Implementing Interactive Literacy Software
in Kenyan Early Childhood Education Classes

Rose Iminza
Aga Khan Academy, Kenya

Larysa Lysenko, Anne Wade & Philip Abrami
Concordia University, Canada

ABSTRACT

This paper reports a case of implementing the free web-based interactive literacy software, ABRACADBRA, in early childhood education classes of Mombasa County, Kenya. A comprehensive model of training and support was offered to classroom teachers to help them integrate the software in preschool English Language instruction for three terms in 2019. The recorded changes in teaching suggest improvements in young students' foundational reading ability and computer skills among others. A combination of teacher resilience and school leadership drove successful implementation of ABRACADBRA. Avenues for future research include studying the effects of the software on a range of preschoolers' learning outcomes and examining the training and support model for optimal, sustainable, and scalable effects on instruction.

Keywords: *educational technology; early childhood education; developing countries*

INTRODUCTION

The concept of educating and empowering young children has been in place for many years and early childhood education, either informally or formally and to a larger or lesser extent, is currently being practiced globally. The massive schooling reform rolling out in Kenya anchors early childhood/preschool education as an integral component of the 2-6-3-3-3 Basic Education Curriculum Framework (BECF) with the competency-based curriculum (CBC) as its central component. Under BECF, the progressive implementation of the curriculum starts with the two-year preschool at the age of four through six years of age and transitions to the six-year primary school system and further (KICD, 2016). It is during these first two years that a preschooler is expected to start developing the seven core competencies including creativity and imagination, communication and collaboration, critical thinking and problem solving, citizenship, self-efficacy, digital literacy, and the skill of learning to learn.

Naturally, it is through the teachers' adoption and integration of adequate pedagogy, curriculum design, textbooks, lesson plans and other teaching-learning materials that the young learners will first experience and foster these core competencies. Due to the rising value and demand attached to Early Childhood Education (ECE), the preschool teachers have drawn national attention especially regarding their capacity to implement the new curriculum (Olikshoo et al., 2019). However, since 2010 the dossier of early childhood education including pre-service and in-service teacher training, as well as the development of teaching and learning materials has been decentralized to various branches of local educational authorities. Specifically, the 47 county governments oversee early childhood education whereas the in-service training of teachers in early childhood education is deferred to district boards of education (Ruto-Korir, Jepkemboi, & Boit 2020). How such decentralization affects the implementation of the national competence-based reform in preschool classes and the efforts towards instilling the professional practice of teaching young children requires thorough examination. Historically, as Ruto-Korir et.al. (2020) mentioned,

teaching at the early childhood level attracted high school dropouts or high school graduates with the lowest grades and without formal qualifications. Even though in recent years the share of pre-primary Kenyan teachers with at least some formal education has grown from 70% to 82% (World Bank, 2019), qualified ECE teachers continue to be in short supply. Avenues for professional in-service training and development opportunities are rare and unsatisfactory thus teachers are incapacitated to produce adequate impact on the development and learning of young children in the context of schooling reform (Wangila 2017). Moreover, a lack of appropriate teaching and learning materials also contributes to the challenge of Kenyan preschool instruction (Abud & Proulx 2019). Suggesting that the issue with quality ECE is pervasive in developing countries, Mitter & Putcha (2018) make a call for the professionalization of the ECE workforce as a key driver to achieving and ensuring adequate preschool education. Globally, research on ECE and care programs also maintain that higher teacher qualifications are related to improvements in supporting children's development and learning (Manning et al. 2017).

