

The Nuts and Bolts for Effective Literacy and Numeracy Instruction in Early Childhood

Hellen N. Inyega & Justus O. Inyega
University of Nairobi

Abstract

This paper, using the documentary analysis approach, identifies 'six Ts' for improving early literacy and numeracy instruction as tongue, teachers, texts, time-on-task, technology and testing. It answers the question: What are the nuts and bolts needed to revamp early childhood teacher education and teacher professional development for greater impact and improved outcomes in early literacy and numeracy? Key findings affirm that all the six Ts must be addressed collectively for lasting impact on early literacy and numeracy instruction.

Introduction

Literacy and numeracy are skills associated with a person's ability to develop, live a satisfying and rewarding life and participate fully in society. Many learners in East Africa achieve good standards of literacy and numeracy. However, one in four 6-16 year-old learners faces serious difficulty with reading and one-fifth have to contend with insufficient mathematical skills (Uwezo, 2014). According to Uwezo, many of these children come from socially and economically disadvantaged communities. Some of the underlying factors of illiteracy and innumeracy are thus not found in the education system and are not amenable to school-based solutions, hence further complicating matters.

Falling standards in literacy and numeracy demand immediate and decisive action. This paper showcases solutions organisations such as the Research Triangle Institute International and the Aga Khan Foundation are providing to overcome these challenges. The paper identifies six Ts for revamping early childhood teacher education and professional development in East Africa as tongue, teachers, texts, time-on-task, technology and testing and answers the question: What are the nuts and bolts needed to revamp early childhood teacher education and professional development for greater impact on early literacy and numeracy outcomes?

Appropriate Tongue and Early Literacy and Numeracy Instruction

Language in education remains contentious in Africa (Jones, 2013). Many children in (peri-) urban areas still start school using a foreign language (Ouane & Glanz, 2010). Those who start school using a local language are often transitioned to international language(s) within three or so years (Piper, 2010a). The exception is Tanzania (save for those in English-medium schools) where children receive instruction in Kiswahili throughout their primary school cycle.

Language-of-instruction tension (Piper, Kwayumba, & Oyanga, 2015) is due to objective, historical, political, psycho-social and strategic reasons including Africa's colonial past and modern-day challenges of globalisation (Ouane & Glanz, 2010). Families and communities prefer instruction in European languages because end-of-primary-school examinations are in

these languages (Piper, 2010a), the languages are used for broader communication and are avenues to economic prosperity (Jones, 2013). But experts argue that children most easily acquire literacy and numeracy skills in their mother-tongue and that with appropriate instruction, materials, and supportive resources and guidance, they can successfully transfer those skills to a second language, hence ultimately resulting in better achievement in both languages (Piper, 2010b).

Negative consequences of foreign language-in-education policies in Africa include low-quality education (Bunyi, 2005). Language-in-education plays a gate-keeping function: It is a gateway and gatekeeper, depending on its role in facilitating or inhibiting academic success (Trudell, 2012). For learners who find themselves on the wrong side of the gate, unable to access school content for example, there are few options available to them.

Burgeoning literature (e.g., Baker, 2011; Cummins, 2000; Leung & Street, 2012; UNESCO, 2012) supports bi/multilingual education in early years of schooling. Multilingualism, an unexploited asset (Alidou, Boly, Brock-Utne, Diallo, Heugh, & Wolff, 2006), must be nurtured and maximised given the direct influence between level of proficiency in the first language (L1) and development of proficiency in the second language (L2). Cummins' (2007) threshold and interdependence hypotheses suggest that children must attain adequate levels of competence in L1 to experience relative, cognitive and linguistic transfer in L2 learning.

UNESCO (1953) underscored the importance of mother-tongue instruction and the leveraging linguistic capital a child brings to school. Classroom language(s) dramatically affects children's opportunity and ability to learn. Determining what language will be used for instruction is, therefore, critical considering the implications for learning outcomes (Ouane & Glanz, 2010). In East Africa, the promotion of mother-tongue for literacy and numeracy instruction is noteworthy (Commeyras & Inyega, 2007). Research Triangle Institute International (RTI) examined benefits of reading and numeracy instruction in mother-tongue (Piper et al. 2015). Results are summarised in Table 1.

