact Kenyan teachers' abilities to demonstrate best practices regarding early literacy instruction (Bett, 2016; Dubeck et al., 2019). Similar concerns regarding early literacy instruction and training have been identified in high-income countries. For example, recent evaluations in Canada and the United States have identified instructional and performance concerns resulting in poor literacy attainment for children (Binks-Cantrell et al., 2012; NAEP, 2019; Washburn et al., 2016).

Various factors shape teachers' pedagogical knowledge including personal preferences, educational domain knowledge, and skills with instructional tools. Teachers develop personal preferences through their own ongoing education and professional development, as well as through their hands-on teaching experience (Janssen & Lazonder, 2015). Teachers' comfort and skills with instructional tools determine how quickly and thoroughly they can adopt these tools and how successfully they are able to implement the tools in their classrooms (Wolgemuth et al., 2013; Wozney et al., 2006). The effectiveness of technologies and relevant software is dependent on the educators' level of adoption and integration of technology (Mishra & Koheler, 2006; Wolgemuth, et al. 2013). Therefore, the benefits of educational technology lie not only with the efficacy of the tool but also with teachers' ability to successfully implement the tool.

Mishra and Koheler (2006) introduced the Technological Pedagogical Content Knowledge (TPACK) framework as a means for identifying the factors that influence effective integration of technology as a teaching tool. Three core components (pedagogical knowledge, content knowledge,

technological knowledge) and the intersections among these three components identify the key elements that need to be addressed in order to predict effective classroom integration. Research indicates that even when teachers express confidence in each of the basic components of the TPACK framework, they may still struggle in applying this knowledge when designing lessons (Maeng, et al., 2013; Pamuk, 2012). Thus, PD designed to enhance effective integration must allow teachers opportunities to acquire pedagogical, domain and technological skills as well as learning how to extend the use of technology to their own classroom context.

The PD workshops associated with ABRA introduce teachers to the software through direct hands-on use of the software, accompanied by an explanation of the pedagogical constructs underpinning the program design. Training also reviews fundamentals in early literacy development, which can further develop teachers' early literacy teaching knowledge (Helmer et al., 2011). The workshops provide opportunities for teachers to explore how to integrate the technology within their ongoing instruction, as well as develop extension exercises for their classrooms and provide bridges to local or national curriculum. Finally, the workshops encourage teachers to work collaboratively with their peers, to actively explore the software, and to develop authentic and relevant materials such as lesson plans. These features of the ABRA workshops are consistent with models of effective teacher professional training (e.g., Darling-Hammond et al., 2017). Extant research regarding the efficacy of workshop models in general is mixed; however, a recent systematic review and meta-analysis of literacy workshops suggests that positive outcomes are likely for high-quality workshops (Basma & Savage, 2018; Edmondson, 2007; Tournaki et al., 2011).

Together, these findings identify the importance of developing high-quality PD training and supportive instructional tools to enhance teacher learning and teacher practice. To-date ABRA and the asociated PD training have been provided for teachers in Canada, Australia, Hong Kong, China, the United Kingdom, and Kenya (Cheung et al., 2016; Savage et al., 2013; Wolgemuth et al., 2013). In each of these cases, training has been associated with student learning gains. The present study extends existing research by directly comparing perceptions and knowledge between teachers of diverse teaching backgrounds.

Present Study

An important research question in the present study involved exploring the cross-cultural relevance of PD programs designed to enhance integration of an empirically and theoretically strong software program as part of ongoing in-class instruction. The study examined potential differences in domain knowledge, technology skills, and confidence in teaching literacy and with a technology-based tool. Specifically, the study contrasts public school teachers in Kenya and Canada who attended a PD workshop introducing the early literacy program, ABRA, as a teaching and learning tool. Overall, these research questions contribute to our understanding of teachers' experiences with the ABRA PD training workshop. The study also explored areas for improving the training through assessing teachers' needs.