With the growing accessibility of computer devices on the global scale, information and communication technology (ICT) has been heralded for its potential to improve the quality of both ECE teacher training and schooling. According to Abud & Proulx (2019) technology can support improvements in preschool teacher qualifications, education, and training. Thus, the areas for investment in pedagogical innovation should include the development of teaching and learning technology as well as the applications to support professional development and continuous training for preschool teachers. As early as 2016, Macharia & Kimani suggested the use of low-cost computers as a learning tool for young students in Kenyan preschool classes. At about the same time, the national government began funding a Digital Learning Program (DLP, aka Digischool) targeting integration of ICT in primary school teaching and learning (ICT Authority, 2016). To date, the programme has distributed 1.2 million DLP devices such as student tablets, teacher laptops, content servers and projectors. Together with improving infrastructure, supplying electricity to schools, the DLP's activities also include developing digital content and building teacher capacity. However, only a low number of teachers have reported use of these devices with some consistency in their primary classrooms where insufficient training in computer pedagogy (KNEC 2020) and a significant void of digital interactive content within the DLP ecosystem (UNESCO 2019) were the key impediments, and even more so in preschool.

Given the above and at the request of the Mombasa County Director, we tested the feasibility of implementing an educational technology, the web-based interactive early literacy software in a few Kenyan preschool classes to improve pre-primary instruction. The tool being evidence-based and research-proven, provides high quality instructional content and builds teacher capacity. Its important benefits for early literacy teaching and learning have been demonstrated by systematic research (Abrami, Lysenko & Borokhovski 2020). Specifically, the studies of the tool used in preschool instruction found positive effects on the foundational reading skills of kindergarteners in the UK and Canada (Comaskey, Savage & Abrami 2009; McNally, Ruiz-Valenzuela & Rolfe 2016).

CASE DESCRIPTION

Participants

The County Directorate of Education and ICT was pivotal in the teacher selection process as they knew the preschools in most need of this intervention. The focus was also on schools that had access to functional technology; for instance, a school computer laboratory where one of the computers would be turned into a content server and school proximity to each other for ease of county personnel's supervision, monitoring, and support. Initially, 45 teachers from 20 schools accounting for 5.5 % of the 688 teachers in 542 ECE centers and pre-primary classes attached to 161 public and 110 private schools in Mombasa County were identified to participate. However, due to limited budget, one teacher was selected from each school, yielding 21 teacher-participants

from 11 private and 9 public pre-school classes. In 10 of these schools, the software had been previously used in the low primary classes.

METHODOLOGY

To explore the implementation of the literacy software in pre-primary classrooms in Kenya, we applied the case study methodology. The perspectives of the relevant groups of actors were considered to inform this case. Specifically, the data sources were the teachers who completed an unstructured survey of their perceptions about training and implementation experiences; the professional development coordinator's reports about teacher training sessions and the County Support Officer's reports of her school and classroom visits summarizing her observations of the instructional context, classroom instruction and support experiences. The information was analysed along the three major aspects of the intervention -- namely, training, support and implementation and synthesized accordingly. To illustrate teacher uptake and implementation of the innovation, three vignettes are included below. These vignettes focus on the experiences in the ECE centres affiliated with public schools where the computer labs or DLP devices were available for preschoolers. In addition to the availability of technology, the vignettes were selected to reflect the variation in class sizes, levels of in-school support, teaching experience, and pedagogical strategies of strong implementers.

ABRACADABRA Intervention

Software

Developed by Concordia University in Canada, ABRACADABRA (ABRA) is part of a suite of free evidence-based and evidence-proven learning software (Learning Toolkit Plus). It is an online application that provides an interactive environment to develop early literacy. ABRA design relies on the taxonomy of foundational literacy skills and sub-skills, such as phonics and phonemic awareness, fluency, and comprehension needed for young children to be successful in learning how to read and write (National Reading Panel 2000). In line with the tenets of a balanced literacy philosophy, ABRA emphasizes a harmonious balance between code-emphasis and a literature-rich context. The tool is neither linear in use nor prescriptive of a single method of teaching and learning to read. The instructional components can be repurposed based on teaching preferences and learners' needs, allowing teachers to use it when, how, and with whom they see fit. ABRA offers distinct environments for learners, teachers, and parents.

