Learning Essentials for International Education

A compendium of Summaries

Helen Abadzi[1]
Global Partnership for Education

GPE Working Paper Series on Learning No. 10

This document consists of blog articles or informal summaries issued on learning-related issues in 2010-2013.

It exclusively represents the author's personal views and does not imply endorsement of the World Bank or the Global Partnership for Education

[1] Helen Abadzi is a Greek psychologist, who has worked since 1987 as an education specialist and senior evaluation officer in the World Bank and the Global Partnership for Education. She explores cognitive neuroscience applications that may improve the education of the poor. Her publications helped raise early-grade reading fluency to a high-level international priority. Email: habadzi@worldbank.org, habadzi@gmail.com

Illiteracy and selective teacher neglect
Cambodia in 2010

Helen Abadzi, HDNFT
3/23/10

The sound of children's voices reciting in unison could be heard from afar, as our mission approached a school in rural Cambodia. Inside a second-grade classroom, students took turns at the blackboard. One pointed with a stick at a list of words written by the teacher, while the rest recited. A colleague approached, wrote on the blackboard the same words in a different order, and asked the children to read. Suddenly, there was silence. Most kids had merely memorized the sequence of the words and could not even identify single letters.

This scene is frequent. In the poorer schools of low-income countries, many students remain illiterate for years, until they finally drop out. With some care, the process is observable. Typically the teacher writes on the board some letters or words and asks students to repeat them. The letters may be scribbled, the children often sit at a distance, textbooks may be insufficient, and children may not have anyone at home to help them read. But they do repeat the words in unison, getting cues from a few knowledgeable classmates. The teachers stand by the blackboard, address students at large, and call on the few who perform well. They rarely give individual feedback to the rest, even when classes are small. The ones who don't figure out the reading strategy by themselves will eventually drop out.

When asked, teachers readily state that several students cannot read, but they do not seem overly concerned about this deficiency. Traditionally, education was only for those who could learn in little time and practice, and the "meritorious poor" were few. "If the student cannot learn, we send him home", said to me once a respected educator from Mali. This winnowing process wreaks havoc on the Education for All initiative, when "all" are supposed to learn. But it has not been often dealt with, so donors spend billions for access by the poorest, only to have teachers screen them out.

How come this issue has not attracted attention? One reason is that in the middle-class schools of capitals students perform much better. Soon after our rural observations, we observed second graders in a middle-class school of Pnom Penh fluently handling the extremely complex Khmer script. They had all been to preschool, and their educated parents read with them at home. This is the reality that Ministry of Education staff experience in Maputo, Kathmandu, Ouagadougou, Panama City: Of course the children can read. Sometimes officials who were among the "meritorious poor" in their youth seem to have no memory of their dropout classmates; they assert that if they learned to read, everyone else can do it.

However, the schools of the poor have less time for their students. There is teacher absenteeism, a lack of textbooks to take home, parental inability to make up for school weaknesses, no specific curricular time for reading. The result has been chronic illiteracy, high dropout and high repetition rates. To reduce repetition and maximize enrollments, some donors advise governments to promote students automatically. But going to the next grade does not help the illiterates because children must first learn to recognize simple units quickly, and these are taught in grades 1-2. As a result, social promotion tends to create illiterate graduates, who hardly fit the intent of the Millennium Development Goals.

What can be done to help students attain fluency early on? Plenty. Pilots in Liberia, Niger, Mali, and India have shown that it is possible to get big gains within a few months through structured courses that explicitly teach single letters (phonics), show patterns, prescribe practice. To avoid overloading the memory of little-educated teachers, simple scripted lessons and routines specify exactly what to do in class every day. It is also crucial to tell parents that they must expect reading fluency by grade 2.

But implementation on a large scale has been slow. Teacher training colleges worldwide offer little or no training on how people learn to read or why certain methods work better than others. Thus educators may unwittingly promote methods that may work with children who have preschool experience and parental support, such as instant reading of entire words. Donor staff may also approve of methods that resonate with their own experiences. So ironically, donor funds often pay for inappropriate instruction in countries whose students are at risk.

In Cambodia, an international NGO proudly showed me some beautiful grade 1 books developed and piloted on the "whole-language" approach. The pages are filled with large color photos, but they have only a few words of text and no method for systematizing the combinations of the Khmer script. The expatriate task manager did not know any Khmer, but had trusted a local consultant. The consultant said that he had tested the books on his own children. However, officials pointed out that the texts only taught a few of the many possible letter combinations and gave little practice, so children did not really learn to read from them. Unwittingly, the donor agency was raising obstacles for the poor.

Cambodia: Grade 1 "whole language" authentic text seems meaningful but presents a hodgepodge of combinations that are visually too dense for those who are not habituated. The small amount of text is insufficient for automatizing the patterns.

Mozambique: Grade 1 book explicitly teaches specific letter combinations repeated in analogous sequences. Spacing permits faster detection by novice readers.

Reading requires attention to perceptual learning features that seem to be details, but their omission risks wasting international investments. There is a need to obtain technical expertise from professionals who know the research regarding reading fluency and its implications.

To use the donor money efficiently, all students must gain reading fluency early and fast; this will enable them to make sense of texts and use the information for work or make decisions about their lives. Otherwise low-income students may continue to drop out illiterate, while nominal enrollment figures will continue to rise.

How can an donor financing bring down the information barrier?
The Cambodian sequel, 2011-12

The sound of children's voices reciting in unison could be heard from afar, as our mission approached a rural school half an hour away from Pnom Penh, Cambodia. Inside a first-grade classroom, the students recited in unison the patterns to which the teacher was pointing. And they wrote each pattern on their slates. In the next repetition, they raised their fingers and pointed to the blackboard.

An important learning challenge in Cambodia is the unusually complex Khmer script. Derived from an Indian 6th century script, it consists essentially of a matrix that lines up 26 vowels across against 33 consonants down (see picture). The consistent patterns of the vowel changes make it possible to recite and retain the essential script. But that's only the beginning. Combinations are pronounced on the basis of fairly complex rules. To make consonant combinations (e.g. p+r) different letters are formed, often inserted as subscripts. Then there are certain words of Sanskrit origin, where the current pronunciation bears little relation to the written letters.

Buddhist monks managed to learn and pass on this system for about 14 centuries. But under Education for All, all students must learn what a few monks once did. Methods must be found to optimize the retention and recall of the 900+ combinations. (See picture.) Practice is then needed to link those complex shapes into bigger chains and recognize them automatically, within milliseconds.

But donor staff and some younger Cambodians have wanted innovation, modernity. They were raised by middle income parents, automatized the script easily and early, so they were able to enjoy story books. To them the answer to teaching poor kids would be authentic, interesting texts. So the Belgian Cooperation hired local specialists who developed a set of materials to teach Khmer reading through the whole-language method (See pictures). These were piloted in grade 1 of two areas.

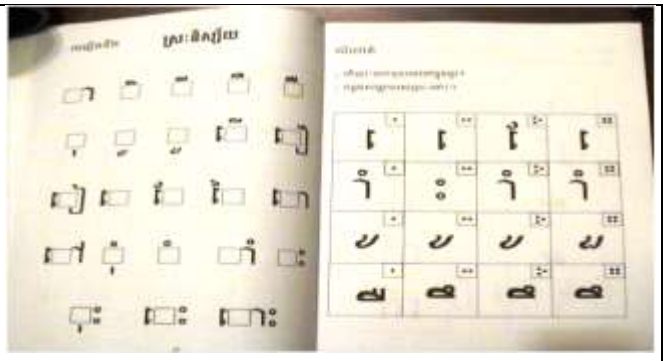
However, in contrast to the analogies that made the script memorable across the centuries, those texts, consist of random combinations. Taken out of the matrix, the shapes become meaningless squiggles. The kids could be made to recognize some entire shapes but not figure out the rules of reading. Predictably, an evaluation study showed that students liked the books and valued reading. But they were limited to the few shapes they had automatized. They were in fact functionally illiterate.

The whole language approach may work with middle-class students, whose families give them extra instruction in breaking down the words. But low-income students must learn all they can in class, and through methods that teachers of limited education can provide. So where to find new methods? There have been studies since the 1940s about the ease of learning when people are exposed to regular pattern changes. If students learned in a systematic way the combinations of consonants with vowels, patterns would be evident that in authentic texts they are not.

This in fact was the Buddhist monks' secret. Sometime after the 6th century a chant was developed to put each consonant through the 24 vowels. The rhythm helps consolidate the sequences and the visual letter changes go with it. This traditional method (called Chet Chhem) works according to memory rules. To outsiders it may seem boring, but the recitations last only a few months. Then patterns are automatized and kids can begin to deal with meaningful texts.

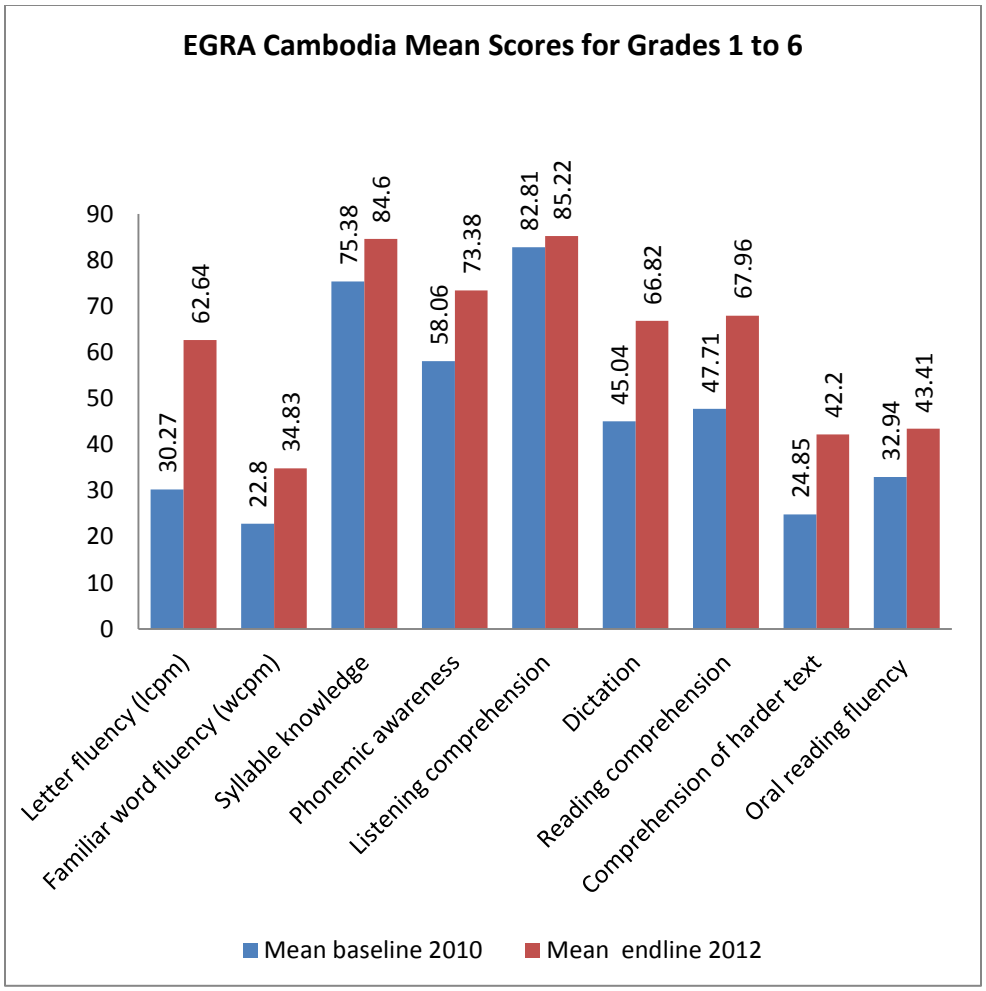
Older Ministry officials who had learned through the Chet Chhem method were really dubious about the modernists' views on using authentic texts. They needed little prodding to do a pilot. (To convince the government and understand, Khmer became my 20th language). About 40 schools started in the fall of 2010 and were monitored along with control schools.

Each of the 11,000 Grade 1 students in the target schools has received their own copy of the pilot text book (see example pages). A realistic implementation plan was agreed in advance with the teachers to ensure that the majority of target schools would complete the reading program within the allocated time.

	
Cambodia: Grade 1 book based on Chet Chemm	The vowel signs taught explicitly and in order

The difference became immediately obvious. By March 2011 teachers in provincial schools self reported results for the first quarter showed 74% of first graders in target schools could read and understand, more than 50% of the text taught to date. Only 47% in control schools could do that. Teachers in target schools of Phnom Penh in particular reported 84% as able to read and understand more than 50% of the text taught to date, compared to 43.85% of control schools in Phnom Penh. Consequently the use of the traditional systematic method was introduced in other grades to ensure that the illiterates learned to read.

A modified early-grade reading test was administered in 2011 and 2012. Improvements were very significant. Not only did students increase in fluency and comprehension in all grades, the number of non-readers was minimized. For example, at baseline 47.6% of students in Grade 2 could not identify letters or read a single word, but at endline only 15.2% of students similarly failed. At endline, 12% of Grade 3 students scored zero in reading comprehension, compared to 37.5% before the reading intervention. In Grade 3, 30% of students in 2010 could not read the first five familiar words, by in 2012 only 7.2% of the third graders had this problem. Among fifth graders, only 6.8% were unable to read a single word from a harder text in comparison to 24.7% at baseline.