Table 1: Causal Impact of PRIMR-MT Interventions on Classes 1 and 2, Kikamba and Lubukusu

Schools in Bungoma and Machakos Counties		Letter sound fluency (clpm)	Syllable fluency (cspm)	Non-word fluency (cwpm)	Oral reading fluency (cwpm)	Reading comprehension (% correct)	Emergent benchmark (% at benchmark)
Class 1	Kikamba	15.3***	2.8	1.6	2.0	5.3*	12.3*
	Lubukusu	9.9***	3.8	1.7*	3.6**	3.1*	6.5*
Class 2	Kikamba	19.6***	8.0	3.3	7.4*	18.0***	25.3**
	Lubukusu	9.0*	7.6	5.3~	5.3*	3.9	17.4*

~ <.10, *p<.05, ** p<.01, *** p<.001

Primary Mathematics and Reading in Mother-Tongue (PRIMR-MT) yielded statistically significant differences in both languages and both grades for letter sound fluency and percentage of pupils reaching basic emergent literacy benchmarks of 17 Correct Words Per Minute (CWPM) set by MoEST (Table 1). PRIMR-MT improved MT learning outcomes for 16 of

24 measures; with strong effects being in letter sound fluency (all four language/grade combinations). PRIMR-MT had Cohen's *d* effect sizes of between 0.37 and 0.56 standard deviations across the grades and languages. Moderate effects were shown for base PRIMR in Class 1 Kikamba and Lubukusu, and Class 1 in Kikamba (0.32 to 0.35 SD), but low effect size for Class 2 Lubukusu (0.10 SD). For both Class 1 and 2, and in both languages, the effect of PRIMR-MT was larger than the effect of base PRIMR. There were statistically significant differences between the base PRIMR and PRIMR-MT treatment groups for oral reading fluency (by 7.3 cwpm more) and reading comprehension (by 17.8 percentage points more). This implies a well-designed MT programme positively impacts reading skills (Piper & Ong'ele, In Press).

There are differences between measures of oral reading fluency and reading comprehension, depending on whether the language of the text is the reader's first or additional language (Abadzi, 2010). Think of the Kiswahili word "ninakupenda". The same notion in English is expressed in three words: "I love you". In this regard, one must thus consider agglutinated and transparent or opaque orthographies in cross-language comparisons.

The relationship between oral reading fluency and reading comprehension is also not linear (Hoover & Gough, 1990). In fact, one cannot assume children will comprehend what they read, when they read with sufficient fluency (Rasinski, Reutzel, Chard, & Linan-Thompson, 2010). In Kenya, many learners can read English words more easily than in Kiswahili and in the mother-tongue (Piper *et al.*, 2015). However, their reading comprehension is significantly lower in English than in Kiswahili or mother-tongue and maybe linked to children's listening comprehension and decoding (Gough & Tunmer, 1986); linguistic and socio-economic features of their home environments (Piper, 2010a); and reading instruction and oral language skills (Kung, 2009; Rose, 2006). Literacy research must thus be contextualised.

Organisations such as Mango Tree and Summer Institute of Linguistics (SIL) design, implement and promote mother-tongue based programmes. The proportion of children who speak different languages and their fluency in the languages determine which ones are to be used in the classroom to drive teacher recruitment and materials development. Moreover, appropriate scaffolding is provided to ensure children have sufficient knowledge and academic vocabulary in the foreign language prior to their transition to learning in L2. This maintenance approach produces bi-literate and numerate learners and helps preserve mother-tongues (WERK, 2015). The transition takes place gradually based on the argument that it takes 6–8 years of schooling for one to acquire near-native competency in a language. Indeed, the use of L1 as a means, not an end in itself, and as a medium of instruction can be the new metaphorical gateway (Trudell, 2012) for children to catch up with their peers internationally in literacy and numeracy (Trudell & Konfe, 2010) with measurable and lasting gains in academic achievement (Heugh, 2006).

Use of L1 enhances learner participation and learning (Heugh, Benson, Bogale, & Yohannes, 2007). However, how can a teacher exploit learners' linguistic resources when they are unfamiliar with L2? New research recommends the use of translanguaging techniques given that everything people know about language, regardless of how many they might speak, are part of only one language system and that the need to communicate pushes people to send and receive messages using all of the resources at their disposal (García & Kleifgen, 2010). García and Wei (2014) argue that teachers need not be bilingual to use translanguaging approaches for

literacy and numeracy instruction. Canagarajah (2013) agrees that what matters most is to help “learners critically reflect on their choices through peer critique and intensive feedback.”

In Pacheco’s (2015) research, a teacher who spoke only English worked with two Arabic-English speaking learners to differentiate between a pumpkin that was muddy and a pumpkin that was filled with mud. With translanguaging techniques learners were meaningfully engaged, increased their knowledge of English and had better comprehension. In Borrero’s (2011) study, learners, who were taught how to translate school documents for their parents made gains in their English reading comprehension. Jiménez, David, Fagan, Risko, Pacheco, Pray and Gonzales (2015) reported that middle-schoolers, who translated carefully selected portions of English language text, gained deeper understandings of their first language and English. This understanding, or metalinguistic awareness, has been linked to higher levels of reading comprehension.

Nankindu’s (2014) study presented pedagogical realities in which teachers use translanguaging strategies between Luganda and English. Nankindu observes:

Primary 1 literacy teachers...seemed fairly confident in teaching literacy using more than one language with some using learners’ knowledge of Luganda as a foundation for teaching reading in English. For instance, syllables in Luganda were read with ease and the transition to blending words in English done smoothly. In fact, majority of the teachers preferred this approach at the stage of word formation consistent with Diaz’s (1999) argument that the use of a familiar language to teach beginning literacy facilitates an understanding of sound-symbol or meaning-symbol correspondence.