Student Module: ABRA's student environment contains alphabetics, fluency, comprehension, and writing activities, many at different levels of difficulty and complexity. As Figure 1 shows, they are linked to 20 interactive books of various genres. The student environment can be accessed at https://literacy.concordia.ca/abra/en/

Figure 1: ABRA modules and books

The gaming elements of ABRA are designed to engage children in reading and writing and to increase their motivation. In each activity (Figure 2), children follow a set of simple rules to progress towards a goal and once it is reached, the children are rewarded with a mini game. Adding to the software game-like feel, each ABRA character has a personal story the children can read or listen to and that reinforces the purpose and context of what they must do in each activity. The embedded support within ABRA tailors the degree of learner scaffolding offered as children interact with the tool. If they respond incorrectly, they are provided with suggestions or can seek help.

Figure 2: An ABRA activity

Teacher and Parent modules: ABRA also offers environments for teachers and parents to encourage their engagement and support for students learning.

The Teacher Module consolidates teaching material embedded in the tool such as just-in-time support for teachers and resources for classroom use including explanations, lesson plans, embedded video teaching vignettes, and printable resources (Figure 3). In addition, the teachers can access the teachers' manual available both electronically and in print form.
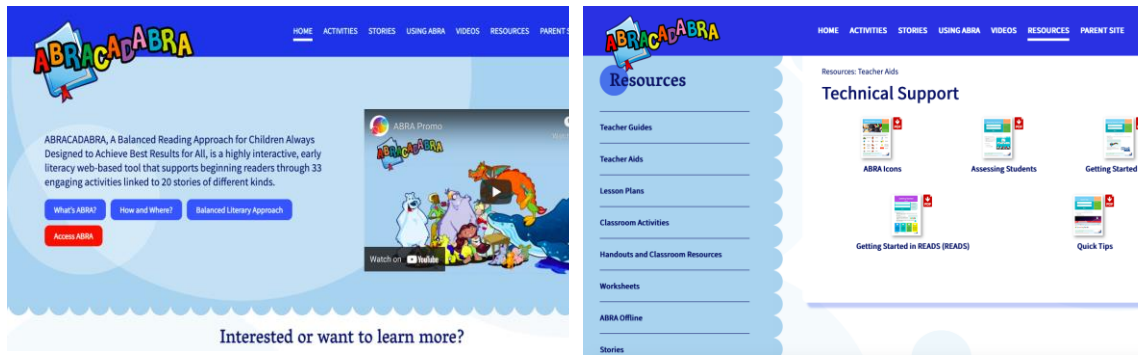
Figure 3: Teacher module

As part of the Teacher Module, the ABRA Assessment feature enables teachers to track student and class performance on instructional activities for a set period (Figure 4). The assessment reports communicate areas of success or difficulty for an individual student or the entire class. The teacher can then make decisions about the balance of instruction, that is, which activities should be delivered and the specific level of an activity that is appropriate to meet students' learning needs. The assessment feature is only accessible from a teacher account in the full version of the application installed on a local server.
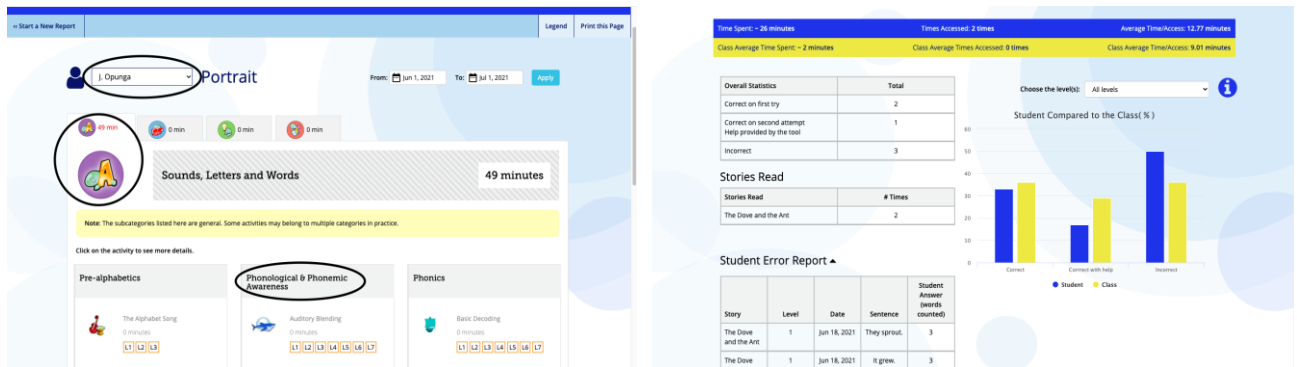

