Scaling up a Technology-Based Literacy Innovation: Evolution of the Teacher Professional Development Course

Jennifer Head
Concordia University, Canada

Larysa Lysenko
Concordia University, Canada

Anne Wade
Concordia University, Canada

Philip C. Abrami
Concordia University, Canada

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Article Info	Abstract
	Good teachers are a major predictor of students' success in school and beyond it. Finding ways to increase the quality of teaching has been a concern for educational systems across various income contexts and, particularly, in the Global South. This paper discusses the iterative design of an online teacher professional development program geared to improving teachers' English language instruction by means of implementing early literacy software. The program was implemented in various modes (face-to-face, blended and online) with early primary teachers scattered throughout Kenya during the pandemic school closures and after reopening. Relying on the blended learning approach, a potentially effective technology-driven TPD offers multifaceted content, has adaptive and flexible design, and is ongoing until mastery of core concepts is achieved. Further, such solution develops motivational dispositions of teachers about teaching with early literacy software so that its perceived value and the likelihood of success are high, and the benefits outweigh the costs of implementation. The next step of this research is to learn about the specific outcomes of the blended TPD, including changes in literacy instruction and subsequent improvements in student literacy skills.

Introduction

Good teachers are a major predictor of students' success in school and beyond it. Naturally, finding ways to increase the quality of teaching has been a concern for educational systems across the range of income contexts but, particularly, for those in the Global South facing the learning crisis. In this regard, there is a need to ensure teacher professional development, the principal avenue to improve teachers' competencies and performance in class, is effective in low- and medium-income countries.

Despite significant strides in access to schooling to date, educational attainment worldwide is well short of the standard set by the 2030 Agenda for Sustainable Development (UNESCO GEM report, 2019). Specifically, the Sustainable Development Goal 4 calls for inclusive and quality education for all. As of 2019, 258 million children and youth were not in school, and 483 million children of primary and lower secondary school age lacked foundational literacy after the years they spent in school (UIS, 2019). Yet, the costs of illiteracy are staggering; poverty, crime, poor health, and a host of other social and personal ills are exacerbated by the inability of people to command basic educational skills (Martinez & Fernandez, 2010). Losses to the global economy caused by low

levels of literacy are around one trillion dollars each year (UIS, 2018). Research argues for the need to develop literacy early in life (e.g., Sparks, Patton & Murdoch, 2014) -- later remediation, no matter how extensive and costly, follows years of student frustration and failure, and hence, does not succeed as well as early intervention.

Among the range of challenges rising at the school, household, community, national levels, and globally (covid-19 pandemic), many relate to the quality of instruction (e.g., Akyeampong, 2019). Research on pedagogy, curriculum, teaching practices and teacher education in developing countries found an over reliance on undifferentiated knowledge transmission methods such as basic recall, rote learning, memorization, repetition, and recitation (e.g., Westbrook et al., 2013; Bold et al., 2017). Hence, there is a need to adopt effective pedagogical practices through teacher professional development, inclusion of educational technology, and interactive instructional approaches that promote small group learning (e.g., McEwan, 2015).

This paper discusses the iterative design of an online teacher professional development program (TPD). This TPD program is geared to improving teachers' capacity to deliver effective English language instruction by means of implementing early literacy software that serves to enhance instruction and is meant to be used in combination with effective practices of literacy teaching. The TPD was piloted in various versions and conditions (face-to-face, blended and online) with early primary teachers scattered throughout Kenya during the pandemic school closures and after reopening.

ABRACADABRA (ABRA), A Balanced Reading Approach for Children Always Designed to Achieve Best Results for All, is one in a suite of evidence-based and research-proven tools called Learning Toolkit+ available to educators free of charge (https://www.concordia.ca/ltk). ABRA is an integrated collection of 33 interactive activities linked to 20 digital stories mapped onto what systematic reviews conclude are the important skills children need to acquire to become literate, designed especially to ensure that struggling readers experience success (National Reading Panel, 2000). It consists of three different environments: Student, Teacher and Parent.

The Teacher environment contains (1) an Assessment report where teachers can track class or individual student activity within the software, and (2) Teacher Resources with access to dozens of print-based and multimedia support materials, including those prepared for the Kenyan context. The Parent environment also contains multimedia materials geared to supporting literacy development in the home. READS, a Repository of Ebooks And Digital Stories, is a searchable catalogue of over 2000 multinational and multilingual stories, many with narration. It was developed to promote fluency, comprehension and vocabulary skills. The focus of the software and the TPD is to eliminate frontal teaching in favor of student-centered and interactive instruction.

Over the years, to improve early primary students' literacy achievement and literacy teaching, the software was integrated into classroom instruction in dozens of primary schools in Kenya. We also studied the implementation of these tools and its outcomes (Abrami et al., 2016; Lysenko et al., 2019). Of particular interest was learning how to work with teachers to improve their English literacy instruction – hence our research of TPD models (Uribe-Banda et al., 2021; Wood et al., 2022). The initial teacher professional development model that was used consisted of a highly interactive, intensive three-day workshop, followed with ongoing biweekly support and planning

meetings with the teachers. Considerable time was spent on the co-construction of sample lesson plans, teacher guides, and job aids for classroom implementation, ensuring the tools aligned well with the national curriculum and were integrated into instruction.