Starting 2012, the Chet Chhem method was introduced to all schools in the country. With students becoming literate, the information barrier came down, and the funding of the Global Partnership can be converted to information. Furthermore the government of Cambodia has expressed deep appreciation to GPE for the technical assistance that was provided.

Perhaps the outcomes are not surprising. *When students are taught according to the ways memory is known to function, they learn faster; and even the weaker among them learn.*

Do you want educational programs to succeed?
The workings of memory can show you the way

Helen Abadzi, HDNFT
3/23/10

You want to call someone up, and your colleague just told you the number. You have nothing to write it on. What will you do to retain the number while looking for a phone? And if someone starts talking to you before you dial, will you still remember the number?

Memory operates in certain ways that ensured human survival over the millennia, so some of its effects are bizarre. For example, we recall better if during learning we chew gum, exert physical effort, are frightened, hear humor, eat slowly digested carbohydrates, smell rosemary aromas, or drink sage tea. We also remember items that are somewhat different from what we know (but not completely unknown), offered at the beginning and end of learning sessions, items that we must use, items distributed over time in small doses, items that we have contemplated. The more frequently and more recently we have thought about some information, the more likely we are to recall it. When students receive information in the ways the mind was set to remember, the efficiency of investments increases exponentially.

To perform basic skills, we must execute them lightning-fast

We all believe we know how our memory works, but some processes are unconscious and hidden from us. Our partial understanding of these mechanisms makes us prone to biases and illusions.

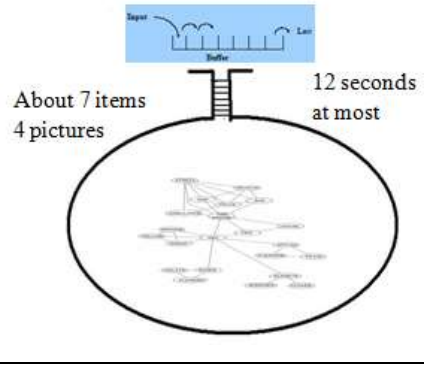
There are different types of memory, which our mind handles in somewhat different ways. The conscious (or declaratory) memory can be *episodic* (names of your classmates, school events) or *semantic* (rules and facts like how to look up a word in a dictionary). The *procedural memory* (how to ride a bike, operate a lathe) is largely unconscious, as are *visual perception*, habitation, conditioning.

Schools are primarily concerned with creating *semantic* memory, such as rules and facts prescribed in the curricula (such as the capital of Chile), and to a secondary degree with procedural skills (how to use a pencil, operate vocational equipment.) People are set up to imitate movements and behaviors, so procedural memory is important and recently understood type. In particular learning of movement sequences is a somewhat mysterious process created by the mirror neurons in our brains, that can help teachers perform sets of actions fluently.

To become consolidated, our conscious knowledge first goes through *working memory*. This brain mechanism holds what you are thinking of right now. But its capacity is very limited. For simple written content or numbers, it may hold about seven items of information for only about 12 seconds. One component of working memory evaluates and rearranges material, while another holds pictures and a third holds verbal items in series (better known as *short-term memory*). By contrast, *long-term memory* stores the information you have learned thus far.

So, learning is like pouring information items into the biggest bottle in the world. People never run out of capacity to store knowledge in long-term memory, the fat part of the bottle; but working memory is the bottle neck, and it is extremely narrow. To push large amounts information through this neck, the brain tries to clamp small items into larger pieces. Practice and feedback are required for items to be clamped together. The smaller chunks are then connected into larger chunks, about like train cars hitched to form a railroad of fluent and automatic performance.

Training practice, and feedback gradually build long chains of complex skills (like operating equipment) that are executed effortlessly; thus they quickly pass through the bottle neck. If you had to remember every move whenever you turned on your laptop to work, you would forget what you wanted to write on email.



Consolidation of memory involving conscious knowledge

Because working memory handles what is in your mind right now, it is crucial for decision-making and integration of knowledge. The greater its capacity, the more efficiently people can use the data they receive in their everyday lives. Working memory capacity increases as children grow and neural connections ("white matter") are built, which send messages fast to various parts of the brain. Working memory capacity predicts school performance independently of intelligence. The capacity peaks around the age of 20 and then gradually declines. Schooling lengthens working memory, and longer schooling is related to a larger capacity.

Because of limited working memory capacity **we are constantly performing in a very narrow timeframe of about 12 seconds** or less. We must recognize letters and other items within a few milliseconds; otherwise we cannot hold the messages they convey in our minds long enough to interpret them or make decisions; **by the end of a sentence we forget the beginning** ! We must do intermediate calculations fast and automatically in order to solve daily problems. *Students cannot afford to read paragraphs letter by letter or get answers to math problems by counting on their fingers*. Schools must provide practice time so that small items can be chunked. Higher-order skills emerge only after the very basic skills are practiced to the point of automatic and fluent performance.

Why do we remember certain things and forget others?

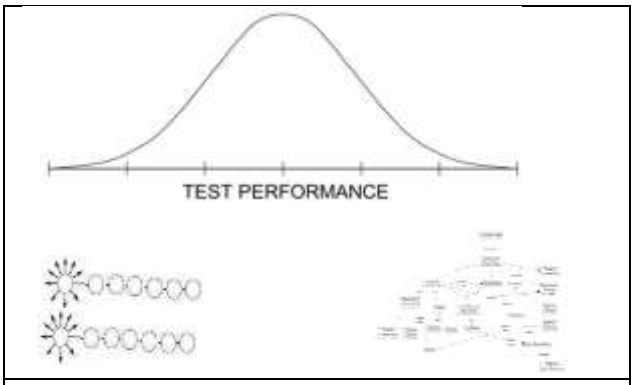
When information manages to pass through the bottleneck and get inside the bottle, it starts becoming consolidated into long-term memory. Knowledge in our minds is organized in cognitive networks. These are genetically set up to encode information on the basis of meaning. To learn and remember an item, a closely matching "hook" is necessary (encoding specificity). Items can only be retrieved along the pathways they were encoded. So, if items are attached to multiple "hooks" (e.g. hearing, touching, seeing, manipulating something), they can be retrieved through many paths. Items that have been contemplated, practiced most often and most recently are more easily retrieved. By contrast, non-distinct items that were just heard once may be

forgotten. Unlike personal events, semantic memory requires repeated exposure for recall. This why time, practice, and feedback matter so much for quality education.

The mind is also set up to draw conclusions from information. These work like new items, and more information can be attached to them. Thus, more knowledgeable people can find more hooks in which to attach items. Eventually knowledge snowballs. And when people analyze or synthesize information or solve problems with it, the information gets reclassified into "deep" structures of abstract principles. This is how people use the organized information to think critically, learn more, value what they learn. And to do the needed tasks within the limits of working memory we must bring out the information effortlessly, without thinking too much.

The implications of memory research on schooling outcomes are multiple. Fluency matters first and foremost because within our working memory we need to think fast and send items into long-term memory. For items to be attached to cognitive networks, prior "hooks" of knowledge are needed; otherwise students simply cannot recall what they heard in class. Activities of rearrangement, analysis, synthesis increase the likelihood that items will be remembered and conclusions drawn. With usage, the items change classification from more superficial categories into deeper principles of principles. All this work must be distributed over time. The brain needs weeks to build new cables ("white matter") and to stabilize proteins along neurons that encode this information.

Overall, "low quality" schools teach a few items connected in series. "High quality" schools teach more items and link them better, so retrieval from multiple parts of the network is easy. They encourage students to derive new items through reasoning. The result is students with dense and connected knowledge networks, who perform well on international comparison tests. The schools that produce these networks have "quality". The students of these schools have well organized and connected knowledge that "pops up" under multiple conditions.



Students with dense and connected networks have a higher probability of finding answers to test items

Cognitive Science and the Holy Grail of Education Quality

Helen Abadzi, HDNFT
3/23/10

What is quality of education? Everyone knows it empirically when they see it, but it has been hard to pin down.

Without a clear definition, various kinds of interventions and policies aim at improving quality. Needed inputs have often been financed, (such as curriculum development, textbooks and library books, teacher or faculty training), but learning outcomes have not matched expectations. Knowledge on how to produce durable learning in students' minds from inputs has been limited.

Economic development requires educated workers, and learning achievement is a proxy for quality and a prerequisite for the primary education Millennium Learning Goal. However, students in lower-income countries often fail to reach even minimal competencies. What should countries do to increase quality and learning outcomes? Studies have focused on systemic issues or costs, with little attention focused on classroom events. A critical element is missing, and without it, interventions and support have limited effectiveness. FTI investments may be more efficient if they support the ways people are set up to learn. Biological memory mechanisms have evolved over the millennia to enhance human survival, and research on the ways humans process information may help get more learning from inputs. The FTI partnership *can incorporate these into a new learning paradigm and succeed in improving educational quality.*

This body of knowledge is not new, but it has been rarely linked to the education sector. It offers a theoretical framework to predict policy outcomes and link performance to economic development (Abadzi 2006 for a review). Some features pertinent to the FTI partner countries are shown below:

- Automaticity is prerequisite to basic skills; reading, calculations, and decisionmaking must take place within a narrow timeframe. (working memory may hold only about 7 simple words for about 12 seconds.) Thus, *fluency is critical in the acquisition of any skill* (including technical and vocational education). *Hundreds of practice hours are needed* to attain speeds that enable text search and scanning of computer screens. (e.g. 250 words per minute).

- Complex knowledge comes only after fluency in simpler skills. The large the items already linked in memory the more the conclusions that can be derived from them. Autonomous learning and self-motivation are a function of lightning fast recall paired with a large amount of knowledge. Well-connected and practiced knowledge pops up fast enough to fit in the 12-second capacity of the working memory.

- Curricula mainly aim to create **semantic memory,** that is memory about ideas, meanings, concepts, procedures. Unlike personal memories semantic memory requires practice and "contemplation." Activities like, discussions, analysis, synthesis organize items so that they can be retrieved and connect them to different parts of the cognitive network. Therefore *organization and connections matter as much as the items themselves*. .

- Prior knowledge is necessary for encoding subsequent information. Items not well connected to prior knowledge or will be forgotten. (Transfer of learning happens very narrowly.) Therefore, kids cannot learn what they missed through automatic promotion; *dropouts typically cannot just return to class and start learning.*

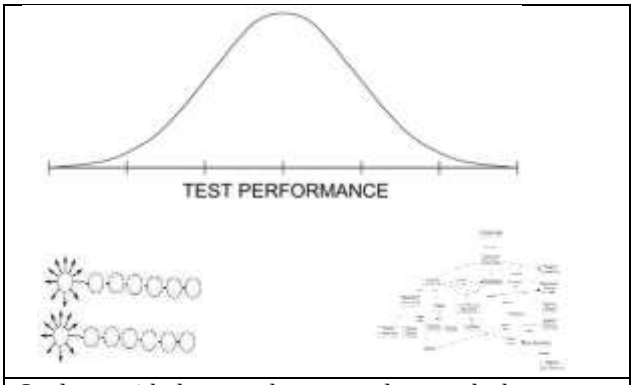
- Creating semantic memory takes time. New nerve connections are created, and the brain's architecture is modified. Practice, homework, feedback, good *instructional time use are needed* to coax the neurons into growing. Nutritional inputs are also needed for these biological processes.

- No textbooks – little formation of semantic memory. Textbooks enable students to *contemplate" the material*, analyze and synthesize it (if they know the language and can read). Furthermore textbooks help categorize and order concepts; they also describe contents in complex sentences that are remembered better than brief notes. So, students of all levels are much more likely to recall the curricular material if they use textbooks. By contrast, those who spend their class time copying from the blackboard miss this opportunity.

- To learn, students must pay attention and expect teacher interaction. Attention is only maintained when stimuli change, and if they do not, students may daydream. *Less educated teachers often merely 'broadcast' to students* and tend to interact only with the best; the rest may become inattentive and fail to learn material that is presented. (a common phenomenon called hidden dropout by the Albanian researcher S. Llambiri).

- People are set up to imitate sequences of movements. Procedures are learned more efficiently by watching a performance rather than through verbal explanations. The system of mirror neurons in our brains enables us to follow efficiently the steps of a dance, for example. TVET students and also teacher *trainees could spend much time watching live performance or videos*. (In fact teachers often reproduce in class the behaviors they witnessed as students).

- Discipline and self-control develop in school as a result of performing tasks students would rather not do. It may also result from moderate amounts of pressure and failures that force the mind into a detail-searching mode. This *"non-cognitive" skill is crucial for employability*.