Figure 4: ABRA assessment

The Parent Module provides access to multimedia literacy resources and tips on how to support students' use of ABRA in the home.

Training and support

In addition to the software, training and support of teachers were the key components of the intervention. To aid implementation, we put the following framework in place.

The training of teachers unfolded as a three-day workshop with the focus on how to use the ABRA software to teach literacy. In addition to 21 pre-school teachers who successfully completed the training, five county officials representing the participating jurisdictions also attended the workshop. It was envisaged that these officers would enable the teacher support system. A team consisting of the local seasoned Learning Toolkit coordinator and two experienced ABRA primary teachers (champions) facilitated the training.

A variety of cooperative learning strategies and interactive techniques such as gallery walks, jigsaw puzzles, roulette and think pair-share were used for training. The intent was that participation in these activities would encourage teachers to employ some of them for use in their own classrooms. Approaches for managing split and large classes were also utilized. Inclusion, differentiation, heterogeneous grouping, positive interdependence, and individual accountability were modeled to ensure boys and girls had equal opportunity to learn literacy skills with ABRA. Teachers shared a computer during training as a model for maximizing the use of devices available to them in their classrooms. The multiple login feature on ABRA was used during the training. Immersion was a significant aspect of the training where guiding questions were assigned to teachers to help them deepen their understanding while exploring the tool. The teachers were required to demonstrate learned concepts at every stage through short reflections, and lesson planning aided teachers to situate ABRA within the curriculum. During training, explicit linkages between the curriculum and the software were established. Working in groups, teachers prepared a lesson plan, presented their lesson plan to peers, and subsequently micro-taught a fragment of it and received feedback. Lesson planning and the subsequent micro-teaching offered teachers hands-on experience in adequate integration of ABRA activities in literacy instruction. Although most of the teachers were using computer technology at such a scale for the first time, they were eager to learn more each day. Teachers came to the sessions early and stayed longer, taking their time to learn from each other and practicing with the software. The excitement and commitment were evident in their interactions, feedback, presentations, and reflections. In addition to preparing teachers to integrate the software in literacy instruction, the ABRA training lays the foundation for the provision of in-school support. Following successful classroom implementation, the trained teachers would share new skill development and personal experiences with their peers who were also learning to teach with ABRA.

The support to the implementation unfolded in the following school term and came from the trainers, the Curriculum Support Officers, ABRA champions and peers. For instance, the support team members held weekly thematic planning sessions with teachers and used classroom visits to support instruction. The county officials monitored the implementation of the software alongside with CBC. To this end, they were expected to visit the teachers in their classrooms, observe their lessons, and provide feedback to the teachers as well as to coordinate and moderate the bi-weekly cluster meetings for the teachers to plan instruction and reflections. In practice, some of these activities were completed because of the demands of time imposed by the competing programs within the county departments. Bi-monthly planning sessions focused on the following aspects: integration of the software into instruction, alignment of ABRA with the Kenya curriculum designs, differentiated instruction, and using cooperative learning strategies to teach ABRA in large classes.

ABRA teacher resources were introduced to the teachers at the training where they had ample opportunity to interact with them. They offer an array of ABRA curricular materials including the ABRA Teacher Guide, job aids, extension activities and worksheets developed specifically to align the use of the tool with the literacy curriculum. In addition to ABRA-embedded resources, supplementary materials were also provided including refined lesson plans that had been developed in previous years by teachers in primary school. The use of these resources was suggested rather than prescribed and was left to each teacher's discretion.