Repeatedly over the years, the importance of both the interactive training and the value of follow-up support were noted by both trainers and teachers. Follow-up training was deemed essential as teachers had questions and concerns with ongoing classroom deployment of the software following the initial training. In addition, we learned that teachers needed professional development on how to teach emerging literacy skills to children and how to use technology effectively for doing so. This model induced some changes in teaching and led to significant gains in student achievement (Lysenko et al., 2019). However, because it is resource-intensive, this TPD model was not scalable, sustainable, or cost-effective. Based on the research evidence on the models that work in developing countries, we designed an online modular TPD literacy program without foregoing the quality and relevancy of the content and pedagogical approach. The summary of this evidence follows.

TPD in Global South: Literature Review

We have frequently encountered national teacher training initiatives that focus on train-the-trainer or cascade models of TPD. These models, while highly efficient are not highly effective. For instance, cascade models are critiqued for the information transmission distortions such as "trickle-down effect" and shallow coverage, and do not deploy effective support strategies as teachers implement new classroom instruction (e.g., Englebrecht et al., 2007; Ono & Ferreira, 2010).

As an initial step to designing a more scalable and sustainable approach to TPD, we examined the evidence from systematic research on teacher education. While TPD models and approaches has been well-researched globally, empirical research focussing on technology-driven TPD is less frequent. However, two recent systematic reviews of evidence on remote TPD in the high-income nations (Schmid et al., 2021; EEF, 2020) suggest that together with knowledge and skills, educators gain self-efficacy through this format. A blended mode of TPD that combines synchronous and asynchronous delivery and face-to-face and online learning seem particularly beneficial. In blended TPD, teachers feel part of a community while saving travel costs and enjoying flexibility and social distance during online and asynchronous components. An older review of interaction in remote learning (Bernard et al., 2009) reveals the advantage of interactive over transmission models of TPD, where successful interactive models are those that ensure learner-content interaction, learner-instructional delivery interaction, and peer-to-peer interaction.

In low and middle-income countries (LMIC), the growing accessibility of technological devices has resulted in an increasing number of studies of the technology-based TPD interventions in pre-service and in-service settings. The results of Hennessy et al.'s (2022) synthesis of 170 studies, report important benefits of technology-driven TPD, such as increased pedagogical and content knowledge, along with greater motivation. Yet the evidence of the TPD's impact on classroom practices and student learning was found insufficient. As well, no consistent evidence on the cost-effectiveness of the TPD interventions was available to draw conclusions. With a special

focus on technology-driven *TPD strategies* and their *design*, we reviewed 33 empirical studies targeting in-service teachers in primary and secondary schools, completed within low resource countries. The summary of findings of this review follow.

TPD Strategies

Teachers are most likely to adopt new pedagogical approaches when, in a training program, they feel a sense of *ownership over learning*. In a successful technology-driven TPD, teachers learnt at their own pace and had some scope to select content, activities, and media and tools. For instance, in the Simoncini et al.'s (2021) study, the self-paced TPD allowed teachers to increase their self-efficacy and offered extended opportunities for practice. Presumably, the highest degree of ownership might belong to the teachers engaged in creation of TPD content and activities. Motteram et al.'s (2020) report on an informal professional WhatsApp group run by the teachers in a refugee camp. Its activities benefited teachers' English skills, but more importantly served as a platform to share and discuss issues related to their context, development and exchange of instructional materials.

In this regard, collaborative context for teacher learning is crucial. The reviewed studies emphasized that for TPD, internet technologies (esp. social media) enable collaboration and the rise of communities of practice by transcending the boundaries of one school. The extent to which these technologies support peer interaction is a critical factor to the survival and durability of a teacher community. For Bett and Makewa (2020), virtual "togetherness" is the indicator of the relevance of the professional group on Facebook. Although important for any form of online group activity, social presence is not necessarily teaching- or learning-related (Motteram et al., 2020). Hence, the challenge of introducing a professional focus to the exchanges, as these are primarily supported by the social media apps.

Based on the face-to-face teacher development, it would be expected that *demonstration and modelling* would be the effective strategies used in technology-based TPD. The reviewed interventions offered audio and video materials to demonstrate pedagogical practices and to stimulate reflection and insights or both. These materials were either designed for a given training or filmed and shared by the trainees or borrowed from existing repositories. However, for effective modelling, the materials reflected authentic classroom practices in locally relevant contexts (Anwar, 2017; Kennedy & Laurillard, 2019).

The contextual relevance to cultural and linguistic boundaries and alignment with local curriculum considerably increase the chances of the program success both short and long-term. Therefore, there is a need to engage the participation of local expertise in the TPD design such as university researchers, curriculum designers, consultants from governmental agencies (Teles & Coutinho, 2011) as well as teachers (Anwar, 2017), trainers of teachers (Low et al., 2021) and even students (Onguko, 2012). The reviewed studies suggest that the main focus of TPD should be on *student learning, practical pedagogies,* teacher reflective practice and motivation. Specifically, together with raising understanding about how their students learn, teachers should be trained about what information can be gathered about students' learning, and how to gather and use this information (Bett & Makewa, 2020). Further, pedagogies promoted in training should be anchored to subject-specific pedagogical practices. For

example, training on student-centered instruction would be more effective if it connects to the subject matter that the teacher teaches. At the same time, an effective TPD both elevates teachers' subject-matter proficiency and yields outcomes that can be readily implemented with or without minimal adaptation to their practice (Anwar, 2017).