Method

Participants

Two groups of Canadian teachers and one group of Kenyan teachers were invited to PD workshops on early literacy instruction using technology, delivered through their local school board. Workshops were provided in English. Canada has two official languages: English and French. Kenya has two official languages: Kiswahili and English. All participants were fluent in English.

Canadian Sample

The 21 Canadian teachers were recruited from two large cities, Vancouver (n = 15) and Toronto (n = 6), (M_{age} = 42.53 SD_{age} = 9.35, range = 31 to 62 years). Years of teaching experience ranged from 1 to 30 years (M = 13.07, SD = 8.67). All participants had completed a university or college program, with 15 participants having completed postgraduate studies or having obtained a graduate degree, and all had completed a teacher education degree. The majority of current teaching assignments for participants in the Canadian sample ranged from Grades 1-4 (n = 12) with three teaching at the Grade 6-7 level, and one teaching high school. Four participants did not answer this question and one was not currently teaching.

Kenyan Sample

In total, 34 Kenyan teachers were recruited from one larger city, Mombasa (M_{age} = 40.28 SD_{age} = 10.99, range = 25 to 59 year). Years of teaching experience ranged from 2 to 34 years (M = 17.22, SD = 10.82). All participants had completed high school and 57% had completed university or college or graduate studies. All of the participants had completed a teacher education degree. Only 17 teachers provided responses regarding current teaching assignments including five participants teaching Grade 1 classes, four participants teaching Grade 2, seven participants teaching Grade 3, and one participant teaching multiple grades (Grades 1-3).

All Kenyan teachers and all but two Canadian teachers had attended a PD workshop on the topic of literacy in the last three years. Teachers reported having dedicated over 40 hours (M = 40.16, SD = 100.01 hours) to professional development about literacy learning in the last year. This mean was greatly influenced by one participant who was a reading recovery teacher and who identified as having a total of 450 hours of PD. When this teacher was removed as an outlier the mean number of hours was 17.39 (SD= 12.67) and the range was 0-50 hours.

This study was reviewed and approved by a the ethics review board at Wilfrid Laurier University and all participants were treated in accordance with APA/CPA ethical guidelines.

Materials

All participants completed two surveys, one before and one after attending the ABRA training workshop.

Pre-workshop Survey:

The pre-workshop survey comprised 34 items assessing demographic information (gender, age, level of education, years teaching, previous training in literacy instruction), literacy knowledge, and technology knowledge and skills.

Knowledge of Literacy. Participants' knowledge of early literacy constructs (i.e., phonemes and phonological awareness) was measured using a 16-item scale adapted from a 54-item scale developed by Binks-Cantrell and colleagues (2012). Items assessed participants' ability to define phonemes and phonological awareness and to identify the number of speech sounds in a series of words. Reliability was high (Cronbach's alpha = .80).

Comfort Using Technology. Participants completed an 8-item scale that assessed their perceptions toward using technology in general, with each item using a 5-point scale (1 = Strongly disagree to 5 = Strongly agree). Items framed as conveying a negative view of technology were reverse coded. High scores indicated greater comfort using technology. A total score was calculated by adding all eight items (Maximum score = 40).

Comfort Teaching with Technology. Participants completed a 5-item scale to report their perceptions toward teaching with technology in the classroom. All items used a 5-point scale (1 = Strongly disagree to 5 = Strongly agree). One negatively phrased item was reverse-coded. High scores indicated greater comfort teaching with technology (Maximum score = 25).

Confidence Teaching Early Literacy Skills. Teachers were asked to rate how confident they would be teaching each of four aspects of early reading (i.e., reading comprehension, writing, fluency, and alphabetics) using a 5-point scale (1 = very confident to 5 = very unconfident). Low scores reflected greater confidence.

Post-workshop Survey

In order to allow for comparisons before and after the workshop, the post-workshop survey included the confidence teaching early literacy skills questions from the pre-test. In addition, comfort teaching each of the four aspects of early reading (reading comprehension, writing, word-level reading, and alphabetics) was assessed using a 5-point scale (1= very comfortable to 5 = very uncomfortable), with low scores indicating greater comfort. Kenyan teachers were asked to rate their confidence teaching the English language using the same 5-point scale, with lower scores reflecting higher confidence. The post-test survey also assessed perceptions toward the workshop as well as confidence using ABRA as a teaching tool.