Along with the weekly planning meetings and in-class visits, a WhatsApp group was created for the provision of continuous off-site support. The conversations were moderated by the county officials and the trainers. The teachers actively contributed to the dialogue by sharing their initial experiences implementing the tool and posting photos and videos of the classroom activities in the weeks following training. The participants also exchanged opinions and testimonies of the successes and challenges they encountered in their classrooms. However, with time, the contributions on the group conversations waned off to only a few of the teachers and officials.

Technical support was another key to the viability of this project since the participating schools were required to make a formal commitment to the provision and maintenance of functional technology. Thus, school administrators had to ensure the necessary infrastructure was in place in the computer labs, such as, allocation of a school computer to host the local installation of the software and establish regular maintenance on the equipment. In addition, the school administrators were expected to create a schedule to maximize preschoolers' access to the computer labs and to allow teachers free time to attend training and planning meetings. In the participating public schools, a partner organization that provided reconditioned computers to public schools, and the local team worked together to ensure that the schools were outfitted with internally networked computers with ABRA installed. As this was not the approach used in the private schools, a few laptops were assigned for use by teachers.

Support from the county's educational authority added an important touch to the intervention. The fact that the County Director drove this initiative is noteworthy. For the research team, this was one of the few times when a county government official advocated for the use of evidence-based software throughout a region. In support of the project, he requested that all ECE teachers in the county be trained on the software. This officer personally attended the training and gave prominence to follow up support sessions that were offered to teachers during implementation. To this end, the department gave teachers the formal permission to hold meetings in their clusters. A Curriculum Support Officer (CSO), who happened to be a seasoned ABRA user, was assigned to serve as a coach in the project one day per week. Other CSOs were also encouraged to participate in the project.

ABRA Implementation

At the onset, the teachers expressed enthusiasm and excitement to teach with ABRA. Many of the participating teachers requested to have the software installed on their personal devices as teachers also knew that some headteachers would be slow in providing access to reliable technology. Indeed, this was especially the case for the private ECE centres and the ABRA instruction was seriously hampered as a result. Nonetheless, over the next several months of 2019, a few determined teachers who did not have access to adequate technology, instead made visits to the Teacher Resources site to learn other strategies for implementation when they occasionally borrowed computers for their classrooms.

Overall, eight of the 21 participating teachers implemented the software albeit to differing degrees. The implementation by five of the teachers especially stood out. Collectively, all implementing teachers favoured the use of the ABRA Alphabetics activities, primarily because they reinforce phonics, phonological and phonemic awareness. The national curriculum emphasizes teaching these components as critical for preschoolers' literacy. The thematic strands in the curriculum on listening, speaking, and reading are also aptly covered in the ABRA Alphabetics module. Lastly, it was easy for the teachers to link the ABRA stories to other curricular areas including family, values, and environment. Further, the software's game-like approach stirred students' interest in the 'game' of learning as they interacted with the tool's content and readily engaged in the ABRA lessons. The following vignettes illustrate some of the teachers' experiences implementing the tool. Fictional names are used.

> ***Vignette 1: Mwanaisha*** teaches preschoolers in a public primary school that has recently received a computer lab. She has been teaching in this school since graduating from ECDE training college in 2010. Her class is small; there are 27 students with 15 boys and 12 girls. The school has a high level of truant children; traditionally in this community, parents are not supportive of education. Mwanaisha's class registers a good attendance, and she attributes this to her teaching with ABRA. Her working relationship with the parents has improved as she has learnt to involve them a lot more in their children's learning since her

ABRA training. She continues to explore ways of collaborating with parents and uses ideas from the embedded pedagogical resources.