For teachers to adequately apply what they learnt, successful TPD incites them to reflect on their teaching practice. Strategies that stimulate reflection may include professional discussions on social media groups (e.g., Motteram et al., 2020), writing an online reflective journal (Teles & Coutinho, 2011) or contributing to the collaborative creation of educational resources (Saenz Rodrigez et al., 2017). Although several factors help motivate teachers to advance through the TPD programs, incentives related to professional recognition such as formal certification (Wolfenden et al., 2017) and program endorsement by the governmental agencies (Kennedy & Laurillard, 2019) are important. Other motivating factors include the quality of training (Truong & Murrey, 2019), opportunities for professional dialogue (Schreiber & Jantsz, 2020), emotional support through socialization with peers (Motteram et al., 2020), and real-time feedback (Mendenhall et al., 2018). Intrinsic motivators relate to self-directed learning outcomes such as growing confidence (Simoncini et al., 2020), sense of autonomy, progress and attainment (Truong & Murrey, 2019).

TPD Design Features

Face-to-face components of technology-based TPD interventions were reported as critical by the majority of reviewed studies, arguing for the blended TPD delivery. In a study of fully online TPD (Truong & Murrey, 2019), absence of face-to-face interaction was reported as a "prevailing demotivator". Although the balance between remote and face-to-face instruction in blended TPD varied across the studies, the latter has been integrated to build the foundations of a learning group (Motteram & Dawson, 2019), orient trainees (Low et al., 2021), complement remote instruction (Qasem & Viswanathappa, 2016); make up for the lack of connectivity (Mendenhall et al., 2018); and to help coach teachers (Lim & Liang, 2020), to name a few.

As Schmid et al. (2021) point out that the relevance of asynchronous and synchronous instruction is not obvious today because the use of web-based applications has influenced this discourse. Namely, some studies explicitly relied on a blend of synchronous and asynchronous tools and strategies to allow teachers anytime, anywhere real-time interactions for professional learning (Qasem & Viswanathappa, 2016). Others selected a tool for its particular function. For instance, in Nami et al. (2018) an asynchronous discussion forum was used for its potential to prompt teachers' reflectivity.

Teacher familiarity with the tools was reported as a decisive factor in a TPD design. To this end, an intervention might rely on multiple tools where each was used for a distinct purpose. For instance, to address the multimodality of interactions/communication, Dubeck et al. (2015) used WhatsApp for sharing and Google forms for assessments, whereas a Learning Management System (LMS) served as a repository of materials. Other studies argued for flexible TPD design that allows for timely customization and, therefore, increases intervention accessibility. For instance, Anwar (2017) reported how, based on the teacher feedback, some features of a LMS

were replaced by the tools that the teachers were conversant and comfortable with. In this regard, preparing teachers for technology-driven professional learning should be an integral part of professional development (Low et al., 2021) and should target basic technology skills, troubleshooting and online TPD course operating skills.

In terms of various forms of interactivity offered by the technology-driven TPD, the reviewed studies emphasized the importance of peer dialogue for successful teacher learning. LMS forums (Wambugu, 2018), social media (Mendenhall et al., 2018) or mobile text messaging (Dubeck et al., 2015) were the dialogue-enabling venues where facilitators were trainers (Wolfenden et al., 2017) or peer trainees (Haßler et al., 2020). Technology enabling photo and video sharing and distribution of materials enhanced teacher professional interactions (Motteram & Dawson, 2019). Formal feedback mechanisms augmented interactivity. Even though teachers liked interacting with their peers and valued their peer feedback, they expected feedback to come from their trainers (Wambugu, 2018).

The reviewed studies suggest the need to monitor teacher learning growth. Mendenhall et al. (2020) used the methodology of most significant change by engaging teacher-participants in reflective story telling. Onguko (2012) prioritized the use of reflective journals. Dialogic forms of assessment were spotlighted in Wolfenden et al. (2017) including contributions to the discussion forum and peer-reviewed structured written responses. In Low et al. (2021) a formal evaluation framework included case scenarios drawing on a teachers' capacity to apply knowledge, analyze, and solve problems. Otherwise, for Dubeck et al. (2016) interactive text messages generated sufficient evidence of teacher progress.

In the scarce number of studies that discussed Low and Medium Income Countries (LMICs), technology-based professional development can be a cost-effective solution. The reviewed studies highlighted models that repurpose the sharing and communication features of social media for professional learning, relied on teacher-owned mobile devices, distributed pre-loaded TPD materials on devices (iPods, SD cards) and drew from Open Educational Resources. Some combination of the above was reported to be cost-effective. In Lim and Liang's study (2020), a LMS served only as a resource repository, as teachers used their own smartphones to access TPD support via a social media group. Use of inexpensive technologies for TPD, such as cell phones to send support text-messages (Dubeck et al., 2015) and to make support phone calls (Haßler et al., 2020) were reported to be effective. Together with the empirical evidence on the technology-driven TPD interventions in LMIC, theories of multimedia interaction and expectancy-value underpin the design of this TPD.