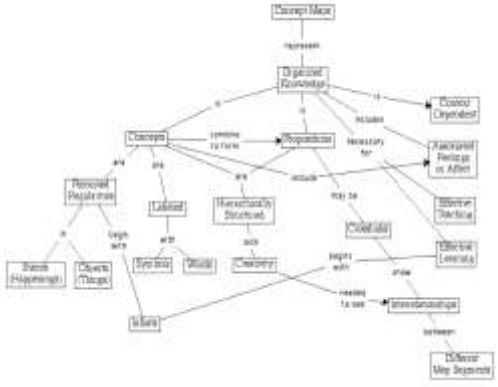
Students with dense and connected networks have a higher probability of finding answers to test items

Therefore *knowledge is most efficiently stored for subsequent use through time to practice, automatized basic skills, written materials, contemplation of the subject matter, reviews spaced at rather long intervals.* "**Low-quality"** schools process information inefficiently: They tend to waste time, have no textbooks to take home, and their teachers rarely use "contemplation" activities. Students spend their time reciting a few disconnected facts.[2] As a result, they may only know a few items connected in series that can only be

[2] The human mind seems set up for recitation and repetition, so memorizing a modicum of material is efficient. Factual manipulation is needed for conceptual understanding; there is no tradeoff between the two.

retrieved by closely matched factual questions. By contrast, **"high quality"** schools process information more efficiently: They help *encode more items, set them in multiple parts of the network for easy retrieval, give practice to create fluency, and encourage students to derive new knowledge through reasoning*. The result is students who have dense and connected cognitive networks, with knowledge that pops up when needed.[3] They can pass difficult tests, perform in the labor market, make rational life decisions, and reasoned political choices.

Figures 1 and 2: Low- and high-quality schools develop differently structured knowledge

Cognitive networks of students in low-quality institutions	Cognitive networks of students in high-quality institutions
The heroes of the revolution are… The chemicals in the periodic table of elements are.. 2x2=4, 2x3=6, 2x4=8, 2x5=10…. The principles of constitutional law are..	
Items linked mainly in series are retrieved only through specific questions. Employers can't use unretrieavable information.	Dense, connected knowledge pops up quickly in a variety of circumstances. Sought after by employers.

Thus, *quality is eminently definable in terms of semantic memory formation*. The basic variables are causally linked to networks of semantic and procedural memory composed from school curricula. [4] Promoting them ought to educate nearly all students, rather than just the brightest, as it often happens. Therefore the following items should be included in policies and components of donor investments aimed at quality. They pertain to all educational levels, from early-childhood development to technical, higher, and nonformal education.

- Fluency of basic skills (emphasis on achievement in grades 1-2)
- Prior knowledge needed for a specific topic
- Textbooks or a structured set of materials per student
- Use of the allotted time for instruction, practice, contemplation of the material, feedback
- Educational measurement for the purpose of feedback

[3] Procedural memory on how to do things (e.g. turn on the computer, tie shoelaces, operate lathes) is included.

[4] High-quality schools also handle emotions and provide rewards (sometimes called school climate). However, the relationship of emotions to achievement is not straightforward. Rewards to teachers and students certainly matter, but the brain's reward system is complex, and research offers limited advice on how to target sector policies.

- Training of teachers (or faculty) to guide students in the elaboration activities appropriate to a specific topic; due to imitation of movements, video-based training may change behaviors more efficiently
- Supervision of the relevant teaching activities, use of effective incentives

Predictably, the more and less mature educational systems deliver services that are quite different. Studies suggest the following quality-oriented priorities in countries of different income levels.

Quality issues in lower-income countries	Fluency in basic skills (reading, math) Lack of textbooks at all levels Significant teacher absenteeism, much time wastage Limited knowledge of official languages Dearth of training, materials, and policy on home languages Little supervision of teachers Hidden dropout (teachers work with the best in primary school) No textbooks in class or to take home Nutrition and health issues significant and unaddressed Adult illiteracy courses have modest outcomes
Quality issues in Middle-income countries	Low-income areas share problems of low-income countries Keeping secondary students in school, helping them catch up Teaching methods unsupported by research (e.g. discovery learning) Time wastage in less effective tasks Transfer of learning – issue particularly in vocational education Hidden dropout (teachers work with the best in secondary school)
Quality issues in higher income countries	Complexity, integration, critical thinking Engaging students in expertise-producing tasks High-tech equipment that increases learning efficiency

What Can GPE Partner Countries Do to Instill More Learning in Students?

Education essentially *converts country budgets and donor funds to encoded memory*. This conversion takes place in classrooms. Use of efficient classroom activities would result in more information encoded for the long run, in less time, with fewer trials and practice. Then students would fail and repeat less often, and would have more knowledge available for daily decisionmaking.

The amount and efficiency of instruction can greatly improve in partner countries and enable students to retain much more information during an instructional hour. Time use, reading and math fluency, teachers' querying tactics, percentage of "contemplative" vs. fact-oriented repetition activities matter a lot. Textbooks and supplementary books are needed to structure the material and thus retain it. Millions of books are procured in partner countries but school observations have often shown they are unavailable or remain unused. Instead, students spend the valuable class time copying or taking dictation rather than contemplating the material and classifying it into meaningful categories. One consequence from the chronic lack of textbooks is a low reading speed all the way to the university. Therefore students need more time and effort to process complex texts.

Textbook strategies must aim to reduce costs, and ensure continuous provision of affordable copies, preferably through market mechanisms. This means that the local printing industry must be aided to respond to the need. And for the long term, perhaps electronic readers would be possible. All the secondary and higher education books will fit into one and perhaps reduce procurement problems. The FTI partnership could potentially facilitate such a technology transfer and help test the viability of the equipment for study, power supply, thefts.

Because cognitive networks add new items to existing information, students missing the prerequisites at any level (usually automatized basic skills) cannot retain new information efficiently. Thus, remediation programs and strategies are needed for those falling behind. Often the only available solution is private tutoring, but this only benefits the better off.

Feedback is an essential property of neurons, and its role is often neglected. The better students who participate more tend to get feedback. Systematic means are needed for giving it during class. Testing is one means, but it often does not result in feedback to students or teachers.

Teacher training can greatly benefit from the insights of information processing research. It is often said that preservice and inservice courses fail to instill teaching skills; participants may discuss or pass examinations about desirable teaching methods, but in class they behave differently, often according to how their own teachers behaved. Research suggests that video-based training sessions and visualizations of improved practice may succeed in changing behaviors where lectures fail. These research insights could be tested through randomized trials and scaled rapidly if their effects are significant.

To get more learning with less time and cost, sector plans could be designed to take this new paradigm into account and appraise classroom instructional conditions. Quality is beckoning us. To play a substantive role in the 21st century human development, the FTI partnership can update the knowledge of its Partner staff and provide the relevant advice to clients.

Sixty words per minute for all:
Why this weird goal for the early grades?

Helen Abadzi, HDNFT
3/23/10

What percentage of sixth graders in the lower-income FTI partner countries can read relatively fluently? Take a guess. Nearly everyone? What if the answer is 50% of those who survived to grade 6?

The countries that use achievement tests to monitor student progress often find that low-income and rural populations have low scores. Sometimes students lack basic skills after years in school. However, this information typically comes too late. Assessments are usually given in grades 4-6, after many students have fallen too far behind to keep up with school. Children in the early grades may not reliably respond to written tests. How should student learning be monitored in grades 1 and 2? What must be done to ensure the acquisition of basic skills among the poor early on?
Cognitive and educational research offers advice that can be put to use quickly and relatively inexpensively. Fluent and accurate reading is a prerequisite for understanding texts and learning from textbooks. Thus, achievement in the early grades can be assessed by listening to students read a simple text for about one minute. By the end of grade 1 students should be able to read very common words, albeit haltingly. By the end of grade 2 at the latest, students should be reading simple texts fluently, at a rate of at least 60 words per minute.

What is the rationale for this assessment standard? To fluent readers the skill seems trivial, but there is complex neuroscience behind it. The brain must be "programmed" through many hours of practice and feedback, until reaction time to letters decreases down to milliseconds. Brain imaging studies show that as students approach the speed of about 45-60 words per minute, a special area in the brain gets activated. That's when reading starts becoming effortless. Then students pay attention to the meaning of the text rather than individual letters. To understand, readers must hold a text in their heads for a while, but human working memory may last only about 12 seconds. So paradoxically, a minimum reading speed is necessary to understand text. If someone reads less than about 45 words per minute, by the end of the sentence they may forget the beginning!

Worldwide, curricula specify that students should "crack the code" and read brief texts of common words by the end of grade 1. Middle-class students usually have no difficulty attaining this standard (unless they have reading disabilities). In fact, multi-country research using the Roman script has shown that when the spelling rules are simple and instruction is sufficient, most children need just 4-6 months to learn reading in their own language. However, teaching in languages with complex spelling patterns, like English, French, Portuguese, or unvoweled Urdu takes longer to learn and requires much more practice.

Delays in reading are more frequent among the poor who have little home support, particularly when faced with languages that they also do not speak well. One reason is that people identify letters faster within words they know; so poor children learning to read in schools that use

English, French, or Portuguese are at a particular disadvantage. They could potentially learn to read in their own national languages (that are usually spelled phonetically) within a few months, but with limited language knowledge they need several years to become fluent in the languages that have complex spelling.

Reading- speed norms and benchmarks have been developed in the United States, Chile, and a few other countries. Oral reading surveys have been carried out in more than 40 countries, including the United States, Peru, India, Mali, Pakistan, Uganda, and South Africa; these have shown that many poor students fail to meet curricular requirements early on. The reading assessment includes tests such as reading letters, very common words taught in school, and a short text similar to those found at the end of a grade 1 textbook. Students are asked to read the text aloud to an examiner one by one. They may be tape-recorded, or the number of words read correctly in one minute may be counted with a stopwatch. To verify comprehension, students are then asked 3-5 very simple questions pertaining to the material in the text. (In agglutinative languages, like Swahili, care must be taken to segment phrases into words.) Similar tests are under development for math skills.

What can governments do if they sample a number of students and find many of them unable to read in grade 2? At that level, it is possible for the poor to catch up with intensive reading instruction during the regular school day, evenings, and vacations. Research in India and Africa shows that speed and accuracy can substantially increase in 6-12 weeks with phonics instruction and efficient use of class time.

To bring about fluent reading for all, policies must be directed towards this goal. Specific reading hours should be designated in the curricula for grades 1-2 rather than the prevalent practice of mixing reading instruction with language. Every child should have a textbook to take home and study, and the textbook should teach phonics and offer many pages of practice to help students pick up fluency.

Teachers must be trained in phonics, explicit instruction of individual letters and combinations and should use instructional time for teaching. Teachers in low-income countries have themselves become literate under inefficient conditions, and they may believe that only few can learn reading. There is a need to emphasize in training techniques to help all learn the basics, even when classes are large. Teachers must ask questions of students at random rather than work with those who can do the work. They need to ensure that even when students are verbally repeating in unison or copying from the blackboard that they recognize the letters they see. Seating them (on the floor if necessary) close to the blackboard and the teacher is likely to maintain students' attention. Standing in various parts of the class using flash cards (simple sheets of paper with material written) will increase the probability that students see the letters and connect them to sounds. Finally, teachers could listen to each child read for one minute once a day and take action if a child cannot do so.

Teachers can be supported through incentives; for example, prizes can be given to those who manage to have all their students reading 60 words per minute by the end of grade 2. Supervisors, inspectors, district officers should supervise the lower grades based on this fluency goal. Communities can also monitor reading speed. Even illiterate parents can distinguish

whether children read fluently. It is important, therefore, that parents learn to expect the acquisition of fluency in grades 1 and 2 and demand that schools prepare their children for this task. Public information videos (such as one developed in Perú) can help parents and educators understand these standards and their rationale. Though not sufficient to bring about comprehension, fluency is necessary.

Failure to learn reading is the primary reason for repetition in the early grades. Students cannot learn from books until they can read fluently, and they may even be unable to solve verbal problems written in math books. The loss of opportunities to learn early on results in knowledge gaps that persist all the way to the university. By that time, the students should be reading about 250 words per minute. If they only read 90, they cannot read volumes of material, as current modern jobs demand. They cannot read computer screens fast enough to deal with the material. Thus, early-grade reading strongly affects the efficiency of an education system.

To memorize or not to memorize? The pros and cons of the question

Helen Abadzi
HDNFT
September 2010

One day when I was 11 years old, I was walking past our neighborhood Greek Orthodox church when I heard women chanting inside. Since women are not normally allowed to chant in the Greek churches, I went in to investigate. It was a weekly mass of supplication to the Virgin Mary that is only for women. I started attending regularly, and with the children's unique learning capacity, I soon memorized a chain of koine Greek chants that lasts about an hour. In adulthood I have chanted it about six times, and this spaced periodic reconsolidation has engraved it indelibly in long-term memory. The last time I chanted it I thought a lot about the research and common beliefs related to memorization.

Human culture could not have evolved without memorization. In societies of little or no literacy, long poems were transmitted across generations. The Celtic epics, Iliad and Odyssey, Vedas, African genealogies were transmitted orally for centuries before being written. "As long as an old man remembers and a child learns, we have progress" said Periander, a Corinthian ancient Greek philosopher. And childhood is the time to learn long verbal sequences easily, because later the needed effort is much greater.

Memorization may have had an additional survival value in evolution. The difficulty in memorizing long sequences in later years almost seals us within the culture of our youth. People who know texts by heart get a strange pleasure from retrieving them into working memory, of joining the chorus of people like them who utter the same sequences. Recitation of such texts conveys the message that we share the common knowledge of a certain group, we are therefore identified as belonging to it, and we can share in its benefits and responsibilities.