On translanguaging Nankindu (2014) argues:

Several benefits were noted including skills development and general academic achievement in the classroom. The teacher was least concerned about the policy which recommends English only and the parents/guardians who want their children to master English immediately. Instead he concentrated more on learners being able to read and write.

Consistent with Nankindu (2014), Piper and Miksic (2011) and Dubeck, Jukes and Okello (2012) found that teachers in Kenya and Uganda did not adhere to language-in-education policy but did what was pedagogically more sound for learners in literacy and numeracy instruction. Nankindu’s views also resonate with Canagarajah’s (2011b) that language acquisition takes place in multilingual contexts with an engagement with many codes and that it is becoming difficult to suppress the use of many codes in classrooms. Canagarajah posits that this practice is pervasive and a sharp contrast to the language-in-education policy to the extent that such pedagogical realities have not been acknowledged by education policy makers in many contexts. The approach seems suspect when treated as adulterating the purity of the recommended instructional code and the validity of monolingual approaches to teaching and learning. In Nankindu’s words, teaching literacy in multilingual situations requires multilingual media of instruction other than monolingual plans, as is currently the case.

Teachers do incorporate learners' languages into their literacy and numeracy instruction. They cite code-meshing (Canagarajah, 2006a), which merges local varieties with standard written English, choral practice and code-switching (Jones & Barkhuizen, 2011) as part of ideological and communal aspects of literacy and, therefore, demonstrate that literacy practices are saturated with ideology as well as translation strategies (Canagarajah, 2006a), translanguaging (Canagarajah, 2011a, 2011b) and interlanguaging (Widdowson, 2006).

Pedagogically, critical literacies with oppositional readings, cross-examinations, and self-conscious, self-analytic orientations do occur in non-Western realities though not in the same way as in the West. Language learning and use succeed through performance strategies, situational resources, and social negotiations in fluid communicative contexts (Canagarajah (2011a). According to Canagarajah, proficiency is practice-based, adaptive and emergent, and language acquisition is multimodal, multisensory, multilateral and multidimensional. Thus, paradigms based on heterogeneity in applied linguistics to accommodate diversity in successful communication must be developed. Canagarajah comments:

[T]ranslation strategy, familiarity with standard varieties, expert use of local variants, and the rhetorical strategies of switching, suggest that multilingual communities have a long tradition of using such communicative practices (p. 602).

Creese and Blackledge (2010) question commonsense understanding of a bilingual pedagogy predicated on what Cummins (2008) refers to as "two solitudes" assumption. Creese and Blackledge argue for a release from monolingual children by means of bilingual instructional strategies, in which two or more languages are used alongside each other. They emphasise a language ecology perspective that seeks to describe the interdependence of skills and knowledge across languages, the need to explore what "teachable" pedagogic resources are available in flexible, concurrent approaches to learning and teaching literacy and numeracy bilingually.

The implication is that the foregoing arguments support policy and practice that nurtures multilingualism but also provides the required space for international languages of wider communication. After all, different languages can and do complement each other on different scales of value. Children should learn in a tongue most familiar to them (WERK, 2015). Time spent learning in mother-tongue is not time wasted.

Teachers and Early Literacy and Numeracy Instruction

Teachers are powerful resources and important change-agents in education reform (Darling-Hammond, 2003; Dewey, 1933); their catalytic role results in quality education. According to Darling-Hammond (2003), teachers' role in helping children acquire knowledge, skills and values for engaging fully and effectively in life, society and the workplace cannot be underestimated. Children who attend quality pre-schools tend to be more successful in primary school and beyond. Early grade programmes with better-trained practitioners are more effective. Indeed, the quality of teacher-learner interaction is central to the learning experience. A quality teacher workforce must thus be cultivated and sustained within a framework of

strong school leadership (Darling-Hammond, 2003) to improve learning outcomes in literacy and numeracy.

However, many teachers in Africa are not taught how to teach literacy and numeracy in a tongue most familiar to the learners, are under-supported with content knowledge and effective techniques and oversupplied with vague theories and methodologies (Begi, 2014). Those trained in literacy and numeracy instruction receive theoretical rather than practical training, and no modelling on how to introduce children to basic skills such as phonics, comprehension, number value and solving word problems. As such, practical support, not theory, is what teachers need and are asking for. Upskilling of early grade teachers in East Africa remains a challenge. Many do not meet qualification requirement, yet their role is critical to learners' positive experiences and outcomes, well-being and development. In this regard, concerted efforts are needed to enhance teachers' content and pedagogical knowledge in literacy and numeracy and prioritise professional development across one's teaching career.