ABRA PD Workshop

In each location, the hands-on workshop was presented by a certified ABRA trainer with assistance from trained facilitators and included a PowerPoint presentation explaining the four foundational ABRA activities: reading comprehension, writing, fluency, alphabetics. Participants were provided with worksheets as guides and training activities to engage participants and allow them to self-assess their ABRA knowledge. The trainer provided detailed descriptions of each activity and

demonstrated how users could access and navigate these activities, prior to asking participants to engage with the software on their own. The trainer then showed the participants the teacher landing page and how they could view individual student profiles and their grades. Throughout the training workshop participants were encouraged to actively participate and ask questions regarding ABRA or integration. Queries were answered by the trainer or the workshop facilitators. Training in Canada was conducted by Canadian trainers, while training in Kenya was conducted by Kenyan trainers.

Procedure

Workshops followed the same procedural format, however Canadian sessions occurred on one day while the Kenyan sessions occurred over three afternoons. The Canadian sessions focused primarily on the software while the Kenyan sessions included additional integrative information on how the software would relate to new competency-based curriculum guidelines instituted by the Kenyan government. Session length varied from approximately 3.5-7 hours. All workshops were in-person and interactive. Two to four facilitators were present throughout all of the workshops to provide troubleshooting support and to distribute and collect surveys.

Results

Knowledge of Literacy

Teachers' mean scores on the aggregated 16-item assessment reflected scores just above the midpoint of the measure: Canadian teachers (M = 9.40, SD = 3.32) and Kenyan teachers (M = 9.18, SD = 2.25). Scores ranged from 2 to 14 among Canadian teachers and 4 to 13 among Kenyan teachers (Table 1). Means scores did not differ between the groups of teachers, ($t(1, 52) = .295$, p = n.s). Given that this measure reflected teachers' ability to count phonemes and to define constructs associated with literacy, analyses were conducted to compare teacher groups on these two subscales. There were no differences between the Kenyan and Canadian teachers for phoneme counting ($t(1, 53) = .015$, p = n.s. or defining constructs $t(1, 53) = -.039$, p = n.s.).

Table 1

Means and Standard Deviations for Literacy Knowledge Scores and Phoneme Definition and Phoneme Counting

Location	Kenya			Canada		
	N	M	SD	N	M	SD
Total Literacy Knowledge	34	9.18	2.25	20	9.40	3.32
Phoneme Definition	35	1.14	0.73	20	1.15	0.49
Phoneme Counting	34	8.09	2.45	21	8.10	3.32

Correlations conducted to examine potential relationships between teachers' total literacy knowledge and their pre-workshop and post-workshop confidence in teaching literacy were not significant (r = -.039, p = n.s. and r = .092, p = n.s., respectively).

Total literacy knowledge scores did not differ between those teachers who had previously attended PD (M = 8.95, SD = 3.30) and those who had not previously attended PD (M = 8.50, SD = 1.70), $t(1, 24) = .266$, p = n.s.

Confidence Teaching Literacy

Teachers were asked to indicate how confident they felt about their ability to teach each of the four aspects of early reading (reading comprehension, writing, word-level reading, and alphabetics) before and after participating in the workshop. Kenyan teachers were additionally asked to assess confidence in their ability to teach English to non-native speakers.

Overall, mean scores for each of the areas of early reading prior to and after the workshop reflected low scores on the 5-point scale, indicating higher levels of confidence[1] (Table 2). A 2 (time: pre-workshop/post-workshop) X 2 (country: Kenya/Canada) mixed model ANOVA was conducted for reading comprehension, writing, and word-level reading. The main effect for time was not significant. Although the main effect for country was significant F (3, 23) = 3.23, $p < .05$, $\eta_p^2 = .297$, this main effect was qualified by a significant interaction F (3, 23) = 3.68, $p < .05$, $\eta_p^2 = .324$. Examination of the interaction indicated no differences in reported confidence between the Kenyan and Canadian teachers for teaching reading comprehension prior to the workshop t (1,35) = 1.20, p = n.s.. However, following the workshop Kenyan teachers reported greater confidence than their Canadian peers, $t(1,46) = 2.22$, $p < .05$.