Well memorized sequences constitute an invisible book. The information in memorized passages can be unpacked, even years after they have been learned. Adults can recall them, examine them in working memory, and finally understand the meaning, given their increased knowledge about the world. But it requires some effort to get information from memorized texts.

Research shows that memorized material is encoded on the basis of sequence rather than meaning. ". Items linked in series usually have few connections with other known items and can most easily be recalled when a precise cue is given, such as hearing the first stanza of a poem and recalling the next. The material is therefore not searchable in a relatively "random" order, as one would search their memory for items categorized through meaning (Reisberg 2001, Abadzi 2006 for a review). One has to go through a text from the beginning to the end in order to find a needed item. (For example, what is the message in the last stanza of your national anthem?)

Thus the information inside memorized text is disadvantaged and "inert. It does not jump to mind when one looks for something related to it. And only the portion of a text that enters into working memory can be understood. As a child, I would not have been able to answer any substantial questions on the chants. Sometimes I hear an ancient word whose meaning I never

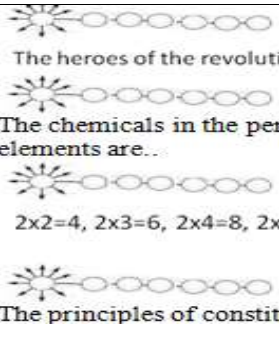
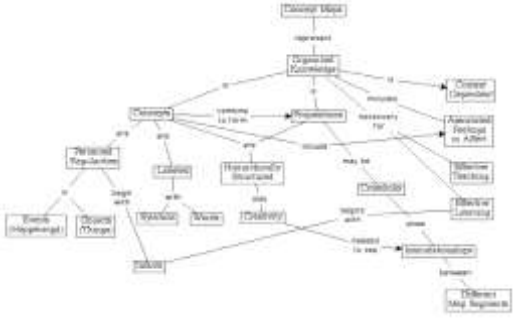
learned, and with some effort I can find in my mind stanzas from poems or prayers that contain it. By recalling the stanzas before and after it I can reasonably guess the meaning.

Because material connected in series often lacks connections to other parts of the network, it is easily forgotten. Mnemonics were used as well as rhythm for facilitation. (Sequences of three items seem to get chunked easily, set in prosody, such as iambic meters.) The chants in my head are held together by multiple cues: rhyme, rhythm, and tune, the church space (state-dependent learning), even the smell of the candles and incense.

This example illustrates the educational advantages and disadvantages of this memory feature. In earlier years and before textbooks were widely available, committing material to memory was an effective input mode. Furthermore, the discipline of memorizing would be likely to train executive functions. However, staff who work in the education sector sometimes state that children should not memorize or that "memorization is not learning".

Such statements indicate misunderstandings about how memory works. There is nothing wrong with children memorizing significant sequences, such as the multiplication tables or historical dates. At those ages it only takes 4-5 tries to encode the shorter series, and then the sequence is automatized and pops up in the mind, without conscious searches. Ability to recall facts quickly is a great advantage, because they can be integrated with one's thoughts within the limited timeframe of the working memory. *The challenge of working with memorized passages is to retrieve each data point individually at will.* For example, children in Guinée who recite in unison the definition of an isosceles triangle must learn how these words related to each other ("un triangle isocele a deux axes de symmetrie"). For that, students must be given "elaboration" exercises that will link the items of the recited series to other knowledge that children have, so that later they can be retrieved in different ways. Such exercises involve application, analysis, synthesis, evaluation. Japanese teachers, for example, often ask students to memorize rules and recite them chorally, but they immediately put the rules in practice (Stigler and Hiebert 1999, p. 71).

However, in lower-income countries, teachers do not go beyond recall. They are often content to just hearing the children recite and take the recitation as evidence of knowing the lesson. Thus children's memorized knowledge remains "inert". Not surprisingly, many children dislike repeating disconnected facts on cue as they grow older and clamor for connected knowledge and the resultant critical thinking. So memorization gets a bad name.

Items connected in series can only be retrieved from one link to the next	Items connected in complex networks on the basis of meaning can be retrieved through multiple paths
	

Furthermore, many sequences that low-income students repeat are only two or three words long and have no special meaning. So the students do not receive texts to bring out and examine later in working memory. Lacking cues they are likely to forget most sequences later, and they will not have the chance to examine the sequences years later and figure out their meaning. This constitutes extremely inefficient use of instructional time and government budgets.

Children's ability to recite short sequences could add value to the acquisition of knowledge and build up executive functions, which are needed in the world of work and higher study. While they still remember the sequences their meaning must be discussed. Overall, schools can take much more advantage of this important human ability that wanes as we age. But staff working in the education need to understand clearly how human memory works and how it can be best used to build the much-needed complex skills in the 21st century.

References

Abadzi, H. 2006. Efficient Learning for the Poor: Insights from the Frontier of Cognitive Neuroscience. World Bank.

Reisberg, D. Cognition. Norton, W. W. & Company, 2001.

Stigler, James and James Hiebert. 1999. The Teaching Gap: Best Ideas from the World's Teachers for Improving Education in the Classroom. New York: The Free Press

Does Educational Financing Get Converted to Information?
Instructional time Use and Wastage

By Helen Abadzi
Senior Evaluation Specialist
Education for All Fast Track Initiative Secretariat
habadzi@worldbank.org

Imagine a factory that is closed 20 percent of the time, whose workers do not show up another 20 percent of the time, that lacks raw materials 30 percent of the time, and produces defective items 40 percent of the time. Would you finance its operation?

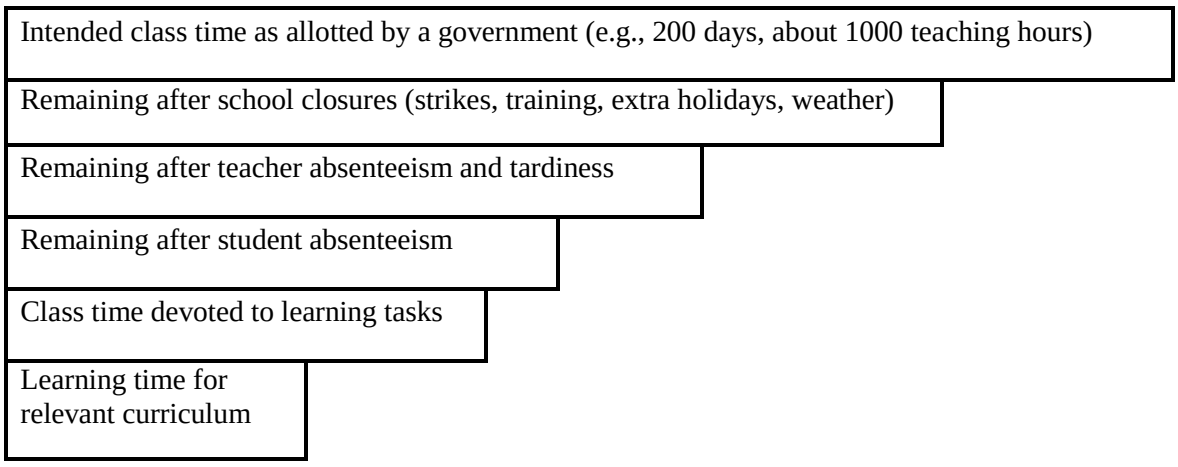
Too often lower-income countries finance such "factories". Funding funds pay for teachers' salaries, buildings, teacher training, and materials, Schools officially operate about 180 days, 4–5 hours per day. In some African countries schools open 2 weeks late and close 2-4 weeks earlier. Then there are informal school closures, teacher absenteeism, teacher delays and early departures, and lack of instruction during class (Figure 1).

A study conducted by the World Bank's Human Development Network in 2004-05 showed that students were engaged in learning 78% of the time in Tunisia, 71% in Morocco, 63% in the Brazilian state of Pernambuco, and 39% in Ghana. Abadzi 2007). A similar USAID study in the Dominican Republic showed time use at 65%.

The instructional time loss is equivalent to many days of school. Estimates suggest that only 76 of the 197 days available to Ghanaian students were spent on learning tasks, while Tunisian students got 148 of the 190 days officially available to them. Thus Tunisian students get twice as much of the intended classroom time as Ghanaian students. Inside the class, Ghanaian teachers spent 70.2% of the time engaging students in learning, while Tunisian teachers spent 87% of the time. The non-instructional time (some of which is necessary) included management activities, instructions, textbook distributions, socialization, or the teacher being out of the room. It ranged from 13.3% in Tunisia to 28% in Ghana.

Further measurements in various Brazilian states in 2009 confirmed initial findings. Time spent on instruction was on average below 66%. Time spent on classroom management was 25-31%. About 74 days were lost in a year of 200 days, 5 hours per day.

Figure 1: Instructional Time Loss Model



Possibly due to poor organization and lack of prior knowledge, 19% students in Ghana and 21% in Pernambuco were found to be "off task", that is uninvolved with class activities. By comparison, only about 10% of Tunisian students and 9% of Moroccan students were "off task". Research has time use and engagement learning activities to achievement outcomes.

How was the Use of Instructional Time Measured?

Time is a mediator variable that requires rigorous measurement and monitoring. For measurement questionnaires and observations have been used (Abadzi 2007). For quick and inexpensive answers, data were obtained through a single unannounced visit to schools. Surveys were given to teachers, principles, and students. These contained similar questions regarding number of days of unplanned school closures up to the date of the survey, number of days teachers had been absent for any reason, use of substitutes and other means to keep students occupied. Teams of trained observers visited schools and administered questionnaires, ascertained how many teachers were absent on that day and asked questions regarding teacher delays on that day and on average days. They also observed classes through a modified version of the Stallings Classroom Snapshot. Responses of were then "triangulated" to arrive at time loss estimates for school closures, class cancellations, teacher absenteeism, delays, and early departures. Subsequent measurements in Mali, Benin, Brazil have mainly used the modified Stallings Classroom snapshot.

To ensure service delivery to the poor, time use must improve. It is not enough to provide the ingredients of instruction. Inputs like teaching aids must be employed and give students the opportunity to receive information, process it, retain it, contemplate it, review it. Sufficient time is needed to master the instructional objectives intended in specific subjects. This is the crux of educational "quality."

Policy dialog may help countries address their sources of "leakage" at the school level, teacher level, and classroom level and plan actions toward eliminating them. It helps to strengthen the supervisory chain from central to regional to school levels, training and feedback for teachers and principals on use of time. Probably no schools use 100 percent of their time productively, but a realistic goal would be to attain the 80% instructional time use observed in Tunisia.

How Funding is Lost with Instructional Time Wastage

An hour of class in a particular school can be seen as a fraction corresponding to a country's recurrent expenditure budget. Losses of the magnitude shown in the various studies suggest that schooling costs more than it ought to or achieves less for what it costs. These include:

Internal efficiency indicators. Other things being equal, repetition and dropout rates are likely to be higher in a country which uses about 40 percent of instructional time for learning than in another which uses about 80 percent (for example Ghana versus Tunisia).

Teacher salaries. Systematic and extensive teacher absenteeism creates distortions. In some countries absentees are ghost teachers, with salaries used for political rewards. If wages are calculated based on the number of hours worked, teaching in some countries may really be a part-time job, with higher hourly earnings than those formally calculated. Sometimes salaries are very low and efforts are made to raise them to acceptable levels, such as the frequently used benchmark of three times the per capita GDP. But before increasing salaries across the board, it is useful to ascertain how much teachers are paid for the work they actually do. Dialog with teacher unions may focus on increasing instructional time before pay increases.

Unit costs. When time is wasted, governments assume that students get services that are not in fact provided. Perhaps unit costs per successful graduate should be used rather than unit costs per student,

because they would more accurately reflect the real cost of providing services to students.

Graduates' rates of return are calculated on the basis of actual costs and with the implicit expectation that students will be taught and will actually learn basic skills. Projections such as the amount of marginal earnings of an additional year of schooling may be unrealistic if students are served for only half the year or if they are illiterate and cannot benefit from the instruction. For example, Ghanaian students often need six years to become literate, but with an average time use of 39 percent this may not be surprising. In six years, they spend about as much time in classroom learning as students of higher-income countries spend in two years.

Effects on education expenditures. Some countries may devote a smaller percentage of their GDP to education but use time better, so they may use funds more efficiently than countries which spend more and waste more. However, expenditures, measured as a share of GDP or of total public expenditures, do not show these differences. Yet, expenditures as a share of GDP are used to estimate financing needs for specific countries, and if the figures are considered low, efforts are made to increase them. But if a country doubles its education budget and still uses use only half of the available instructional time, the extra financing will not have the expected impact. Policy dialog aimed at increasing instructional time would be advisable before dialogue on increasing education expenditures. Time wastage may be one reason why educational expenditures have tripled in the last three decades while student performance has not improved.

Continuing social inequity. Often, time is used less well in the schools of the poor, so assumptions about the pro-poor poverty alleviation effect of education may be unrealistic, and the equity effect may be lower than expected. This would affect benefit-incidence analyses and Lorenz curves. Additional public investment may fail to mitigate poverty, unless it improves instructional delivery.

Overall, instructional time loss has grave economic, governance, and monitoring implications. The future of the Education for All initiative may depend on how seriously governments and donors take instructional time wastage. All concerned must ensure that the time governments buy for their students is actually spent in obtaining learning outcomes.