Initiatives, such as AKF, bridge teachers' literacy and numeracy instructional knowledge and skills gaps through re-engineered early childhood teacher preparation and professional development packages (Piper, 2014). AKF implemented a 16-month East Africa Quality Early Learning initiative in 64 schools in Coastal and North Eastern Kenya and 51 schools in Uganda. EAQEL expanded 1st-3rd graders' education opportunities and improved their learning outcomes in reading and numeracy. In consequence, teachers became more confident in using/adapting a five-step Reading to Learn approach: preparing for reading, shared reading, sentence making, spelling and writing in their classrooms. Similar findings were reported in numeracy.

Also, the Centre for British Teachers (CfBT) is implementing a two-year four-pronged Wasichana Wote Wasome (WWW, Let All Girls Learn) numeracy and literacy project in 500 schools in Turkana, Marsabit, Samburu, Tana River, Kwale, Kilifi, Mombasa and Nairobi. The WWW's Girl at School project utilises coaching to improve teachers' pedagogical skills in literacy and numeracy and mainstreaming gender sensitive pedagogies. 'Girl at Home' improves the home environment for better girls' school attendance, conducts cash transfers for poor households in urban slums, distributes back-to-school kits (uniforms and stationery), conducts regular visits by community health workers and community Trainer-of-Trainers, deworm and improve hygiene and sanitation practices at school and household level, and promotes re-entry of young mothers back to school. 'Girl in Community', implemented through community dialogues and conversations, promotes enrolment and retention of girls in school. 'Girl Herself' improves individual girl's readiness to learn through physical and psycho-social wellbeing, confidence-building and aspirations and child rights awareness activities. The outcome is whole school behaviour change, health improvement and girl-friendly schools. CfBT has achieved its goal of enrolling 7,400 girls into primary school, retained 6,400 in school and transitioned 3,200 to secondary school. Increased learning and attendance of a further 64,000 girls has led to an additional 16,000 "girl-years" in school. About 1,500 teachers have received coaching in literacy and gender sensitive pedagogy; 12,000 of the poorest households in urban slums have benefitted from cash transfers—with 7,200 of these achieving sustainable increases in household income; ten district education officers have increased their capacity to manage

education data; and 500 head teachers, 500 SMC members, 1,000 teachers and 30 Quality Assurance and Standards Officers trained in making education girl-friendly. At least 5,000 men and 10,000 boys are expected to change their attitudes towards gender and girls' education, hence leading to sustained long-term decreases in violence against girls and women.

Creative Associates implemented a 21st-Century Basic Education Programme aimed to improve early reading in Kiswahili through training of teachers and other stakeholders on effective reading curriculum implementation and assessment practices. RTI sought to improve reading in Kiswahili and English and mathematical skills of 1st and 2nd graders in 502 government and non-formal settlement schools in peri-urban and rural areas of Nairobi, Nakuru, and Kiambu counties in Kenya (Piper & Mugenda, 2014). Through teacher professional development and targeted on-going classroom support, coaching and mentoring, teachers improved their instructional behaviour (Zuilkowski & Piper, 2014). Consequently, there was a positive impact on learners' literacy and numeracy outcomes (Piper & Mugenda, 2014). PRIMR results informed current scale-up of literacy and numeracy programmes (USAID Kenya, 2014) beginning in January 2015 targeting five million children by 2019.

The University of Nairobi (UoN) implemented an Early Grade Reading Instruction Curriculum to develop capacity of 298 teachers (Female = 200; Male = 98) for literacy instruction in Kiswahili and English. EGRIC grounded teachers in philosophical and historical foundations of reading and enabled them to develop reading instructional materials and resources. They diagnosed and provided remediation to children with reading problems. They received on-going support and mentoring face-to-face and through SMS and e-learning. They developed video-cases currently in use for teacher preparation and professional development. Pre- and post-tests yielded statistically significant differences in teacher knowledge on all save for one sub-skill of reading: word knowledge ($F(2, 266) = 9.056, p < 0.000$); fluency ($F(1, 267) = 8.287, p < 0.04$); vocabulary ($F(2, 268) = 19.339, p < 0.000$); comprehension ($F(1, 268) = 20.628, p < 0.000$); motivation ($F(2, 268) = 13.131, p < 0.000$); grouping for instruction ($F(2, 268) = 8.609, p < 0.000$); assessment ($F(2, 266) = 6.299, p < 0.002$); adapting for individual differences ($F(1, 266) = 24.019, p < 0.000$). Sub-skill on instructional materials was not statistically significant ($F(1, 267) = .154, p < 0.695$).

The UoN and University of York are currently implementing cross-age peer tutoring in reading among 3rd-6th graders in Kenya. Teachers' capacity to co-ordinate the out-of-class reading is built twice per term. Learners are latching onto leisure reading with minimum supervision, as originally envisioned.