Her school is about one kilometre from the training and support headquarters, and she takes advantage of this proximity. For instance, by the time the training workshop was complete, the school had not yet commissioned their computer lab. So, to teach her weekly lessons with ABRA, Mwanaisha borrowed laptops. With five laptops in a computer centre, she paired up her students to share a device whilst the remaining students organized in two groups were doing other lesson activities. Once the lab was ready, she had accumulated enough experience to become the school's ABRA "go to person". She has gained confidence both from her peer-teachers in grades 1-3 teaching with ABRA, and the headteacher now allows her to hold the key to the lab even though lab access was denied to her prior. Her students have built comfort in using the software too. Two of her students showcased the ABRA activities to the President of the Republic of Kenya on a visit to the county. This is how she summarizes her experience:

> *"My learners always ask to go and play ABRA games even when it is not time for English activity lesson. Things are different, my teaching changed completely as I was always and still am a learner because I believe it's a lifelong process. My learners were now able to at least recognize letters of the alphabet, letter sounds and names for all the twenty-six letters of the alphabets. My ABRA journey has been a very successful one, it has molded me to be a 21st Century teacher, improved my social networking, making new friends whom were ready to learn from me and vice versa. My learners love school very much and love me because of ABRA. Because of that the parents are happy. Although we do not have enough computers, I have started peer teaching my co-teachers how to use the tool so that all our children love schooling at our ECE centre".*

Vignette 2: Rehema is a teacher in a preschool class in a public school situated in a highly populated area. She has 11 years of teaching experience, nine of which she had taught in a high-cost private school before she was employed at the ECE centre attached to this public school. Here, the ABRA software has been used in the primary grades over the past years. Rehema has self-drive and eagerness to try out new pedagogies and technology and these have translated into strong implementation. Whenever Rehema faces a problem with planning or engaging the learners, she reaches out for support from her school ABRA champion and colleagues. Though she teaches a large class of 78 students (35 boys and 43 girls), with a helping hand from an assistant teacher she manages her ABRA instruction quite well. For one, it helps Rehema to comply with the requirements of CBC. She gets creative as she draws on the ABRA teacher resources to prepare complementary activities for ABRA lessons and shares her designs with other teachers. For instance, ABRA in Large (Split) Classes quick guide helped her to organize group work in stations where ABRA computer station is one of them. This is what she says about her experience:

> "*I learnt a lot of things, I learnt how to make good lesson plans, materials for teaching, ways of forming functional groups and how to teach using the few computers we have. For the first time I can teach computer lesson to my learners and they learn and do. I learnt how to manage my many learners and how to make my learners happy with school. School is more fun for them and they think I am the best teacher because all the children in the other classes tell them so. But it is all because I take them to the computer lab to play. I am a better CBC teacher because I use digital literacy to improve the competencies of CBC such as communication and collaboration too. I invited my co-teacher to my class and now*

> *she wants to go for this ABRA training too. But I am teaching her and she is catching up slowly".*

Rehema enjoys strong in-school support. Yet, one of the other things she thinks empowered her was her own willingness to support colleagues who were struggling with implementation. She comments: "*I also got better when I assisted my peers*". She has since enrolled for a degree in ECE and hopes to be a teacher trainer someday.

Vignette 3: Jane teaches a preschool class in a public primary school in a relatively affluent area in Mombasa. The school's primary teachers are seasoned ABRA users as they have been teaching with the software for about five years. Jane has seven years of teaching experience and manages a pre-primary class of about 52 learners (23 boys and 29 girls). Her headteacher is equally supportive of preschoolers learning with ABRA and ensures that the computer lab is well maintained and accessible for her class. Therefore, when Jane's class is in the lab, there are enough functional computers to organize the students to work in pairs. Observations show that Jane enjoys her teaching with ABRA immensely. Importantly there has been improvement in the students' uptake and autonomy as well as enthusiasm in coming to school daily. She attributes these successes to teaching with the tool. She says:

> *"In December 2018, I was introduced to ABRA and was taught how to incorporate it in language activities. At first, I thought it was not possible since I had children who are not exposed to digital life at all, so I did my lesson plan and arranged on how I was to take them in the computer lab. While we were in the lab, we made rules and introduced children of pre-primary 1 to the gadgets. It was amazing, the learners were happy and eager to learn more. Since then, ABRA has made it easy for me to facilitate learning. For sure, I have achieved the following: learners enjoy peer teaching and sharing experiences; learners cooperate in activities assigned to them. All learners have equal opportunities to participate in activities. Lastly, they have greatly improved reading and fluency".*