References

Abadzi, H. 2007. Absenteeism and Beyond: Loss and Costs of Instructional Time in Schools. Washington, DC: World Bank.

Abadzi, 2009. H. Instructional Time Loss in Developing Countries: Concepts, Measurement, and Implications. World Bank Research Observer, July 2009, 1-24.

Bruns, Barbara, Madalena dos Santos), Érica Amorim), and Tássia Cruz. 2010. Inside the "black box" of Brazilian classrooms. Paper presented at World Bank seminar, November 29.

EDUCA. 2005. "Uso del Tiempo en la Escuela Dominicana." Encuesta EDUCA-GALLUP. (financed by USAID). Santo Domingo, República Dominicana.

2011

Are you promoting complex "21st century" skills? Please stop by grade 1 first

Imagine this: A health care worker or parent in a village, with a laptop or mobile device, can access development knowledge in real time through geo coding and geo mapping.....She can upload her own data, throw light on the likely effect of new interventions, and mobilize the community to demand better or more targeted health programs. (Mr. Zoellick's speech at Georgetown U, 9/20/2010).

Unfortunately in most African countries the vision outlined by our President would be science fiction. Not just because health care workers often fail to show up, but because many barely know how to read. Certainly it would be great if such employees have "21st century" skills 5-10 years from now. But can this be realistically achieved in low-income countries and how? To enhance policy dialogue, it is useful to heed the hints of learning research.

You are reading this message on your computer rapidly, by instantly identifying each word. You know the context, and your hands move fluently and unconsciously on the keyboard. To achieve this literacy level, you learned each small step explicitly and practiced it to perfection starting perhaps at age 5; 2-3 items were initially combined into chunks that practice fashioned into longer and longer chains. Automaticity happens unconsciously, so you probably sketchy memories of how you learned to read. Similarly, you probably have sketchy memories of the thousands of instructional hours with textbooks that gave you the factual and language knowledge you now used effortlessly. Furthermore, teachers showed up every day and gave individual feedback, while parents supervised homework practice at night. Some tasks were boring but you had to do them, so you acquired "executive control", an important 'noncognitive" skill. You ate the needed nutrients and escaped diarrheas or cerebral malaria, so your brain circuits are lightning-fast. This went on for 15-20 years.

By contrast, what resources do African students bring in order to build long knowledge chains? They leave their mother tongue behind in grade 1 to learn reading through official languages with complex spelling systems (English, French, Portuguese). Schools may waste 70% of the instructional time in absenteeism and the rest in blackboard copying, since there are often few textbooks. The teachers may just interact with the few who can keep up, while the rest stay illiterate and drop out. Even those better students (and it takes a genius to learn under these circumstances) may read only 80 words per minute in grade 10 compared to your 250 at the same age. At that low speed, it may take 5 minutes just to get through a page. If you took that long, reading a computer screen would be very tedious.

Governments have grandiose plans of developing complex skills. Donor staff advise them that children and youth should acquire the "4Cs": critical thinking, communication, collaboration and creativity. But those are complex skills, and they depend on multiple trivial skills that must first be automatized. To produce novel combinations, relevant information must already exist in memory, and it must also come up fast when needed.

The high-level goals may detract from the lower-level means needed to achieve them. For example, a donor-financed project in a certain country plans to *support the acquisition of catalytic skills mainly by promoting student-centered learning in general education through teacher training reforms.* This sounds laudable, but is it doable given the abilities of average humans? Let's suppose that the future village health worker gets a voucher for a prep school in grade 10 that excels in "student-centered learning". The student may still need five years of constant study to catch up with the other students, and it won't be fun. Every new item to be remembered must find in long-term memory very relevant pre-existing knowledge and attach itself fast, otherwise it will be forgotten. Maybe in 30 years Bank projects will procure brain implants for students, but currently there is no known way of circumventing the piecemeal construction of knowledge networks and need for automaticity.

So to get the "4Cs", students must become very fluent in the "3 Rs": reading, writing and arithmetic. If a country is serious about increasing the skills level of its entire population, no child must be left behind during grade 1. Governments must splurge big-time for kindergartens and the lower primary grades. But mere inputs are not enough. Implementers must pay minute attention to the trivial details that will give kids those little early chunks needed for compiling the bigger chains. They must creatively devise systematic means for giving just-in-time feedback even to the lowest performers who will otherwise not make it. Lower-primary education may not be very sexy, but it's the highway to high-level skills.

A poor village child who is taught to read fluently at the end of grade 1 could potentially get to grade 10 reading 150 words per minute, a stock of automatic math calculations, and well-learned basic information to hook new items as they come in. At such levels, knowledge starts accumulating faster and faster. This could be the village health worker of the future. Her hands are already nimble with cell phones, so she could imitate the additional movements needed to operate a laptop. With the basic cognitive and procedural skills already in place to "hook" new knowledge, she could do what the World Bank's President envisages.

GLOBAL PARTNERSHIP for EDUCATION
quality education for all children

How do skills develop? Some insights from Cognitive Neuroscience

Helen Abadzi
Senior Education Specialist
Global Partnership for Education
c/o World Bank
habadzi@worldbank.org

You are reading this message rapidly, by instantly identifying each word. To achieve this reading fluency, you learned each small step explicitly and practiced it to perfection starting perhaps at age 5; 2-3 items were initially combined into chunks that practice fashioned into longer and longer chains. Automaticity happens unconsciously, so you may have no memories of how you learned to read. And you probably also have vague memories of the thousands of instructional hours with textbooks that gave you the factual and language knowledge you now use effortlessly to communicate. To do all this, your teachers showed up every day and gave you individual feedback, while parents supervised homework practice at night. Some tasks were boring but you had to do them, so you acquired "executive control", an important 'noncognitive" skill. You ate the needed nutrients and escaped diarrheas or cerebral malaria, so your brain circuits are lightning-fast. This went on for 15-20 years.

African countries want their citizens to acquire and use the complex skills that you have. Many pithy documents have been written on how to achieve these states, but answers seem unclear. Yet specific answers do exist, and they come from cognitive science. People everywhere learn, think, and make decisions using the same general cognitive rules. They outline what the average human mind can and cannot do. What are these? Very briefly they are outlined below.

The mind has a short timeframe – Fast and fluent actions are crucial

Short-term memory (better known as *working memory*) holds the information that you are currently thinking of. According to some studies, it can keep only about seven items of information for only about 12 seconds. So if we take too long to read, by the end of a sentence we forget the beginning! This means we become fluent in reading, writing, calculation, cell phone operations, checking electric circuits or throwing food ingredients in a boiling pot. We must furthermore do these low-level tasks without thinking much, otherwise our working memory gets flooded, and we cannot continue.

And how does fluency arise? Our mind is set up to combine easily two items or movements. With practice, those chunks then get combined with two others and become one bigger chunk. With more practice, that bigger chunk gets combined with others. It's like wagons joined 2-3 at a time to build a long railroad of actions: reading instructions, stopping to do what they say, calculating something, looking for items of a certain shape to fix a broken device, writing a message that it was all done. Normally the mind does not take, say 7 wagons to link them all together in one try. If the needed links

are not practiced, the wagons don't link. And if prior similar items don't exist, new ones cannot be learned as easily.

An illiterate may know how parts of a machine fit; but s/he needs practice to chunk the movements needed to take the machine apart or put it together and may need to read instructions. If one of these procedures fails, the action stops. Or s/he can read so slowly, that the mind cannot contain the message along with the other parts of the task. Such an employee is slow and clumsy, so an employer may get impatient and look for others who can do the tasks.

So to get complex "21st century" skills, proficiency is needed in each one of their components. But many African schools cannot give the students the explicit instruction and practice needed to build those automated long chains of skills. Students leave their mother tongue behind in grade 1 to learn reading through official languages with complex spelling systems (English, French, Portuguese). Schools may waste 70% of the instructional time in absenteeism and the rest in blackboard copying, since there are often few textbooks. The teachers may just interact with the few who can keep up, while the rest stay illiterate and drop out. Even those better students (and it takes a genius to learn under these circumstances) may read only 80 words per minute in grade 10 compared to your 250 at the same age. At that low speed, it may take 5 minutes just to get through a page, let alone understand the message and act on it. By the end of the page, your mind has lost the beginning.

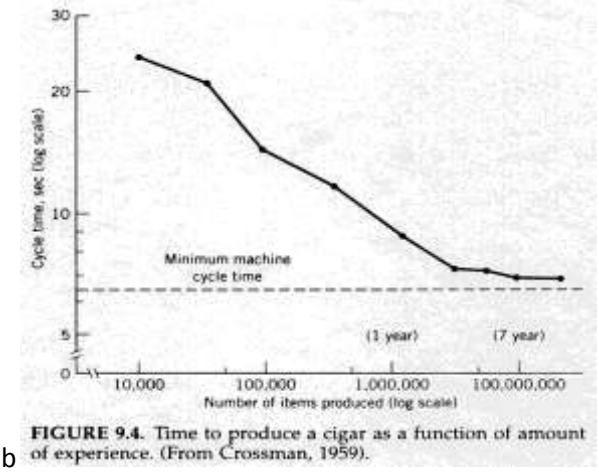
<table>
<tr>
<td>b 

FIGURE 9.4. Time to produce a cigar as a function of amount of experience. (From Crossman, 1959).</td>
<td>  </td>
</tr>
<tr>
<td>Practice increases speed and facilitates entry of information into working memory</td>
<td>A professional driver must also read signs, calculate distances, and write receipts fast.</td>
</tr>
</table>

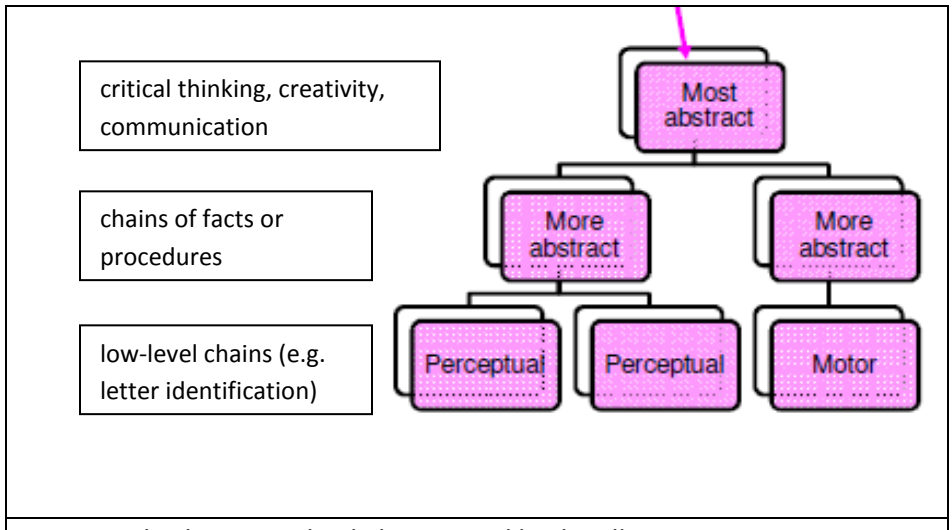
There are even more 'bad news' about our cognitive limitations. Some very low-level skills, such as fine movements to hold a pencil, play music, distinguish a letter shape in milliseconds may have "sensitive periods"; they are best learned before puberty. The ability to become proficient in skills that depend on these low-level functions declines with time. The brain has a lot of plasticity, and may learn them at any age given effort;, but if longer procedures depend on the new skills, overall performance may suffer.

For example, an accomplished writer who learns to word-process at age 50 may forget the messages meant to be transmitted as s/he fumbles with the keys and may take longer to finish the products.

What does this imply about acquisition of new skills for retraining of employees? Or lifelong learning of scientific and technological knowledge? Humans can learn higher-level skills at any time in life. But if low-level essential components are missing they may be later learned inefficiently and slowly (e.g. typing needed for computer operation). Also, low-level skills tend to be very specific, and the planning matters behind the movements, not the movements themselves. Playing the piano does not prepare you to type. Knowing how to repair shows may not have an advantage in learning computer repair.

To perform in 21st century jobs, more is needed than well-practiced chains of procedures. Workers must make decisions in split seconds that are optimal for a certain situation, and they must think critically. Some people say that children and youth need to acquire the "*4Cs": critical thinking, communication, collaboration and creativity.* But these are all complex processes that depend on lower-level components. The workers must have a lot of factual information, and they must have practiced its retrieval, so that it will come up fast into the working memory when needed. Novel, creative combinations can only be derived from information that already exists in memory. Workers must have learned in an organized fashion a great deal of facts from which to reason.

Unfortunately faculties of education do not teach cognitive science, and these principles are not widely known. Thus, expectations may be unrealistic. Some public documents suggest that complex skills can somehow emerge with little instruction or practice, or without proficiency in the lower-level component skills. Such a misunderstanding is embodied in the competency-based curricula that have become fashionable. Students who may be barely decoding or counting on their fingers are somehow expected to perform fluently and fast various parts of a complex operation. But instead they may fumble, get lost in the sequences, and waste the instructional time that could have been spent in automatizing the underlying skills. But after students fall behind, is there enough time left to catch up? To do, 15-year olds who can barely read would have to spend the entire day studying. Once students fall behind on automatizing small chunks, they cannot usually form the bigger ones that depend on them.



note: graphic by Dr. Michael Thomas, Birkbeck College, UK

How to optimize cognition? How to use the findings to shape country policies?