To revamp early childhood teacher education and professional development, we must recruit the best learners for teacher education courses; ensure beginning teachers develop knowledge, understanding and ability to apply early literacy and numeracy theory and research effectively in practice and to reflect, improve and upskill throughout their careers. Apparently, we must assess teachers' knowledge, skills and behaviours and provide robust induction programmes to novice teachers.

Once we build teachers' familiarity with literacy and numeracy strategies, approaches, methodologies and interventions for effective instruction across the curriculum, their eclectic

blend of techniques will yield direct skill-based differentiated literacy and numeracy instruction, individualised and co-operative group work learning and alignment of classroom practice and curricula. Teachers will break down barriers to literacy and numeracy attainment for all learners and use a continuum of well-considered assessment approaches to iteratively plan and teach, for feedback on learners' progress and goal-setting to improve learning. Ultimately, children will benefit from intense, positive, and content-rich interactions with teachers.

Texts and Early Literacy and Numeracy Instruction

'Texts' are teaching and learning materials and resources. Children in many countries have access to some texts (Davidson, 2014). Davidson posits that the texts are often insufficient, too difficult for children to read, expensive, and poorly designed. Davidson warns that expensive glossy books, with high graphics content and much use of colour, should not be misconstrued to mean texts are innovative and necessary. Those factors raise cost without accompanying evidence to improvements in learning outcomes. Davidson asserts that buying books that are too difficult and in a language children do not understand is not a good solution either.

In a survey of 16 randomly selected primary and secondary schools in Tanzania, one stakeholder lamented about the Secondary Education Development Programme (SEDP)'s lack of reading materials by stating:

If learners had books to read at least it could compensate to some extent for the shortage of teachers. Unfortunately, books seem to be a rare commodity in nearly all schools despite the SEDP goal of one textbook in every subject for every student. Even the school libraries have no books in sight. Library has become just another word for reading room, where pupils can sit and study their exercise books (Davidson, 2013).

Instructional materials, in different languages, are sorely lacking (Begi, 2014). Across Africa publishing focuses mainly on textbooks, not supplemental reading materials (Tembe, 2014). According to Tembe, there are insufficient materials to sustain the reading culture and lack of books leads to a vicious cycle of illiteracy. Having few or no books leads to no reading which, in turn, leads to no demand for books. If there is no demand then it would not be cost-effective to produce books. The few books in many primary grades are too difficult for young children to read. They tend to look at the pictures, but cannot decode the words. Children need to use the knowledge they learn about letter names and sounds to read words – not look at pictures.

Organisations such as Room to Read (RtR) have demonstrated that learners can be provided with sustainable, locally-produced, abundant, and inexpensive materials which dramatically improve the print environment and can be directly integrated into lesson plans and increase the probability that teachers will use them (Piper & Mugenda, 2014). RtR supplies supplemental materials to foster a leisure reading culture and strategically increase children's reading time in line with Anderson, Wilson and Fielding (1988) who found a positive correlation between how much learners read and their reading achievement. Reading time in the early grades,

scheduling the time on school timetable and effective utilisation of library lessons are central to reading achievement.

Health and Literacy Intervention (HALI), National Book Development Council of Kenya (NBDCK) and UoN implemented buddy reading programmes that expanded children's reading opportunities and spaces, exposure to quality, culturally relevant and engaging core and supplemental reading materials and contact with competent readers to scaffold their learning. Teachers affirm that buddy reading was an activity learners were never pushed to do. Their attitude towards reading and numeracy changed.

Books that children can read, in multiple languages, and with gradually increasing levels of difficulty are needed (Davidson, 2014). They include decodable texts with words children have learned to sound out independently and are useful at the very beginning of 1st grade because children are learning to map a few letter names/sounds and can read only a few words independently. Decodable text is a bridge to conventional reading. Levelled texts range from simple to gradually more complex and challenging materials. They expose learners to different genres of literature, build their reading proficiency, vocabulary, comprehension and fluency skills.

In RtR, teachers' capacity is often built to allow for a more accurate match between a student and a book and to provide daily reading and numeracy instruction using levelled texts. Learner-book ratio of 1:1 has been reached (Piper & Mugenda, 2014). All the texts are field-tested, revised severally and impact evaluations are conducted with target learners before eventual use. The texts move children without preschool education and little exposure to the alphabet from basic letter knowledge to full fluency and comprehension within one school year (Davidson, 2014).

In Uganda, LLB and Mango Tree work with local speakers to develop materials in mother-tongue and to preserve indigenous mathematical strategies and techniques. LLB familiarised teachers with revised Lëblango orthography and produced culturally appropriate reading material for teachers and learners including primers, folk stories, school books, health and hygiene guidelines, games and history. Translators adapted from other languages educational materials on numeracy, nutrition, farming and health. LLB also facilitated pre-school infrastructure development. Mango Tree engaged local writers to use locally-available resources to develop funny, engaging, child-centred, quality, low-cost core and supplemental reading materials; and provided mother-tongue based instructional support. They advocated for Local Language Boards to support orthography and reading materials development and worked with local communities to foster effective use of developed materials and resources. This ensured cost-effectiveness, sustainability and learning of requisite literacy and numeracy skills.