CONCLUSION

This small pilot study features an initial attempt to integrate a computer-based literacy intervention in Kenyan preschool classes. Here, with training and support, a handful of regular ECE teachers were able to implement ABRA software with their five and six year old students. The software helped teachers to adequately address foundational areas of literacy development, that are key predictors of students' reading success in later years, as well as digital literacies and some other curricular competencies. In the absence of preschoolers' reading achievement data but based on the available reports and observations, we can speculate that at least three hundred girls and boys in this study benefited from the literacy instruction enhanced by ABRA use. Evidently, this is a drop in the ocean as compared to the total population of 94,000 ECE students in the county. While the county authority intended to extend ABRA use throughout the county's ECE centres, it is difficult to estimate the extent of such expansion. For instance, even though 60 percent of the county's pre-primary classes are attached to public schools that are equipped with computer devices under the national DLP initiative, too few of these classes have access to a fully outfitted computer lab or a computer centre in their classroom (Barasa, Barasa & Omulando, 2020). The challenge is even greater in private schools where budgets are meager and thus, purchasing and maintaining the technology is not always a priority.

In such contexts, the importance of school leadership is unequivocal for an educational technology project. Our study suggests that in those schools where headteachers valued the pedagogical potential of integrating learning technology into classroom instruction, structures to support its

implementation were put in place. For instance, administrators allowed teachers free time for in- and out-of-school professional development, timetabled preschoolers' access to school computers, and paid the bills for computer maintenance and electricity to power the devices. Such actions paved the way for the teachers who ultimately became the key agents in ABRA implementation. Teacher agency as choices, effort and persistence to implement an innovation depends on how much teachers value this innovation, how successful they expect it to be, and how important they perceive the costs of implementation to be (Abrami, Poulsen & Chambers 2004; Wozney, Venkatesh & Abrami 2006). The teachers in our study perceived the value of ABRA instruction and the likelihood of its success in their preschool classes as being high. For these teachers the anticipated benefits outweighed the costs of implementation, such as the need for greater effort and more class preparation time, dealing with malfunctioning technology and managing its use in large classes.

Although commitment from teachers and their school leaders was vital for this small study, it is far from being sufficient to sustain the complex process of implementing an educational innovation such as ABRA and bring to scale like the local authority intended. There is an important role for the overarching governing agency to play, in this case the county government, especially as it relates to the alignment of their policies with the innovation. While it was fortunate that this project was initiated by the county authority which helped establish school buy-in, more specific and ongoing engagement on their part is required. If the programme were to spread throughout the county, ABRA intervention should transition to the county educational authority who should also build its capacity for a progressive heavy lifting for implementation as a potential payer and doer-at-scale (Starr 2021). In addition to establishing systemic support for its implementation, this means ensuring that ABRA remains among the short- and long-term strategies of the authorities, even when their priorities change over time.

In this regard, our research team continues to learn about how to work with policymakers, such that they embrace the integration of evidence-based educational innovations throughout educational policies. We are also searching for an effective model of training and support that targets ECE teachers' low entry qualification to minimize general technophobia and build adequate knowledge and skills on how to integrate technology into instruction. To prepare this model for scaling, we are examining how to make it simpler, cheaper, and more broadly adaptable in order to enable others to replicate it at high quality and with high impact. To the latter end, studying the extent to which teaching with ABRA software improves the pre-schoolers' ability to read and ensure their achievement in primary school is on our research agenda.

As we work further on this project, we aspire that the research evidence it will generate leads to improvements in literacy instruction, and ultimately sets children on the road to future success. Finally, we hope to witness every ECE teacher in the county using ABRA, as the aim of the project was ultimately to move in that direction.

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