To build long chains of automatized skills, certain ingredients are needed. They pertain equally to all educational levels, from early-childhood development to technical, higher, and nonformal education. To design and implement an effective response through education and training systems, these should become policies to be dealt with explicitly.

Fluency in the prerequisite skills for a given level
  - e.g. fluent reading and math in grades 1-2, fast writing for university, etc
- **Remediation if students are missing the needed component skills**
  - remediation strategies needed to prepare students for next academic levels or for work
- **Textbooks or a structured set of materials per student to take home for practice**
  - This is a perennial problem, governance difficulties urgently need attention
- **Use of allotted time for instruction, practice, reconfiguration of concepts**
  - Governments really pay for classroom time, but wastage is frequent; governments must enforce clear instructions on how to spend time
- **Teacher training for the appropriate activities**
  - training in the subject matter
  - training in methodology (video-modeling methods more efficient in behavior change)
- **Supervision of the relevant teaching activities**
  - Frequent feedback and reinforcement to teaching staff, given the way the brain's reward system works
- **Assessment of learning for feedback and accountability**
  - Measurement and certification mechanisms as needed; measurement is important, but actual instruction is more important.

In summary, literacy, numeracy, language comprehension, in fact any skill can only be conceived within a timeframe of execution. If someone needs even 2 minutes to perform each part of a sequence, the skill is as good as nonexistent. Maybe in 30 years there will be brain implants to aid memory, but currently there is no known way of circumventing the piecemeal construction of knowledge networks and chunking of lower-level components to automaticity.

So to get to the "4Cs", students must become very fluent in the "3 Rs": reading, writing and arithmetic. If a country is serious about increasing the skills level of its entire population, no child must be left behind during grade 1. Governments must splurge big-time for kindergartens and the lower primary grades. But given the specific ways that knowledge is constructed in our minds, implementers must pay minute attention to the trivial details that will give kids those little early chunks needed for compiling the bigger chains. They must creatively devise systematic means for giving just-in-time feedback even to the lowest performers who will otherwise not make it. Lower-primary education still remains the highway to high-level skills.

The processes discussed above ought to help create realistic and implementable skills and labor policies. In countries where nearly everyone has automatized building-block skills, sophisticated labor strategies are possible. In lower-income countries, however such skills are rare; investment strategies and capital are not enough to turn countries like Rwanda into Singapore or Korea. To automatize low-level skills at the population level the strategy focus must be on making the lower primary education more efficient.

References

Note: All items mentioned therein have specific references, omitted for brevity.

Bapi, R.S.; Pammi, V.S.C.; Miyapuram, K.P.; and Ahmed (2005). Investigation of sequence learning: A cognitive and computational neuroscience perspective. Current Science, 89:1690-1698.

Chase, W.G. & Simon, H.A. (1973). "Perception in chess". *Cognitive Psychology* **4** (1): 55–81. doi:10.1016/0010-0285(73)90004-2.

Gobet, F.; de Voogt, A.J.; & Retschitzki, J. (2004). *Moves in mind: The psychology of board games.* Hove, UK: Psychology Press.

Gobet, F.; Lane, P.C.R.; Croker, S.; Cheng, P.C.H.; Jones, G.; Oliver, I.; & Pine, J.M. (2001). *Chunking mechanisms in human learning.* Trends in Cognitive Sciences, 5, 236-243.

Huitt, W. (2003). The information processing approach to cognition. *Educational Psychology Interactive*. Valdosta, GA: Valdosta State University.

Katona, George. 1940. Organizing and Memorizing: Studies in the psychology of teaching and learning. Columbia University Press.

Keele, S.W. (1973). Attention and Human Performance. Pacific Palisades: Goodyear

Lashley, K.S. (1951). The problem of serial order in behavior. In Jeffress, L.A., editor, Cerebral Mechanisms in Behavior. Wiley, New York.

Maybery, M. et al. "Grouping of list items reflected in the timing of recall: implications for models of serial verbal memory." Journal of Memory and Language 47: 360-385. 30 October 2001.

Pramling, Niklas. 2011. Possibilities as limitations: A study of the scientific uptake and moulding of G.A. Miller's metaphor of chunk. *Theory and Psychology* June 2011 vol. 21 no. 3 277-297

Rosenbaum, D.A.; Kenny, S.B.; and Derr, M.A. (1983). Hierarchical control of rapid movement sequences. Journal of Experimental Psychology: Human Perception and Performance, 9:86-102.

Sakai, K.; Kitaguchi, K.; and Hikosaka, O. (2003). Chunking during human visuomotor sequence learning. Experimental Brain Research, 152:229-242.

Simon, Herbert. 1974. How big is a chunk? *Science Vol. 183 no. 4124* pp. 482-488 *DOI: 10.1126/science.183.4124.482*

Terrace, H. (2001). Chunking and serially organized behavior in pigeons, monkeys and humans. In Cook, R. G., editor, Avian visual cognition. Comparative Cognition Press, Medford, MA.

Thomas, M. S. C. & Knowland, V. (2009). Sensitive periods in brain development: Implications for education policy. *European Psychiatric Review*, *2(1)*, 17-20

http://en.wikipedia.org/wiki/Chunking_%28psychology%29

DRAFT

How to teach basic reading effectively in local languages? Some insights from learning research

Helen Abadzi
EFA FTI Secretariat
7/17/2013

The Education for All (EFA) initiative aspires to educate all children of the world. But many of the poorer students fail to learn reading and may drop out illiterate. The reasons may be a lack of textbooks, teachers' knowledge about reading instruction, parents' inability to help, or limited reading practice. Countries with multiple local languages often teach in official languages such as English, French, or Portuguese, that have complex spelling rules. Learning to speak and read such a language requires many hours of teaching and practice. It is easier in many cases to teach basic reading in local languages that are almost always simply spelled. Research shows that when students become fluent in simply spelled languages that they know, they will instantly recognize the known letters and will just have to learn more the complex combinations of the official languages. They may also do better in math (citations below).

Fluent and accurate reading is a prerequisite for understanding texts and learning from print. To do this, the brain must be "programmed" through many hours of practice and feedback, until reaction time to letters becomes instant. As students approach the speed of about 45-60 words per minute, a special area in the brain gets activated. Then reading becomes effortless, and students attend to the meaning of the text rather than individual letters. From then on speed increases exponentially, but only after massive amounts of practice. Without it, students get stuck reading at low speeds and cannot deal with much text.

There are many reading methods, and all may work given enough time and parental help. Also every class may have 2-3 very good students who will learn no matter what. But EFA means that "**all**" must learn, so **the instruction must be aimed at the lower achievers**. Students in low-income countries are often at risk of early dropout, and it is important to make them fluent readers as early as possible. This document uses implications from learning research and presents means to help the poorest get there the fastest.

Literacy in 100 days – if attention is paid to the important learning variables

The fundamental reading instruction to make children learn the decoding rules may only need 3-4 months of consistent work (about 100 days). If kids keep up during this initial decoding stage, they may attain relatively effortless reading. The next stage will be more practice for speed and attention to meaning. To do this, there should be specific time in the curriculum for reading instruction, at least an hour every day. Beginner reading instruction should not be mixed with language arts.

Script lessons for the teachers. Teachers very often do not know how to teach reading. It is best to prepare a series of about 60 lessons written up for them with all the activities they need. They can carry them out rather than try to create them. Also, teachers ought to be regularly supervised, one supervisor for every 12 or 15 teachers who will visit about once a week. Teachers must learn to read and write the local languages, since they may have never done this.

Teacher training can be done by videotaping a model teacher doing the activities more or less correctly and editing the video to improve correctness and flow. Then the videos should be played to teachers multiple times.

- **Teaching one letter at a time, using synthetic phonics**. Using letters one by one to compose words (synthetic phonics) works better than entire words. Teach them one by one, at most one letter per day. It is useful to start teaching the most common letters of a language, so that many words can be made early on. It is not wise to show pictures and expect children to "read" the names; many get cues and just say the word without knowing the letters.

Focus children's attention to the new letter. A teacher should present a large copy of the letter on the blackboard or flash card. S/he should say as little as possible in order to "impress" children with it. Only "the sound of this letter is b, b, b". Children should repeat and touch the letter on their books to ensure that they are not mindlessly saying the sound. A large b on the board or a flash card will increase the probability all will connect sound and letter, particularly those sitting further away. Nevertheless, the fact that children appear to be paying attention and repeating is no guarantee that they are linking the shapes being taught with the sounds. The weaker students may not focus the attention on the letter shown or isolate it from other shapes on the blackboard.

One way to focus on the relevant letters may be to reduce physical distance. For visual perception reasons, students should probably sit no more than 5 meters away from the blackboard. If possible, students should be brought near the blackboard during instruction. In crowded classes teacher could approach the back rows and direct questions to specific children rather than wait for volunteers.

Pattern detection and letter permutations. The mind seeks patterns and learns them fast, and children are expert pattern detectors. Teaching must include explicit instruction on the rules and change patterns related to various sounds and parts of speech. These include comparisons (ka ba za da la, also ak ab az ad al) and contrasts (such as *ka ki ku ke ko*). The first letter to teach may be a common exclamation (a!) and then the second must make permutations with the first: ab ba. In the first few lessons, **nonsense words** that conform to the rules of a language help children sense how the alphabet works and increase speed of identification through practice. They also ensure that students actually know and are decoding. (Children must be told that these don't make sense.) Thus when teaching a letter, make "legal" combinations with previous letters, meaningful or not (aba, bab, baab, abba). After 6-7 letters are taught, there should be no further need for nonsense words.

- **Phonological awareness.** Illiterate children and adults do not know where words start and end. They need exercises to acquire "phonological awareness": sounding out each word, rhyming, omitting the first letter, clapping hands with the number of syllables. These should be done early in grade 1 and taper off after a few weeks.

- **Writing stabilizes memory of letters.** Students will remember the letter shapes and sounds much better if they write them down many times (on slate, ground, paper, in the air with finger, on table). They and the teacher should sound them out while writing, give letter dictation exercises. Copying practice increases writing speed, needed later for expressing concepts before they are forgotten. But children should know the sounds they write or repeat, because they can easily copy a lot of text as if it were art.

- **Independent reading practice** will speed up letter identification. Children should read the texts all together, alone, in small pairs, reread the same text after some time, take books home to read to parents.

Children should get **homework** to read at home every evening to stabilize memory before sleep. Because they easily learn sequences of words by heart, they should get a **lot of different reading exercises**, not just a few sentences. They should read aloud until they instantly identify each letter and read fluently, effortlessly. However, getting the students to do this is challenging; they often do not know how to follow text along the lines. They make mistakes which discourage them, and the younger students may quickly stop. Teachers must keep focusing them on independent reading.

- **Feedback for all, even briefly.** Feedback is essential to improve performance. Yet many teachers "broadcast" to the class and pay more attention to the better students. Children may repeat words without looking at the letters; and if 2-3 children take turns to read a few words on the blackboard, the rest may memorize the order and may seem to be reading when they don't know. If children fall behind early on, they may never catch up. The teacher ought to hear each child read for about one minute per day, during a time others are practicing. They can check students systematically row by row. After one month or so, the 3-4 better students could be systematically identified and set to work with the weaker kids. Students who missed classes should be paired with others who know or briefly taught to catch up.

- **Efficient textbooks**. In simply spelled languages, children usually decode any word if they know the letters, so there is no need for controlled vocabulary, as in English or French. But local languages often have few materials, written by teachers. There is a need to produce more, but often high-income standards are used. Pictures tend to be large, with only 1-2 lines of text per page, and much white paper. The effects of pictures on initial reading are dubious, and research shows that later they are useful only if they directly inform on the content. To economize space and reproduce books cheaply, every page in a beginning reader should maximize text amount and minimize picture size. Visual perception studies suggest that in grades 1-2 letters should be at least 24 point fonts courier, double-spaced, with 3 spaces between letters.

Speed and accuracy helps students comprehend. To understand, readers must hold a text in their heads for a while, but human short-term memory lasts only about 12 seconds. So paradoxically, a minimum reading speed is necessary to understand text. If someone reads less than about 45 words per minute, by the end of the sentence they may forget the beginning! Most children reading at this speed will understand simple text on their own, without special comprehension training. Instead, breadth and depth of vocabulary knowledge determine comprehension.