Theoretical Framework

Abrami (2010) and Abrami et al. (2011) offered multimedia interaction theory to capture the complexities of learning with educational technology within a single framework. Its purpose is to comprehensively organize key principles and influences on learning with technology as a means to guide research on underlying processes, understanding individual and contextual differences, tool development and validation, and efforts at scalability and sustainability. The model (see Figure 1) synthesizes a collection of perspectives that contribute to instructional design and development of educational software and its application for learning.

Contemporary cognitive approaches to motivation and learning such as theories of self -regulation (Zimmerman, 2000; Zimmerman & Schunk, 2011) recognize that actively engaged, successful individual students employ internal processes such as a) monitoring their learning and demonstrating meta-cognitive awareness; b) setting personal goals and planning strategies to learn, use feedback to enhance learning and meet these goals; and c) displaying intrinsic interest, self-efficacy beliefs, and effort-based attributions for learning. Co-regulation and shared regulation when students internalize processes learned in collaborative activities can reinforce learning with technology and, therefore, should be transferable to technology-mediated learning environments.
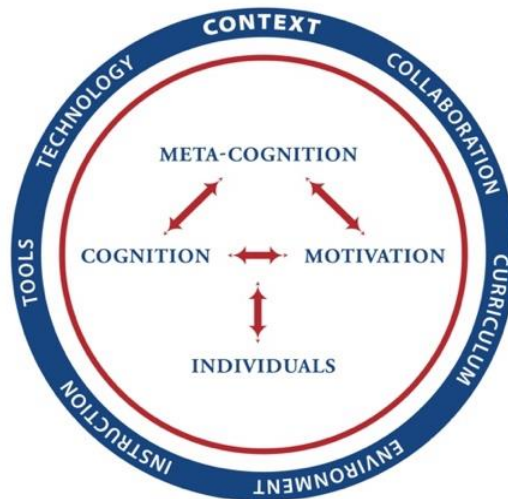

Figure 1. Multimedia Interaction Model

While these factors lie at the center of learning, external or context factors are connected with the motivational aspect of professional learning for effective instruction and need to be understood and accounted for. Abrami et al. (2004) and Wozney et al. (2006) applied expectancy-value theory to construct a unified view of the diverse issues that influence a teacher's decision to implement a technology-based educational innovation and persist in its use. The model posits that innovative practices are related to positive expectations of success, valuing of transformative experiences and minimization of perceived costs. Specifically, value assesses the degree to which teachers perceive the innovation or its associated outcomes as worthwhile including benefits to the teacher (such as congruence with teaching philosophy, career advancement), and to the student (such as increased achievement, improved attitudes). Expectancy relates to teachers' perceptions of the contingency between their use of the strategy and the desired outcomes, and factors affecting these perceptions including internal attributions (such as teacher self-efficacy and skill), and external attributions (such as student characteristics, classroom environment and collegial support). Cost, as perceived physical and psychological demands of implementation, operates as disincentive to innovating and may include class preparation time, effort, and specialized materials.

Accounting for these factors is the purpose of effective instructional design. However, the central challenge of instructional design for multimedia learning is to encourage learners to engage in appropriate cognitive processing during learning, while not overloading the processing capacity of the verbal or visual channels (Mayer, 2008). To address this challenge, Mayer formulated a series of research-based principles for the effective design of multimedia learning tools that focus the learner's attention and processing of information and avoid distractions

or spurious mental activity leading to cognitive overload. These principles work to reduce extraneous processing and the waste of cognitive capacity, manage essential processing and reduce complexity, foster generative processing and encourage the use of cognitive capacity.

Designing the TPD Course

Guided by the research evidence on effective technology-driven TPD in LMIC, along with theories of multimedia interaction and expectancy-value, and in collaboration with literacy subject-matter experts, a series of twelve TPD learning modules were designed to help support teachers develop their skills in teaching early literacy and in using ABRA and READS in their classrooms—available to the educational community at no charge (https://literacy.concordia.ca/tpd/). The intended audience is primarily early literacy teachers and student-teachers, but training and information sessions can also be offered to ICT teachers and curriculum consultants. These were initially designed to be accessed online. However, offline versions were subsequently added to each module due to the lack of connectivity in schools.

All modules follow a similar structure. Teachers are introduced to the theoretical underpinning of a core literacy skill such as Alphabetics (e.g., encompassing Pre-alphabetics, Phonemic and Phonological Awareness and Phonics), Fluency, Comprehension, and Writing (NRP report, 2000). Teachers are then guided on how the ABRA/READS software addresses each of these skills and provided with strategies on how to implement these tools in their classroom. Each module was designed with several built-in opportunities for interaction with instructors, peers, and the content itself, features integral to the success of distance education (Bernard et al., 2009). The content is presented in both print and multimedia mediums, and each screen has an audio button as an optional aid for users that are visually impaired.