Time-on-Task and Early Literacy and Numeracy Instruction

Children's learning is a function of effective use of school time. Time-on-task, or explicitly devoted time to instruction in specific subjects, is key. Gove and Cvelich's (2011) study found

that an increase of one hour of instruction per week in Mathematics, Science or reading improves test scores, with a larger effect for girls and learners from lower-income families. According to Gove and Cvelich, numerous factors reduce the actual amount of time spent on instruction in many low-income countries. Time is wasted and children have little opportunity to learn when the school year and day are too short; when schools teach in double shifts; when educators go on strike; when schools close down due to insecurity; teachers leave school for bureaucratic transactions; when instruction stops for “planning” and in-service training; when both teachers and learners are absent; when available time is poorly managed; “moonlighting” by teachers for additional income; during illnesses; when time devoted to focused instruction within the classroom is limited and of poor quality; and when curricular guidelines reduce time devoted to direct instruction on skills. Gove and Cvelich (2011) assert that after subtracting time lost, the remaining instructional time, as a share of the total days available, only amounts to 31 percent in Guatemala, 34 percent in Ethiopia, and 45 percent in Nepal. Thus, insufficient time is available to teach and reinforce reading and Mathematics skills.

Creative Associates and Dignitas work with teachers to institute focused and efficient use of whatever little time is afforded for learners. Through coaching, mentoring, on-going professional support and teacher-reflections, teachers look back on lessons taught to determine what worked, what did not and why, increase time on-task and focus on authentic literacy and numeracy activities with astounding results (Piper & Mugenda, 2014).

Between 1999 and 2005, Molteno’s Breakthrough to Literacy implemented simple, tightly focused interventions in reading using dedicated time, mother-tongue instruction, provision of training and materials, and focused measurement of results in Zambia. Learner’s reading scores improved by 300 percent to 500 percent in just a few years. In South Africa, Molteno and RTI implemented Systematic Method for Reading Success using control and treatment groups and pre- and post-measurement assessment. Instructional improvements focused on time-use, mother-tongue instruction, simplified materials, and use of step-by-step lesson templates. Though implemented for less than a year, children in treatment schools learnt two to three times faster than children in control schools (with effect sizes of around 0.8). Mali’s Institut pour l’Education Populaire’s Read-Learn-Lead used tightly designed daily reading lesson plans, mother tongue instruction, and focused time for reading instruction and produce improvements of several hundred percent in only one year of intervention, with an overall effect size of 0.4. Time-on-task thus ensures learners reap full benefit of schooling. Addressing root causes of lost instructional time requires support to teachers who are often overwhelmed by class size, limited materials, and poor facilities and addressing teacher absenteeism.

Teachers must be motivated to show up for class and to provide quality education (Gove & Cvelich, 2011). Incentives can vary depending on location, community or gender and be as simple as showing respect and appreciation for their efforts or raising their status through mass media campaigns, reducing class size, providing continuous training and professional career paths, or increasing compensation (Uwezo, 2012). Evidence is mixed on impact of financial incentives on improving teacher performance. In Kenya, a programme for hiring additional teachers on short-term and managing them through local school committees was successful in increasing student achievement over one that paid for teacher attendance or examination scores

(Uwezo, 2009). According to Uwezo, granting teachers greater autonomy and control over their classrooms and working conditions yields positive results.

In Northern Ghana, 30 percent of teachers were absent at any given time, thrice a week contrary to Indian states of Bihar and Uttar Pradesh where teacher absences are significantly lower for teachers on annually renewable contracts (Gove & Cvelich, 2011). According to Gove and Cvelich direct monitoring, combined with financial incentives based on teacher attendance, increases attendance among para-teachers. They posit that motivational programmes developed in partnership with teachers can improve teacher attendance. When teachers are appropriately compensated, teaching will attract and retain a qualified workforce.

Female-teacher-specific strategies include establishing links with community-based women's organisations, providing mentoring opportunities between experienced and newer female teachers, and recruiting and deploying them in pairs. Similarly, communities that offer teachers housing and integrate them into the community are less likely to fail. In each context, barriers to attracting and retaining good teachers and work with teachers' unions to address challenges must be understood (Gove & Cvelich, 2011). Moreover, Gove and Cvelich aver that time-on-task goes hand-in-hand with quality teaching. Teachers must know how to engage learners actively and achieve set objectives in early childhood education. Children must be at the centre of literacy and numeracy planning and instruction. Matching teachers with their home communities can also have positive effect.