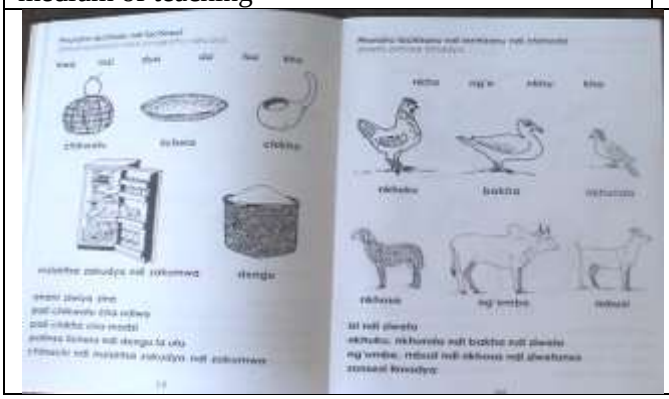
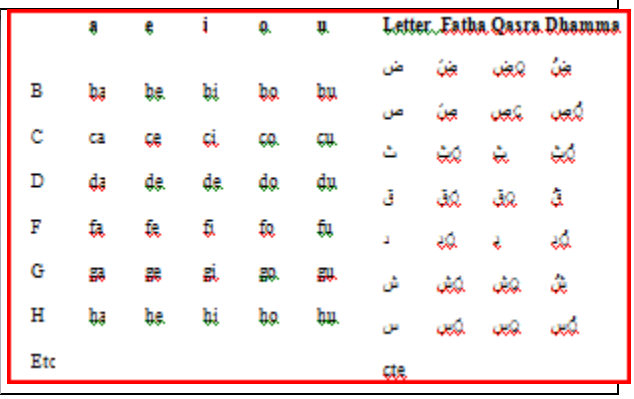
- **Listening comprehension**. Reading or telling stories and asking for comprehension lengthens children's memory and prepares them to keep large chunks of text in their minds. In consistently spelled languages, children may learn to read even if vocabulary initially is limited, but to facilitate comprehension, it must expand.

How do people know if a child reads fluently? Children may read haltingly, letter by letter: t h i s i s t h e . As they get better and approximate 45-60 words per minute, they may sound fluent but read with a flat voice, which suggests partial understanding. As they get more practice, their reading sounds like natural expressive speech (called prosody). When children sound like that, they probably understand well what they read. Teachers, inspectors, parents, can count words per minute with a watch.

Community sensitization. One often hears parents say "my child knows our language, I am sending him to school to learn English". There is a need to make them understand the advantages of the local language instruction. One way is to report student progress; parents can be told if their child is reading fluently enough to meet the national reading goal (e.g. at least 45-60 words per minute; as has been done in Liberia). Creating reading **competitions** among schools can generate enthusiasm and highly the importance of reading fluency. Teachers may also be given **prizes** if they manage to make their entire class meet the reading goal.

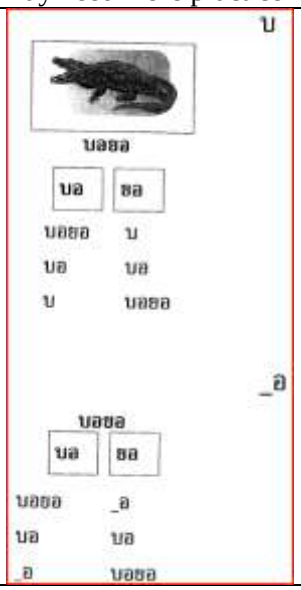
What to do **if a child has a mother tongue that has not been selected for use in literacy**? Unless there are political issues, children may benefit from spelling simplicity if they become literate in a similar language or one that they know partially (e.g. interact in the playground or in the market). Also in grade 1, children still learn languages easily and some research suggests that they may do better than studying in the formal language.

Mozambique – whole language in Portuguese with calligraphic letters	Students just sketch the letters without learning sounds
	

Malawi –Chichewa reader – multiple letters in one page and little practice. The poor outcomes made mother tongue instruction seem an ineffective medium of teaching	Better: Analogies to automatize syllables, which people learn easily
	

Some children repeat what is written on the blackboard without looking at the letters Distance, teacher neglect, small size of displayed letters contribute to this problem	Is this child really reading or pointing to a memorized order of a text?

Some methods may use pictures for long words or untaught letters, but this increases visual complexity	Phonics and analogies: Textbook “Eu Leio”, by Frouke Draisma (Progresso, Mozambique)	Pathani Malay (Summer Institute of Linguistics) Analytical phonics, common method but may need more practice
		

Laos: Flash cards made out of simple paper are great, but letters should be big, take up at least half a page	Uncrowded large letters for beginning readers

Once upon a time there was a land ruled by king Midas

24 point font double spaced, 3 spaces

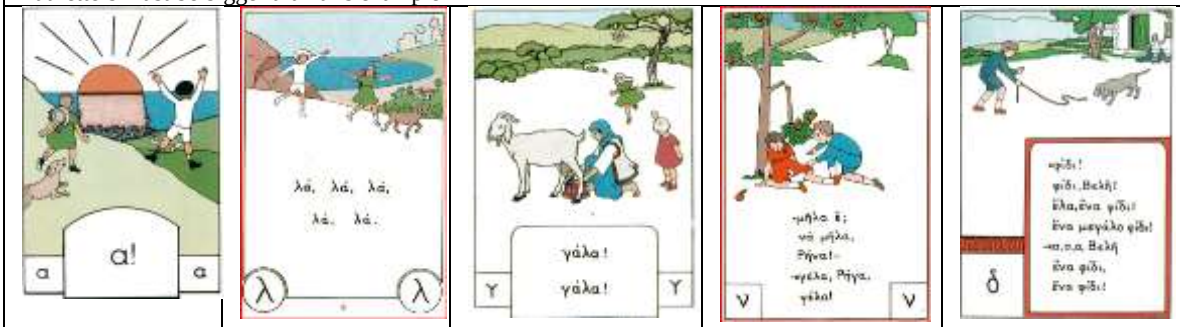
Cambodia – waiting for the bell: poorly used instructional time

Bangladesh: teacher listening to a child read for one minute per day (Gono Shahaja Shangstha NGO)

Cambodia: distance between blackboard and children reduces the impact of the messages…

… and contributes to distraction

Greece, 1919. Teaching one letter at a time, forming sentences only with known letters, content gradually increases
But letters must be bigger than this example



India: matching the syllabic letters on the chart , along with some affection (Pratham NGO)

Asian syllabic scripts are written with more "ink" than Latin and take longer to automatize, though spelling systems are simple

References

Abadzi, Helen. 2004. Education for All or Just for the Smartest Poor? Prospects, 34: 271-289.

Abadzi, Helen. 2006. Efficient Learning for the Poor: Insights from the Frontier of Cognitive Neuroscience'. World Bank: Directions in Development.

Abadzi, Helen. 2008. Efficient Learning for the Poor: New Insights into Literacy Acquisition for Children. International Review of Education; 54, 5-6, 581-604.

Bowers, p. J. Kirby, S. Deacon. 2010. The effects of morphological instruction on literacy skills: A systematic review of the literature. Review of educational research, 80, 2, 144-179

Changizi, M. A., Zhang, Q., Ye, H. & Shimojo, S. 2004. The structures of letters and symbols throughout human history are selected to match those found in objects in natural scenes.

Changizi, Mark A. and Shinsuke Shimojo. 2005. Character complexity and redundancy in writing systems over human history. Proceedings of the Royal Society B, 272, 267–275

Keller, T. And M. A. Just. 2009. Altering Cortical Connectivity: Remediation-Induced Changes in the White Matter of Poor Readers. Neuron. 64, 624–631.

Pelli, D. G., Burns, C. W., Farell, B., & Moore-Page, D. C. 2006. Feature detection and letter identification. Vision Research, 46(28), 4646-4674.

Pelli, Dennis and Katharine Tillman. 2007. Parts, wholes, and context in reading: A triple dissociation. PLoS ONE, August 2007, e 680.

Szűcs, Dénes and Usha Goswami. 2007. Educational neuroscience: Defining a new discipline for the study of mental representations. Mind, Brain, and Education 1:3, 114–127 [on writing]

Tan, A., and T. Nicholson. 1997. "Flashcards revisited: Training poor readers to read words faster improves their comprehension of text." Journal of Educational Psychology 89: 276–288.

Walter, Steve. 2010. Mother-tongue based education in developing countries: Some emerging insights. Paper submitted for publication.

Note. For simplicity, specific references to every sentence have not been noted. For these, please contact the author at habadzi@educationfasttrack.org or habadzi@worldbank.org

Local Languages and the Virtues of Spelling Consistency

Posted on Monday April 16th, 2012 by Helen Abadzi

In March 2012 I traveled once more to the Gambia, where the government is grappling with the problem of how to make its citizens literate. The 1.5 million people of this country speak nine languages, so English has been the language of instruction. However, most students have failed to learn reading due to the complex spelling of this language, so the government decided to teach first graders by using the five most common languages. A pilot has been underway in the 2011-2012 school year.

A cognitive psychologist from the University of Rome accompanied the mission. Through rapidly appearing words she tested students in all primary grades in English and Wolof. She found that most children did not even know letters. But those who did could read 200 words per minute in Wolof, even though they had not learned explicitly how to read in it. Yet, they could only identify 30 words correct per minute in English. Their vocabulary was too small, and they did not know some common English words like scrub. Obviously the educational advantage of a well-known language was huge. But multiple local languages in low-income countries will never be used to teach complex math and science content.

In most countries of the world, learning content in a foreign language seems odd. Nearly all countries in Europe, Asia, and Latin America teach in their official languages. Thus the Greeks, Albanians, Hungarians, Czechs study in their own languages all the way to the university. Linguistic minorities nowadays are given options. India for example, has a three-language formula. But nearly all African and Pacific Ocean countries are multilingual, and some have no local lingua franca. Politically and practically the former colonial languages were used as a uniting and equalizing tool.

It is commonly said in middle-income environments that learning multiple languages is good, and foreign-language immersion successfully challenges students. Furthermore humans seem set up to speak multiple languages, and most Africans know more than one. And globalization means that citizens should be able to talk to people on the other side of the earth. So the idea goes, let's give to the poor the same advantage of foreign language immersion!

But the prediction is wrong, and all but the best among the poor fail. Why is that? Here are some reasons.

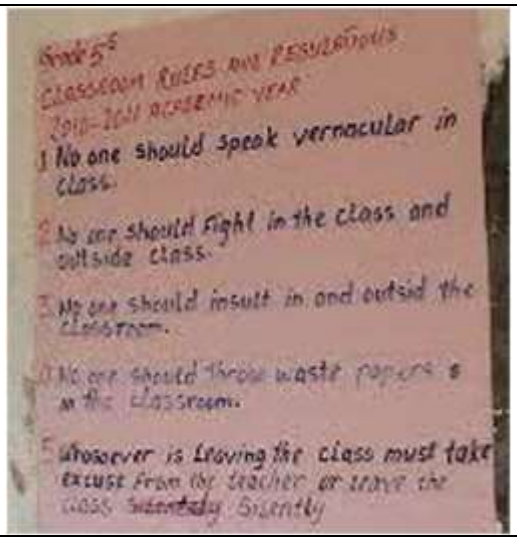
- **We learn languages through personal interaction**. Our mind is set up to learn not from a single speaker (the teacher) broadcasting to everyone but from people speaking to each other. Thus, the same children who know too few English words to learn science may sell merchandise using multiple African languages.

- **The better our vocabulary in one language, the easier it will be to learn more in another**. Our knowledge is classified in intricate networks. If we already have a concept (e.g. "justice") we can easily attach a new label to it. If the concept does not exist, a new item must open, and when these new items

are too many, learning slows down. The more we know the easier it becomes to hook new items, so bilingualism is 'additive". But if students know too little of their own language, burdening them with a whole new set that is broadcast by one teacher may create 'subtractive' bilingualism; students end up not knowing any language very well.

- **In their own languages the poor have smaller vocabularies than the better off.** Somehow schools should help the poor catch up, and students ought to be learning 2000-3000 words per year in English, French, or Portuguese. However, many African schools teach in fact for only about 2 hours a day. So an American 5th grader may know 40,000 words and lemmas, but African students may only know 1000 and thus lack the vocabulary to discuss science.

- **The formal languages used in Africa (English, French, Portuguese) have complex spelling**. To teach reading in them requires vocabulary, sight words, and prediction skills. Even for native speakers, English instruction in reading has a three-year horizon.



No vernacular ! in a Gambian school

However, most languages of the world are spelled consistently. With phonics instruction in transparent orthographies decoding may be achieved in about 4 months. Students pronounce just the letters contained in a word, so they depend less on vocabulary knowledge or on predictions to decipher text; they also have less need of parents reading to them at home. And when students put words in their working memory fast enough and know the vocabulary, they typically understand. Automaticity in the same script transfers from one language to another, so reading fluency in an African language greatly facilitates fluency in English, French, or Portuguese.

Timeframes and subjects create complications. Countries may decide to use local languages, but they stop them in grade 2 or 3, when due to schooling inefficiencies poor children may still be illiterate. And there has been little thinking on what local language use is really good for. Besides reading, there is a need to consider arithmetic, whose verbal code should not change through life. There is science, which must be understood, with vocabulary that children may have not yet learned.

So how to facilitate early-grade instruction in multilingual societies?

Various reading studies and an encouraging pilot in the Gambia show that in consistently spelled languages the literacy basics can be imparted in **about 100 instructional hours**. After the 100 days students then continue to read texts to pick up speed, but Examples from the Gambia and NGOs in Burkina Faso suggest that this is indeed the case. Given the above issues, the following strategy can be formulated:

- Divide the instructional time given to language arts in grade 1 into two parts:
    - Literacy in a local language (including a commonly used language)
    - Oral instruction in English, French, Portuguese
    - Combine these two tracks only after nearly all students are fluent readers in their own languages.
    - Use a bridging course of a few weeks to teach the spelling complexities of English, French, or Portuguese.
- Use the same method to remediate illiterate students in the school. A "**literate school in 100 days**" would teach all illiterate students using the same grade 1 reading method. The older students have longer working memory and executive control, and they may know some letters. They are likely therefore to learn the reading basics much more quickly and transition into their official-language textbooks that earlier they could not read.