In addition, prior to the workshop Kenyan teachers reported greater confidence than their Canadian peers for teaching writing ($t(36) = 2.27$, $p < .05$), and this pattern was also evident after the workshop ($t(46) = 2.83$, $p < .01$).

Finally, Kenyan teachers reported greater confidence than their Canadian peers for teaching word-level reading prior to the workshop ($t(38) = 3.28$, $p < .01$). After the workshop there were no significant differences in reported confidence for the Kenyan and Canadian teachers, $t(46) = 1.34$, p = n.s.

For alphabetics, Canadian teachers scored below the midpoint of the scale, indicating some confidence in teaching in this domain (M = 2.33, SD = .97).

After the workshop, confidence was higher for the Kenyan than Canadian teachers for reading comprehension ($t(1,46) = 2.12$, p = .031), writing ($t(1,45) = 2.72$, p = .007), and alphabetics ($t(1,46) = 3.34$, p = .002). However, there were no differences between the teacher groups for word-level reading, $t(1, 46) = 1.34$, p = n.s.

In addition, to confidence in teaching literacy, Kenyan teachers were asked to identify their confidence in teaching English. Kenyan teachers indicated relatively high confidence teaching the English language (M = 1.72 SD = 1.18). In addition, teachers who attended literacy-based PD in the past

[1] Due to a technical difficulty on the pre-test, only data for Canadian teachers were available for confidence in teaching alphabetics.

(M = 6.89, SD = 2.39) did not differ from those who reported no previous PD (M = 6.56, SD = 4.39) in their confidence teaching English (t(27) = .26, p = n.s.).

Table 2

Means and Standard Deviations for Teachers Ratings for Confidence Regarding Teaching in Early Reading Areas Prior and Post PD

Location	Kenya		Canada	
	M	SD	M	SD
Confidence Ratings Prior to PD				
Pre Comprehension	2.06	1.34	2.06	0.66
Pre Writing	1.70	1.49	2.47	0.94
Pre Word-Level Reading	1.20	0.42	2.29	0.85
Pre Alphabetics	-----	------	2.33	0.97
Pre English Language Lessons	1.72	1.18	-----	-----
Confidence Ratings Post PD				
Post Comprehension	1.40	0.69	1.88	0.78
Post Writing	1.30	0.68	2.06	0.75
Post Word-Level Reading	1.50	0.71	1.88	0.86

Comfort Teaching Literacy

Comfort teaching literacy was assessed at post-test through one question for each of the four literacy areas: reading comprehension, writing, word-level reading, and alphabetics. Lower scores indicated higher comfort levels. For each of the four literacy areas comfort scores were close to ceiling and did not differ between the two groups (Table 3). In addition, there were no significant differences among any of the four areas for either the Kenyan or Canadian teachers' ratings, largest t(1,49) = 1.55, p = n.s. for reading comprehension.

Table 3

Means and Standard Deviations for Comfort Scores Teaching Literacy

Location	Kenya (N=33)		Canada (N=18)		
	M	SD	M	SD	t
Comprehension	1.55	0.62	1.28	0.57	-1.52
Writing	1.63	0.70	1.61	0.92	-0.11
Word-Level Reading	1.61	0.83	1.44	1.04	-0.608
Alphabetics	1.42	0.56	1.39	1.03	-0.16

Comfort with Technology

Ratings of comfort with technology in general were high (maximum = 40) with no significant differences between scores of the Kenyan (M = 30.88, SD = 5.20) and Canadian teachers (M = *28*.76, SD = 5.92), t(1,53) = -.139, p = n.s.