The design of the modules keeps with Mayer's (2008) evidence-based principles for multimedia instructional design. The content is configured to reduce extraneous processing during learning. Namely, each module contains only materials essential to building mental models of literacy and literacy instruction (the *coherence* principle). The essential material is highlighted throughout by listing objectives (see Figure 2), bolding key terms, having a summary section, etc. (the *signaling* principle*).* In all animation videos corresponding narration and animation happen at the same time (the *temporal contiguity* principle).
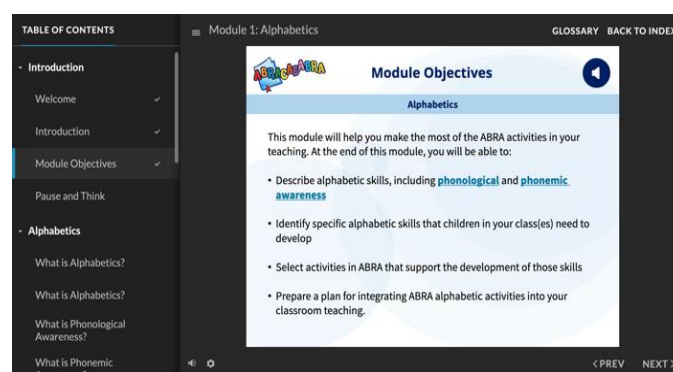

Figure 2. Alphabetics Module Objectives

Most of the animated videos do not have on-screen text next to narrated animation (the *redundancy* principle), unless there was a compelling reason to deviate, such as providing a sample breakdown of a word to illustrate blending and segmenting skills (see Figure 3) or comparing written words to the phonetic alphabet spellings. A transcript is available for anyone seeking a text-based equivalent to this content. Many of our live action videos have a transcript at the bottom to support those who may require a text-based version of the content.
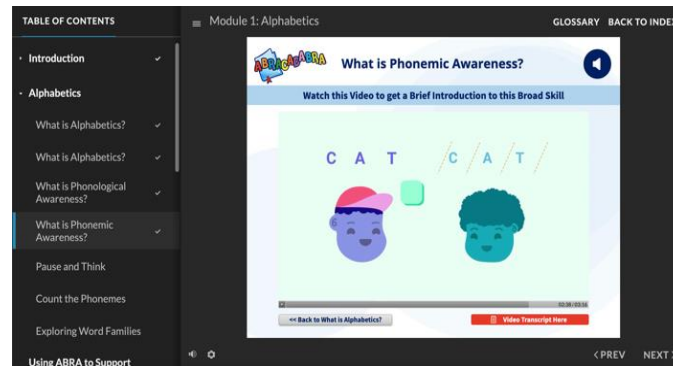

Figure 3. Sample On-screen Text on Narrated Animation

Further, ascertaining that graphics should be placed near corresponding text (the *spatial contiguity* principle), the embedded illustrations are on-theme for the content of the individual page, (see Figure 4), and diagrams and tables are near relevant text – as much as the design limitation of the module have allowed.
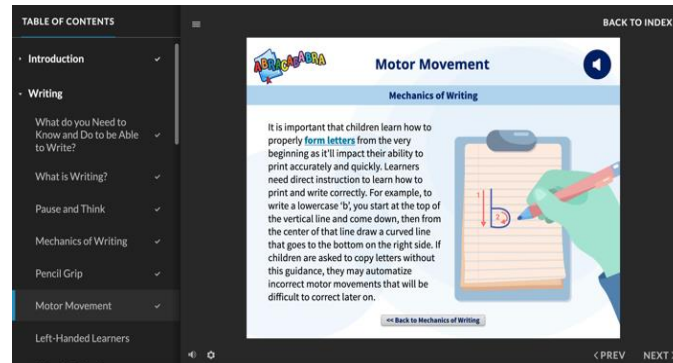

Figure 4. Example of the Writing Module

The principles for managing essential processing (segmenting, pretraining, and modality), and principles for fostering generative processing (multimedia, and personalization) are also accounted for in the design. Namely, the modules and the animation videos are divided into learner-paced segments. The main concept is introduced before offering access to the videos (see Figure 5).

The animation videos are narrated while the graphics embody what is said, helping to prevent the split-attention effect - that is, when learners are focused on reading the words, they do not watch the animation. The modules are designed in a multimedia fashion, with both text and images. The content is also personalized where appropriate, such as reflection questions phrased to get the teacher thinking about their own experiences. Both align with Mayer's principles for fostering generative processing.
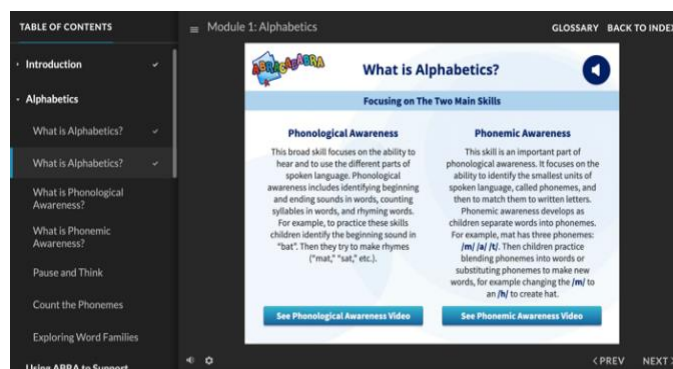
Figure 5. Introduction of Core Literacy Skills

As teachers progress through the modules, they are encouraged to reflect on their learning through knowledge checks, practice the skills through interactive activities (see Figure 6), and develop practical applications relevant to their own classroom context.