Technology and Early Literacy and Numeracy Instruction

ICTs have generated great interest in the education sector worldwide (Piper & Kwayumba, 2014). In fact, ICTs can change what, how, where and when people learn. Increasingly, there is a shift to learners' construction of their own knowledge and the role of the teacher to facilitator. ICTs also have the potential to reach the unreached and expand learning outside classrooms. Harnessing the power and promise of technology to bolster literacy and numeracy instruction is imperative for revamping early childhood education in East Africa.

The African Storybook Project (ASP), HALI, RTI, Summer Institute of Linguistics (SIL) and UoN combine teacher coaching and mentoring with support from electronic gadgets focused on instructional change. Effectiveness and cost-effectiveness of ICTs constitute a major focus in these initiatives. RTI piloted a four-pronged randomised control tablet trial in peri-urban and rural schools of Kisumu, Kenya to cost-effectively improve literacy and numeracy instruction. RTI's ICT pilot had positive impact on learning outcomes in literacy and numeracy, when integrated with an instructional support programme. The pilot informed inclusion of early literacy and numeracy into Kenya's 2014 - 2019 National Education Sector Support Programme (Piper & Kwayumba, 2014). Creative Associates developed a video and sound pictorial package for teachers that improved early literacy and numeracy skills and has informed national scale-up of Tusome Pamoja (let's read together) project. UoN and HALI used low-cost SMS for communication, administrative duties and teacher support. Both organisations report effectiveness of SMS to support literacy and numeracy instruction in primary grades. Teachers affirmed that they received formative feedback from SMS and also mastery of concepts

including letter-sounds. SIL uses an open-source software programme SynPhony to create lists of letters/syllables according to their frequency in written text. This is helpful for languages where there is no established scope and sequence. They also have 'Andika Basic' free-download software with a font-type that is appropriate for developing literacy and numeracy instructional materials for children.

ASP (see <http://www.africanstorybook.org/>) has open-access digital library with multi-genre stories targeting young children in multiple African languages. Authors upload and share stories and adapt online ones for their contexts. Worldreader partners with publishers to digitise and distribute textbooks across Africa. The Aga Khan Academy uses A Balanced Reading Approach for Children Always Designed to Achieve Best Results for All (ABRACADABRA) to help children read to learn from content-areas. RTI's open-source software, Tangerine, enables development of Early Grade Reading and Mathematics Assessments whereas Papaya helps in teaching letter-sound relationships.

Organisations that incorporate ICTs into their programming adhere to the following four principles: Alignment of the technology with learning objectives, teaching skills and learners' needs; accessibility of technology by teachers and learners, including familiarising teachers with different instructional technologies; assessment -where technology for assessing learning outcomes is actively employed; and reinforcement—where technologies reinforce and supplement teachers' teaching in structuring or augmenting lessons and not replace the teacher.

The adoption of evidence-based ICT applications, hot on the heels of proliferation of mobile phones, has the potential of transforming literacy and numeracy instruction in resource-constrained environments. Under the right conditions, teachers in remote locations can connect to the literacy and numeracy instruction super highway and access virtual courses, instructional materials, assessment exercises, and online support, ongoing on-the-job training mentoring and education communities of practice.

Testing and Early Literacy and Numeracy Instruction

Learning is a measurable dimension of quality education determined through learning outcomes. Learning outcomes are statements of what a student is expected to know, understand and/or can demonstrate or have acquired on successful completion of his or her studies (ECTS, 2005). Measuring learning outcomes is increasingly recognised as necessary, not only for monitoring a school system's success but also for improving quality of education. Student achievement can be used to inform education policies, including design and implementation of programmes to improve teaching and learning in the classroom (Kellaghan, Greaney, & Murray, 2009). Educators can use assessment for learning to determine learner progress by the time of assessment. Results can be shared with learners and used to plan the next steps in instruction. Assessment of learning can be used to determine the learners' progress towards achieving learning outcomes set out in the curriculum at fixed points (e.g., end of each term). Assessment information comes from teachers' informed judgements, learners' performance on tests and examinations.

A curriculum that combines clear statements of learning outcomes and accessible examples of what learners should know or be able to do in literacy and numeracy can provide a reliable framework of reference against which teachers, parents and learners can benchmark achievement and progress. Gathering evidence about how well children are learning, and using this information to improve learning opportunities ensures each learner develops requisite literacy and numeracy skills. Gathering and using assessment data at an individual learner's level enables the teacher to adjust instruction to suit learners' needs and to inform them and their parents about the progress that they are making. Gathering and using assessment data at the school level can show how well they are providing for literacy and numeracy needs of individuals and groups of learners in the school. Assessment data can also inform national literacy and numeracy policy.