Teaching with Technology

Both the Kenyan teachers (*M = 19.91,SD* = 3.32) and the Canadian teachers (*M* = 18.95, *SD* = 1.96) indicated relatively high comfort teaching with technology (maximum score = 25) with no significant differences between the groups, *t(*1,50) = -1.16, *p* = n.s.

A strong positive correlation (*r* = .595, *p* =. 001) was found between teachers' ratings of comfort using technology and teaching with technology.

Confidence in Helping Students Navigate ABRA

After the workshop, teachers were asked how confident they felt in being able to help their students navigate ABRA on their own. Both Kenyan (*M* = 1.76, *SD* = .79) and Canadian teachers (*M* = 1.94, *SD* = .73) indicated very high levels of confidence with no significant differences between the Kenyan and Canadian teachers, *t*(49) = .83, *p* = n.s.

Memory for Content Taught in the PD Workshops Regarding ABRA

After the workshop, participants were asked to identify whether they recalled being taught about the four literacy sections in ABRA. Participants' dichotomous (yes/no) ratings were examined. All of the Canadian teachers recalled viewing each of the literacy sections in ABRA. All Kenyan teachers recalled learning about reading comprehension and alphabetics. However, one Kenyan teacher did not recall seeing information on reading fluency or writing.

Pacing of the ABRA Training Workshop

Teachers were asked to rate the pace of instruction in the workshop. Kenyan teachers found the pace as *slightly fast* (*M* = 1.91, *SD* = .29) compared to their Canadian peers who rated the workshop pace as *just right* (*M* = 2.42, *SD* = .46), *t*(49) = 4.81, *p* <.001.

Discussion

The overarching goal of the present study was to examine teachers' knowledge, and perceptions of confidence and comfort teaching English using ABRA as a function of participating in a PD workshop in two different cultural contexts. Consistent with the TPACK model (Mishra & Koheler, 2006), assessment of domain knowledge regarding constructs related to early literacy, as well as confidence in technological knowledge, proved to be important considerations when assessing the pedagogical training that occurred during the workshops. The cross-cultural comparison in the present study indicated more similarities than differences in outcomes across the two groups of teachers, which provided insights regarding the generalizability of this professional workshop. Both groups showed similar weaknesses in knowledge about linguistic constructs, which were skills addressed in the workshop.

Domain knowledge and skills regarding technologies are critical components of the TPACK model (Mishra & Koheler, 2006) and a key to integration of technology as a teaching tool. Although both groups of teachers in the present study self-assessed as having relatively high confidence in

teaching literacy, their actual scores on the measures of knowledge of literacy constructs were quite low. Specifically, the average scores for both Canadian and Kenyan teachers were similar and below 60%. Previous research has identified over-estimation as a concern in the early literacy domain. When teachers are asked to self-assess their knowledge of literacy constructs, they tend to overestimate how much they truly know (Cunningham et al., 2004). Subsequent research demonstrating this gap emphasizes that many teachers do not have a sufficient knowledge of the underlying linguistic concepts needed to effectively teach early literacy (Binks-Cantrell et al., 2012; Joshi et al., 2009; Martinussen et al., 2015). The gap is also interesting in terms of perceptions of what is considered challenging or easy to teach or learn. Although in other domains, such as mathematics and science, it is not uncommon for teachers to indicate limited knowledge and confidence in mathematics and science and request supports to facilitate their teaching (Bleicher, 2007; Nadelson et al., 2013), when it comes to literacy and reading it appears that teachers are either less likely to be aware of their lack of knowledge about underlying constructs or are less likely to report it. This may pose particular challenges in the domain of early literacy instruction. Lack of knowledge regarding fundamental constructs may limit teaching practices, while lack of awareness of this knowledge gap may limit educators from seeking support and PD. Outcomes from exisiting research and those in the present study suggest that in addition to the hands-on *how-to* aspects of PD regarding integration of early literacy software there may need to be a deeper focus on the underlying theory to promote better pedagogy and instruction.