Figure 6. Sample Interactive Activity

These built-in periodic prompts aim to help teachers monitor their learning and build self-regulation skills, such as setting goals, seeking and using feedback, and collaborating with peers (Zimmerman, 2001). However, teachers might limit how they engage with the content and not request feedback, answer all reflection prompts, etc.

Pause and Think slides that appear periodically throughout the modules offer reflection prompts or practice activities (see Figure 7). These were designed to suit both self-paced teachers engaging with the modules individually and teachers working in groups. The latter of which not only encourages learner-content interaction, but also peer-to-peer interaction and offers the opportunity for teachers to practice and develop cooperative learning skills. Teachers are encouraged to share their lesson plans with a trainer or facilitator for feedback and guidance in mastering the skills they are learning.

The flexible design of the modules enables teachers to access the content in a fully online, self-paced fashion, or they may serve as complementary resources within or following face-to-face trainings. The possibility for teachers to select content of interest, and self-pace as they absorb the content, gives them ownership over their learning and helps them work on their self-efficacy. These self-directed opportunities combined with the design (division of topics, simplicity, and length) and the potential social aspect of learning with peers, all serve to promote and

increase teachers' motivation. Furthermore, when the TPD is conducted with the aid of a facilitator, they can issue the embedded Teacher Attitudes Survey. This survey helps facilitators gain a sense of the teachers' competence belief, expectancy for success, interest value, attainment value, utility, and relative cost. Facilitators can then use this information to address teachers' expressed interests and concerns and help keep motivation levels high.
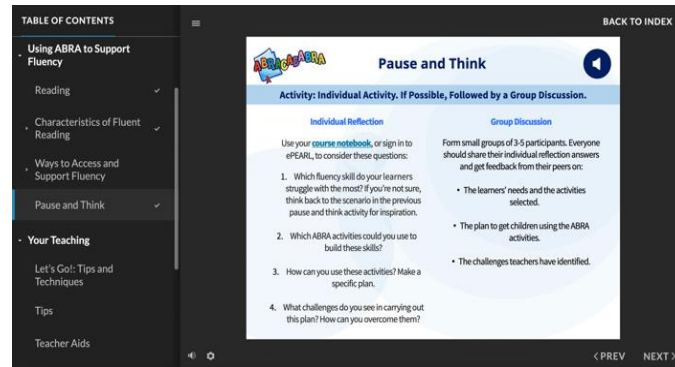

Figure 7. Sample Pause and Think Slide

The design of the program was iterative where each iteration was piloted with Kenya' early primary teachers and then refined to address gaps and concerns to better meet the teachers' needs. The methodology used to collect the data about piloting the two iterations of the TPD and the results are reported in the section below.

Piloting the TPD Designs

Methodology

A cyclical approach to instructional system design (for example, the ADDIE model) expects that the new design is implemented and evaluated. These phases allow exploration of the extent to which the instructional objectives are achieved and whether changes or adjustments are needed in the next version of design. To this end, we piloted iterations of the TPD and collected substantial information that helped us to further the TPD's efficiency and success. Teacher posts on the WhatsApp group and teacher self-reports completed at the conclusion of the course were the main sources of information. The teacher survey asked about their preferences of the TPD mode, and attitudes towards the activities and the course, learning literacy skills and ability to teach them, and reasons for not completing activities. The interview prompted teachers to reflect on the expectations they had for taking the course, routines they followed to progress through the content, and enablers and barriers to course completion.

The participants were a sample of 225 grade one-two-three teachers from public primary schools in Coastal and Western regions of Kenya.

Online TPD

The first iteration of the TPD was piloted during the pandemic. Our initial goal was to compare the methods of face-to-face, online and blended delivery, but due to school closures, safety protocols and health considerations, only the online model was used. A LMS was used both to deliver the TPD content and to track user data, such as

time spent on tasks. Fifty teachers were offered a nine-week course divided into 1 to 2-week lessons that covered one essential topic. This was extended for teachers to catch up and allow higher completion. While lessons focused on the core literacy modules, additional topics (i.e., parental involvement) were added, along with complementary resources, discussion questions, and assignments. The participating teachers utilized multiple methods to express how they experienced the course: they directly messaged the course facilitators, posted to the discussion board, and reflected in-class. They also experienced challenges. For example, some of the major hurdles included difficulty using the learning platform, lack of internet access and cost of data bundles, heavy lesson requirements, and the number of course facilitators were insufficient.

Despite these difficulties, positive testimonials confirmed that teachers benefited from the course. Teachers highlighted gains in literacy knowledge, literacy instruction, confidence, and appreciation for the provided resources:

> *"*I really enjoyed the course; it was well planned and laid out. The objectives were on point, the workload was just enough for that I had enough time to complete the assignments…I had the chance to express my thoughts/ideas on the discussion board…and I was challenged by our instructors."

> "It was a great experience connecting to digital world of learning which built my confidence and expanded my knowledge and skills […] I have learnt a lot from my teammates' discussions board."