When the Millennium Development Goals (MDGs) and the Education for All (EoA) goals timeframe came to a close in 2015, many countries took stock of the milestones they had realised in 15 years and shifted attention from focusing on access only to access and quality of learning as the inception of Sustainable Development Goals (SDGs) gained steam under Goal 4: '[E]nsure inclusive and equitable quality education and promote life-long learning opportunities for all.' In Kenya, research shows very low reading and numeracy outcomes in both formal and non-formal settings (Piper & Zuilkowski, 2015), across urban and rural locales (NASMLA, 2010), and in mother-tongue (Piper, Schroeder, & Trudell, 2015), in Kiswahili and English (Piper & Zuilkowski, 2015). Kenyan children do not reach intended benchmarks (Onsomu, Nzomo, & Obiero, 2005). According to Onsomu, Nzomo and Obiero, just 21 percent of sixth-graders had a 'desirable level' of reading, indicating the ability to handle the reading requirements of the following academic year. The percentage of learners achieving 'minimum' mastery decreased between 1998 and 2000. In fact, outcomes have not improved in more recent surveys (Uwezo, 2015). Wasanga, Ogle and Wambua (2010) found that more than half of the third-graders were still at the emergent-reader stage. Uwezo (2012) concluded that seven out of 10 children in the third grade could not read a 2nd grade level passage (Mugo, Kaburu, Limboro, & Kimutai, 2011).

In 2013, Uwezo assessed 326,610 children aged 6 - 16 in just under 150,000 households in 366 districts and over 10,000 public primary schools in Kenya, Mainland Tanzania and Uganda through tests set at 2nd grade level. Uwezo's (2014) findings indicate that many children across East Africa are not learning basic literacy and numeracy skills. The report reads, in part: "By the time they reach the last year of primary school, one out of four East African children—about 24 per cent—still have not acquired these skills" (Uwezo, 2014, p.1). In Kenya, 64 percent passed literacy and numeracy test; in Tanzania it was 48 percent; and in Uganda it was 36 percent. In Kenya, less than seven out of 10 of all children aged 10-16 have mastered grade two literacy and numeracy skills. In essence, Kenya, Uganda and Tanzania had missed the target of having all children access quality learning. Negligible improvements in learning outcomes over the three rounds of Uwezo assessments point also to inadequate action to tackle education crises in the region.

Research from Uwezo and other organisations has changed the discourse on primary education, from attention to provision of education inputs to the general failure in achieving learning

outcomes. In East Africa, there is now a general sense of urgency to ensure that children are not only in class but also learn. Uwezo (2015) posits that success of actions taken to improve the education sector should be measured by the level of improved learning outcomes. Results have to be directly useful, transparent, and easy for teachers to inform their own instruction and underpin communication with parents and communities and those who supervise the teachers. Learning outcomes ought to be the driving force and energy towards “what works.” Curriculum development agencies in East Africa must develop guidelines for good practice that accompany an early literacy and numeracy curricular framework. They should include extensive advice on how practitioners can collect, document, reflect on and use evidence of children’s learning to inform their work. Evidence should include children’s progress in developing dispositions towards learning, skill acquisition, attitudes and values, as well as in acquiring knowledge and understanding.

Schools and the education system can, and do, make a difference to the life chances of children from disadvantaged backgrounds. In Kenya, the Equity Bank’s “Wings to Fly” programme sponsors bright but needy students alike to progress from secondary to university education. *Dignitas*, another project, “brings back dignity” to children from socially and economically disadvantaged backgrounds who are accorded sponsorship to mitigate the multiplier effect of such backgrounds. The African Population Health Research Council (APHRC) advocates for significantly enhanced resources to counteract disadvantage. These and similar efforts collectively raise the educational attainment of the lowest-performing learners and foster greater equity in the education system and in the society in general. Assessment, differentiation and personalisation in teaching and learning are vital skills for all teachers in all contexts but they are particularly important in the case of children and learners with special educational needs. Considerable investment should continue to be made in initial and continuing professional development for teachers in special-needs education. Schools must use staffing resources to the best effect possible in order to maximise their impact and the advantages for learners. In particular, mainstream and specialist teachers should work collaboratively with parents in drawing up, implementing and reviewing programmes focusing on literacy and numeracy for pupils with learning needs.

In sum, assessment entails measurement of learning, analysis of findings to diagnose problems, as well as use of the findings to demonstrate efficacy, or otherwise, of investments in education and to guide remedy or correction where/as necessary. Assessments play a unique role in determining value for money in the education sector. They should be simple, straightforward, sensible, sound and low-cost but effective in improving learning outcomes and addressing issues of quality, equity and provision of the kind of education that develops cognitive and non-cognitive (namely psychomotor and affective) skills.

Conclusion

Education systems can change the trajectory of children’s future outcomes through effective educational interventions that are instituted early in their lives. Thus, schools must provide the best possible opportunities for children to acquire solid literacy and numeracy skills through the 6Ts, namely tongue, teachers, texts, time-on-task, technology and testing. This actually means spending time, energy and money supporting programmes tailor-made for all the

learners and in multiple mother-tongues and building teachers' skills, devotion, discipline and hard-work. Such implementation requires tight management, governance and accountability on the part of education stakeholders.

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