Technology awareness and skills is another critical aspect that predicts successful integration within the classroom (Mishra & Koehler, 2006) In the present study, teachers from both sites rated themselves well above the midpoint of the scale for comfort with technology and for comfort teaching with technology. This is an important outcome as teachers with more positive attitudes generally are more likely to use technology in their classrooms (Agyei & Voogt, 2011; Kim et al., 2013).

Although on average teachers in our samples indicated familiarity and comfort using technologies, scores did vary with some participants indicating quite low self-ratings. This variability suggests that some teachers may have needed greater, perhaps individualized, support to maximize their learning. Alternatively, provision of workshops may need to include a primer session for some teachers and more extensive instruction when first introducing each construct. Instituting a longitudinal or repeated experience opportunity either in person or virtually may be necessary to better support subsequent implementation in the classroom (Callaghan et al., 2018; Parsons et al., 2019). Research has demonstrated that teachers not only depend on the quality of PD workshop instruction, but they also often require additional support both during and following the workshop (Callaghan et al., 2018).

Previous attendance at PD workshops regarding literacy did not have an impact on confidence in teaching literacy. Research suggests teachers who undergo high-quality PD regarding literacy are more likely to effectively understand literacy concepts and apply them in their teaching (Binks-Cantrell et al., 2012; McMahan et al., 2019). Our findings may indicate that the ABRA workshop provided sufficient information regarding fundamentals of literacy development that the advantages associated with earlier PD in literacy were no longer evident after training. However, we were unable to assess the quality of

prior teacher PD received by the participants in the present study. Assessing content and quality of prior instruction would be an important contribution to future research.

An important question in the present study was to determine potential cross-cultural differences. Overall, outcomes generally reflected more similarities than differences between the Canadian and Kenyan teachers. Teachers faced similar challenges in identifying literacy skills and integrating technology with pedagogical practices. This finding suggests that the key elements of the present PD may be generalizable across multiple sites. Consistent with the TPACK model, both the Canadian and Kenyan teachers in the present study experienced some limitations with respect to their domain knowledge in terms of foundational linguistic skills. In addition, both the Canadian and Kenyan teachers expressed high levels of confidence in comfort with technology and in using technology as a teaching tool. However, there were some differences in confidence with respect to teaching in different areas of early literacy. These variations suggest that small modifications, for example, varying the depth of instruction provided across the different literacy skill areas, may be necessary to make the PD more flexible to optimize these workshops across cultures.

When teachers were asked to rate the pacing of the present workshops, Canadian participants indicated that the pace was just right while Kenyan teachers perceived a need for a slower pace. The Canadian workshops were shorter than the Kenyan workshops. Therefore, this may indicate that the content, language of instruction, or familiarity with technology as a teaching tool required more support for the Kenyan teachers. Tailoring the workshop pace and content to match more closely with the needs of teachers could enhance the experience of the PD. For example, although the participants were able to gain hands-on experience with ABRA at intervals throughout the workshop, there may have been insufficient time for participants to fully explore all of the activities on their own. Additionally, the timing of the workshops in Kenya coincided with the rollout of a new curriculum initiative, which required more extensive efforts on the Kenyan teachers' part to understand how to integrate the technology within the new and unfamiliar expectations of the new curriculum requirements. Although opportunities for discussion and concrete examples were provided during these presentations, consistent with the TPACK model, the lack of familiarity in pedagogical expectations may have impeded the perceived pace of learning for the Kenyan teachers.

Conclusion

Well-designed and well-delivered professional development (PD) offers teachers opportunities to enhance their knowledge, skills and readiness for instruction (Callaghan et al, 2018). Examining how teachers respond to PD is a critical step in designing and optimizing PD to meet teacher needs. In today's society literacy instruction is critical for children, and integration of technology-based instructional tools is important for both teachers and children. Technology can be used to equalize the opportunities across diverse educational contexts, including across cultures. The present study provided insights regarding teachers' responses to PD that promotes early literacy instruction through technology and demonstrates some areas for further development and consideration when developing PD.

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