One teacher noted an immediate improvement in her learners' performance:

> "As a librarian, incorporating ABRA on reading sessions has enabled students to understand the use of Alphabetics, pronunciation, speech and vocabulary…For the learners, it has been a booster as they have been able to gain access to a whole new life, uplifting their performance capabilities and strengthening their confidence."

Blended and Online TPD

In its 2nd iteration piloted with 175 teachers, the scope of the course expanded in two ways: mode of delivery and quantity of support. With the Kenyan government re-opening schools, the in-person component was introduced and, thus, offered two modes of delivery: online and blended. Both modes followed the same structure and same support, and both required considerable access to online content. Arrangements were made with a service carrier to offer discounted data bundles to reduce the personal costs to teachers.

The blended condition offered three in-person sessions, whereas the participants of the online condition enjoyed a handful of online drop-in sessions. Revisions also went into the structure of the 12-lesson course that spanned over 14 weeks. Like in the earlier pilot, the LMS was used to deliver the course. To address some teachers' confusion navigating the platform, improved technical support videos were created to demonstrate how teachers can set up their account, navigate within the tool, and submit their assignments using a dropbox and discussion boards. The videos were provided through the platform and WhatsApp, but some teachers continued to experience difficulties:

"At first using the Dropbox was so difficult." "The most difficult part was to be taught how to navigate without having a person showing you." "…submitting them [assignments] was a problem."

More LMS-related issues surfaced because many of the participating teachers were unaccustomed to using email and had not used an LMS before. Hence, some provided incorrect email addresses or were not able to access their email. While this was manageable within the pilot, it became more unwieldy as the number of teachers increased. Also, a third-party unit at a partner university generated the accounts and this caused delays in getting the errors adjusted.

The biggest hurdle was teacher drop-off around the mid-way point of the course. Some teachers stopped submitting work or would only complete partial assignments. Reminders sent through the LMS announcement feature were largely ignored. When the facilitator reached out individually through WhatsApp, teachers were motivated to complete the work for that lesson, but the decrease of teachers' enthusiasm was evident. When asked, teachers claimed they thought the course was good but very long. They also felt that one week per lesson was too short and had to make personal sacrifices to keep up:

"Assignments are supposed to be done weekly, so most of the time during the day I couldn't do the work. I had to work until maybe late at night. So, I had to sacrifice my rest time."

It became clear that the course content was too heavy and would be pared down for the next iteration. To identify a strategy that would help bolster participation, we disseminated a user feedback survey to the teachers who did not complete all lessons or dropped out early on as well as those who completed the course. Fourteen of the teachers were then interviewed to share their experiences in the TPD program. Regardless of their course completion status, the respondents preferred blended approach to TPD. Otherwise, the absence of in-person interaction stirred the following respondents' concerns:

"I fear issues of online."

"I was wondering why online course. I don't know if it's the African thing or what, but I expected we'll be shown a demonstration or something, physically."

Overall, integration of an in-person component, adjustments to the pace of the course, and provision of data bundles were suggested to make the course more appealing and increase completion rates. The respondents highlighted that learning about literacy skills and improving their ability to teach literacy were the most rewarding aspects of the course:

"I wanted to learn about the course is me using ABRA in teaching English. So that my children could interact with the devices. Learn more using stories from the computers and making it more exciting."

Other benefits of the TPD were also noted:

"Teaching is a dynamic thing, so you don't need to be rigid with whatever ideas that you learnt five years ago. So, it is good to always freshen your mind because new things come up each day."

"There are so many activities that we learn on that course, which are very helpful to our learners".

"I would recommend to every teacher. I've realized that learning starts mainly with literacy."

Teachers appreciated the collaborative aspect of the course. They felt that group work and communication with their peers made them more confident with the course as these offered explanations and ideas exchange. They also made the work easier and motivating. For instance,

"We blend our ideas together… [it was] Very motivating."

"We used the lunchtime for discussions." "We used to stay at school after six in order to finish the discussion so that tomorrow we are not interrupted in class. Now after finishing the discussion, you can go and do it yourself."

"[working together] much more mind-opening. I wish even it was a group of five because we used to discuss then we realize, "Not this way. This way." It's better than having to do it all alone, with you on the computer all alone."

"And it also impacted me because whenever you are down, somebody uplifts, doesn't matter, let us continue. We shall make it… It is easy. It was very motivating."

Further, teachers expressed that working with peers in another school proved beneficial:

"It was quite an experience visiting other teachers from other schools sharing with them the same experience."

Discussion

Retaining the core elements of the previous two iterations, the TPD design continues to evolve. Changes to the design and their rational are discussed below.

The delivery model changed to a blended learning approach only. Whole-group face-to-face sessions were scheduled at the beginning, middle and end of the program, with modest in person support, complemented with synchronous sessions where facilitators provided instruction, answered questions, and facilitated the peer-to-peer support. To allow teachers more control over their learning, teachers were expected to move through relevant portions of the TPD content assigned for each sub-unit at their own pace. Teachers were given more opportunity for the refinement of their own lesson plan design, following self-assessment and peer feedback. Additional peer-to-peer interaction (planning support and feedback) was encouraged during pre-existing school-based meetings.

Three significant changes were made to the structure of the program to enhance engagement and reduce attrition:

Elimination of the LMS: Teachers' lack of familiarity with the tools employed for blended and online TPD was an important factor as the relative novelty of the learning platform for the Kenyan teachers caused frustration.

Managing accounts was challenging and navigating within the environment proved problematic. Our attempts to circumvent these issues (video tutorials, clearer organization) had limited success. Alternative tools were considered, but many relied on the use of email, which proved unpopular with this population. Given WhatsApp is the go-to communication channel for Kenyan teachers, the facilitators and teachers primarily relied on it. Receiving reminders and direct messages through WhatsApp also resulted in more immediate action on the part of teachers to submit missing or late work. Finally, with the elimination of the LMS, the tracking of teacher progress through the TPD content was not possible, we used Google Analytics to collect this valuable information.

Easing of the course requirements: The prior heaviness of content and lesson requirements, along with time constraints became an obstacle for teacher engagement and completion of the program. Thus, changes were made to allow for a more in-depth look at each literacy skill and its constituent sub-skills, while also giving teachers more time to engage with the content (i.e., each broad literacy skill spanned one school-term). For instance, an Alphabetics module focused on teaching Pre-alphabetics, Phonemic and Phonological Awareness, and Phonics where each skill was covered in 3 weeks (1 week of theory and lesson planning, 2 weeks of implementation).

Improved applicability: To increase the contextual relevance and direct utility of the course to classroom practice, a major component of the program was devoted to "a practicum" whereby teachers applied what has been learned through adaptation of model lesson plans to their classroom instruction. In this regard, they incorporated the pedagogical components that have been learned through integration of the software. Use of ABRA and READS is then not seen as an "add-on" in their regular lesson, but instead enhances their teaching of a given literacy sub-skill. To support the application of what they learned about the sub-skill in their classroom, we mapped out what teachers were expected to be teaching each week according to the national competence-based curriculum.

Other considerations draw on teacher self-efficacy, ownership and peer interaction. Teachers are most likely to adopt new pedagogical approaches when they feel ownership over their learning and autonomy in teaching. This course suggests class activities for each sub-skill; however, teachers are strongly encouraged to make it their own or change the lesson based on their own classroom needs, and then reflect on the successes and challenges.

Teachers are required to practice an activity with his/her class and revise it as needed. Then the teacher conducts the revised lesson while another teacher observes and provides feedback. The roles are then reversed. Such mechanism is meant to support teachers to develop connections beyond the limits and timeframe of the TPD. While the increased prominence is placed on applying what's being learned, an impetus for raising a community of practice is also provided.

The 3rd iteration of the TPD in which the above features have been implemented is being piloted.

Conclusion

The illiteracy crisis in the Global South, already critical, has been exacerbated by the pandemic. More than ever, improvements in literacy teaching are needed such that young children can develop strong English literacy skills

in order to reach their potential. Evidence-based TPD models that are scalable, sustainable, and cost-efficient, can serve a critical role. This project serves to contribute to our understanding of how technology-based TPD programs may be designed using two theoretical models.

ABRA and READS are designed to be powerful and effective tools when used by teachers and other professionals whose expertise grows from targeted technology-driven literacy TPD and follow-up support. First, TPD content must be multifaceted and include learning about the evidence on literacy skills and subskills for emerging readers and how to teach them effectively, along with the integration of technology for learning into classroom instruction. Second, instructional design of technology driven TPD should be adaptive, iterative but also flexible allowing for the tools to be adopted, based on teacher familiarity with technology and its utility. Specifically, we learned to avoid the facets of current technology-based TPD approaches (e.g., use of LMS, lack of in-person interaction), which place constraints on instructional design and demand complexities that teachers who are novice technology users are not accustomed to. Third, TPD programs must be ongoing until teachers and other professionals have mastered core understandings and successfully integrated technology in general, and ABRA and READS in particular, into their classroom practices or other settings. Finally, our research on TPD suggests that for pedagogical innovations to be successful and long-lasting, TPD needs to focus on the motivational and attitudinal disposition of teachers and other professionals wherein they develop: a) high expectations of successful integration of the ABRA and READS approach; b) a strong value of the benefits of the ABRA and READS approach; and c) minimize the personal costs of integrating the ABRA and READS approach.

Our plans include ongoing refinement of the blended literacy TPD program with the ultimate objective of wider adoption in Kenya, Rwanda and Bangladesh. Plans are underway for a quasi-experimental validation of the program to learn further about the specific outcomes of the TPD blended approach, including changes in literacy instruction and subsequent improvements in student literacy skills.

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Author Information

Jennifer Head

https://orcid.org/0009-0007-3868-5163

Concordia University

1455, De Maisonneuve Blvd. W. GA1-210

Montreal, Quebec

Canada

Contact e-mail: *jennifer.head@concordia.ca*

Larysa Lysenko

https://orcid.org/ 0000-0002-7929-3381

Concordia University

1455, De Maisonneuve Blvd. W. GA1-210

Montreal, Quebec

Canada

Anne Wade

https://orcid.org/0009-0006-7317-4695

Concordia University

1455, De Maisonneuve Blvd. W. GA1-210

Montreal, Quebec

Canada

Philip C. Abrami

https://orcid.org/0009-0006-7216-476X

Concordia University

1455, De Maisonneuve Blvd. W. GA1-210

Montreal, Quebec

Canada