While learning local languages, children should not fall behind in the official language of instruction. It ought to be taught orally. But the complex spelling of English, French, or Portuguese ought to be introduced only after the vast majority of students have become fluent readers in local languages.

Jerma language in Niger

Deal with expressed and tacit concerns. Languages carry the status connotations of their speaker groups, so some languages are more highly regarded than others. Evidently knowledge of the official language leads to expectations of higher-income employment, and parents are anxious to ensure that their children learn high-status languages. Since the middle-class children perform in official languages, some parents get the idea that these are for the rich and the local languages are for the poor. So there is a need to communicate clearly the advantages of the local language instruction. Several countries have done community sensitization campaigns using the local media, and these seem to work. Experiences in the Gambia suggest that communities may feel pride in their languages when these are used in schools.

Settle through some criteria which language(s) to use. No higher-income country ever had to deal with the linguistic complexity that most of Africa confronts. It is not possible in many countries to use every single language. There are logistics pertaining to teacher assignments, textbook production, and the

like Also in cities schools have students from multiple languages. On occasion there are political and religious conflicts defined along linguistic lines. However, the situation may be less complex than expected. In Africa people commonly use two or three local languages with relatives and neighbors, and many of the languages are closely related. The “language of the playground” in cities or the local lingua franca of rural areas can be determined through a process of social negotiation, where local leaders are asked to decide and approve. The Solidar Swiss NGO in Burkina Faso has developed extensive experience and guidelines for “social negotiation”.

Print grade 1 reading books in local languages. To teach students more efficiently, reading should be taught through phonics with gradual letter presentation, analogies, much text for practicing. Such textbooks have been developed in 5 languages in the Gambia and may be used for adaptation to other languages.

How to deal with the multiplicity of languages in a country?

More research is needed on the children’s command of local languages. But it seems at this point that a consistently spelled language taught at a time when children still learn languages may address the logistical difficulties of teaching in all languages. One small study lends support to this hypothesis. Pulaar-speaking children in Cameroon scored higher in English and math after they had studied in a Kom language school than Pulaar speakers studying directly in English.

Thus an intermediate solution for multilingual societies could potentially be fulfill the needs of low-income students: A small number of regional lingua francas, in which reading can be taught efficiently, through parsimonious steps that deliver the basics in 100 days or so. Examples from the Gambia and NGOs in Burkina Faso suggest that this is possible and very often politically acceptable. Uganda, as well as countries that face large numbers of languages could start pilots in regional languages and move to large-scale implementation if results are satisfactory.

Initially published as a blog at:

http://www.educationforallblog.org/issues/illiteracy/local-languages-and-the-advantages-of-spelling-consistency

Print poverty: Scarce textbooks, abundant illiteracy

April 19, 2011 By Helen Abadzi 14 Comments

Imagine spending 16 years in school watching your teacher writing long texts on the blackboard and then copying them. How much knowledge do you think you would have acquired if your classroom time was spent in this way?

In many FTI Partner countries, textbooks are conspicuously absent from schools – from primary to higher education. And the effects of "print poverty'' on performance are big: students scoring in the 98 percentile of tests may read 4.7 million words per year, or 67 minutes per day, while those scoring in the 10th percentile may read 51,000 words per year or 1 minute a day (Anderson, Fielding, and Wilson 1988).

Many countries lack sufficient capacity to print millions of textbooks, so they must be printed abroad. International competitive bidding takes a long time and unwittingly favors foreign suppliers. Collusion and rigged bidding raise prices inordinately (read Disappearing books: Greed or policy mistakes or both? by my colleague Luis Crouch). Textbooks may be ordered once every five years, and as they wear out they become scarce. The result is both scarcity and high prices. In Malawi, for example, the 2009 Country Status Report showed that 94% of first graders and 34% of eighth graders had no books. And the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) statistics reported that only 42% of students had textbooks in 2000 and in 2007. No progress over all those years.

Importation and prices limit availability, and textbooks in some countries cannot be bought at any price anywhere – except on the black market where private schools and better-off students are the primary customers (see the example of Mozambique in Illegal Sale of School Books Continues in All Africa.com). They are stolen at various points of the distribution system, often from schools, and sold in the streets. In one country they were being sold right outside the Ministry of Education!

Advice on increasing textbook choice may have made the situation worse. Multiple versions of textbooks result in the printing of small lots that cost even more. If schools are asked to choose and pay with their budgets, they find that they can only afford a few. If a principle must decide whether to buy textbooks or fix leaking roofs, the choice is obvious.

And quality often is nothing to write home about. Given the need to keep prices low, textbooks are often skimpy, little more than outlines and in several, the valuable paper is used up by large pictures or parts are left blank. Those of us who went to school using thick, informative,

illustrative books would be surprised to see 75-pagers on high school math, 50 pages for grade 1 basic literacy.

So do teachers and parents complain about this deficiency? Rarely. The earlier generations went to school without textbooks so they think of this as a "natural" way to study. This is also what I saw in Nepal as World Bank task manager around 1992. Nepalese students only studied from handwritten notes in secondary and higher education. Some had inherited the notes of certain university courses from their fathers!

Thus the classrooms become the most expensive copying centers in the world. Students spend their time painstakingly taking down dictation and drawing designs, either from blackboard copying or through verbatim dictation. Predictably, they do not do well in exams. Only 8.6% of students were reaching minimum level of mastery in the 2005 SACMEQ. And since they get little reading practice, they read very slowly at advanced ages. University students in Mali were informally measured and read about 109 words per minute. (this is grade 4 fluency in the US). Needless to say, this is no way to gain 21st century skills.

Perhaps the biggest African problem is an information deficit at all levels. For all of us who are used to textbooks being abundant and reasonably priced the situation is hard to imagine. It's simply impossible to improve quality of education with this deficit. Because knowledge is cumulative and instructional time is poorly used, students may learn little additional material in school.

Affordable and available textbooks should be a policy priority for the FTI partner countries, but the problem is complex. But how to proceed? Any ideas?

Learn more

Disappearing books: Greed or policy mistakes or both? by Luis Crouch (Education for all Blog, April 12, 2011)

Illegal Sale of School Books Continues (All Africa.com, March 11, 2011)

Anderson, R. C., L. G. Fielding, and P. T. Wilson. 1988. Growth in reading and how children spend their time outside of school. Reading Research Quarterly 23: 285–304.

How to “Cure” Illiteracy?

Dated: February 28, 2013 By Helen Abadzi 2 Comments

Lessons We Can Learn From Fighting HIV

©GPE/Paul Martinez

In the outskirts of an African capital, a young woman living in a makeshift hut gets sick. It’s probably just the flu, say the relatives. A traditional healer prescribes herbs and an amulet. Instead of improving, she gets thinner. A local druggist gives her antibiotics, the only drug he can think of. But she is so weak, she cannot even tolerate it. Her funeral takes place a few months later, one more statistic in the AIDS epidemic.

In the same neighborhood, an illiterate young girl hears that a new school has opened and requires no tuition, so she enrolls. A textbook is distributed to all that have beautiful pictures and interesting stories from the very start. Mysteriously she does not even learn letters from it. She sees some squiggles on the blackboard and repeats meaningless phrases, but cannot relate the two. Nor could she make any sense of the language even if she did. She starts attending less and less often. A few months later, the list of students sent to the Ministry of Education omits her name. Her life story as a student ends there.

Prescriptions for illiteracy: beginning pages of the French, English, and Portuguese grade 1 textbooks. Huge chunks of information, knowledge particles appropriate for well- trained middle class kids

"Missing tiny chunks of knowledge"

For now there is no cure for AIDS, and illiteracy might seem a much more preferable fate. But illiteracy may actually shorten lives. People need information to make good decisions quickly, and these often come in written form. Those who cannot process the information may endanger themselves and their children. So in some respects illiteracy is like HIV: its effects incubate for years. They become obvious when a functionally illiterate person signs papers for a high-interest loan that will prove disastrous for their livelihood, or when ignorance damages children, from infant mortality to early marriage, disease, or maternal mortality.

Just like HIV which sometimes has mild symptoms which can go unnoticed, ineffective reading instruction is hard to detect. Many of us donor staff may visit schools that are breeding grounds of illiteracy, but our personal experiences of schooling get in the way of seeing. Many of us did not have illiterate classmates, so we expect normal children somehow to progress to literacy.

The cause of HIV and AIDS is a virus; an evanescent organism that is barely a *chunk of DNA*. It was discovered in 1981 after much research among rival medical teams. Billions have since been spent on antivirals that keep people alive and relatively healthy. In a rough analogy, the cause of illiteracy is missing *tiny chunks of knowledge*.

Increasing the efficiency of instruction

We learn skills by chunking tiny particles of information into bigger chunks, such as letters to words, or single digits into calculations. Middle class kids get these opportunities starting at birth. By the time they enter school, they deal quickly with entire words and meaningful texts right from the start. And they have enough working memory left over to appreciate the pictures of the books. But poor people have fewer chances of developing some neural circuits that facilitate performance. They must start from the features of single letters. These are infinitesimally small and invisible pieces, like viruses. Students need targeted training, feedback, appropriate books, and practice to chunk the tiny particles into bigger pieces. And they must do this without home help. However, the methods they get were made for the knowledgeable middle

class. Look below at the visual and linguistic complexity of African textbooks. Unless the poor are inordinately intelligent, they drop out illiterate.

Large chunks in a Chichewa textbook

The cause of AIDS is no longer a mystery. By contrast, the causes of learning failure are unclear to most donor and government staff. Cognitive neuroscientists research the above topics, but education colleges rarely teach cognitive neuroscience, and when they do, it is aimed at the students of high-income countries. So unlike the AIDS agenda, no money is being spent to study how the brains of children who grow up without exposure to reading process information and identify the unseen obstacles. Instead, billions are currently being spent to educate them through methods that work for very few, just as if Ministries of Health gave out herbs and antibiotics for AIDS.

An illiteracy vaccine

Scientists verified the existence of the virus in samples dated from the 1950s. It was in the 1950s also that cognitive research clarified the rules of chunking and automaticity in the human brain. This research points to efficient and specific solutions. It suggests that there is an illiteracy vaccine available – something that does not yet exist for AIDS. The vaccine is automaticity, the ability to read 45-60 words per minute across languages and scripts. Once children can read fluently, they may retain the ability to read even if they see print rarely.

Just like antiretroviral drugs, treatment needs to be precise. But literacy instruction is not needed for the rest of one's life. In almost all languages (except for English, French, Chinese, maybe Khmer) the basics can be taught in about 100 days. Then more opportunities to read, such as books available in local languages, will stabilize automaticity. Pilots in the Gambia and in Cambodia have shown that *the treatment works*.

Gambian grade 1 textbook: small information chunks and change patterns

However, the road to treat AIDS has followed a faster path. HIV/AIDS activists created the "ACT UP" movement and dogged officials with demonstrations, demanding faster and better treatments. Common teaching practices (PDF) may work at best for 15-20% of poor populations in some countries but thus far no illiterates have taken to the streets demanding appropriate instruction. Thus the many concerns about fixing the learning crisis have not focused on the cause.

The donor community is making huge fundraising efforts to benefit primary education for the poor.

To use the money wisely and teach nearly all students, the AIDS campaigns have several lessons to offer. Governments and donor agencies should insist on simple and effective literacy instruction in consistently-spelled languages. And millions of supplementary books should be made available to ensure automaticity and comprehension. This way, the beneficiaries will be able to get the needed information from print and make decisions to benefit their families. They could even be saved from AIDS itself.

With our current knowledge we are in a position to beat illiteracy before the medical researchers beat AIDS

http://www.educationforallblog.org/issues/literacy-issues/how-to-cure-illiteracy

How to Speed Up Literacy for Lower-Income Students who speak Creoles?

Some Insights from Cognitive neuroscience

Helen Abadzi[5]

Global Partnership for Education

7/17/2013

The vast majority of the world's languages are spelled regularly; words are written as they sound. Students therefore can learn basic reading in a year or less. But due to pronunciation changes in the middle ages, the spelling of English has complex patterns and many irregularities. Teaching the various patterns takes three to four years. And some children's brains have difficulties with the spelling system, so dyslexia in English is more frequent than in other countries.

Learning to read becomes an even bigger problem for children who speak dialects derived from English. This happens in the Caribbean, but also in countries like Sierra Leone, Liberia, and the Nigerian Delta. Mapping the sounds of the dialects to the already complex English spelling becomes a guessing game and results in large-scale illiteracy that cannot be easily dealt with. The Caribbean is relatively prosperous and can afford to spend more on reading remedies, but African and Oceanian countries cannot.

For this reason there have been movements to write English dialects phonetically. Then children can be taught to read through a consistent spelling system in a year or less. (French-derived Creoles, such as those of Haiti or St. Lucia in the Caribbean, were written phonetically decades ago.) Perhaps the most prominent example for English is the Jamaican patois (patwa). Efforts to create consistent spelling have been refined by prof. Hubert Devonish, Jamaican language unit, University of the West Indies. (**hubert.devonish**@uwimona.edu.jm; http://www.mona.uwi.edu/dllp/jlu/index.htm)

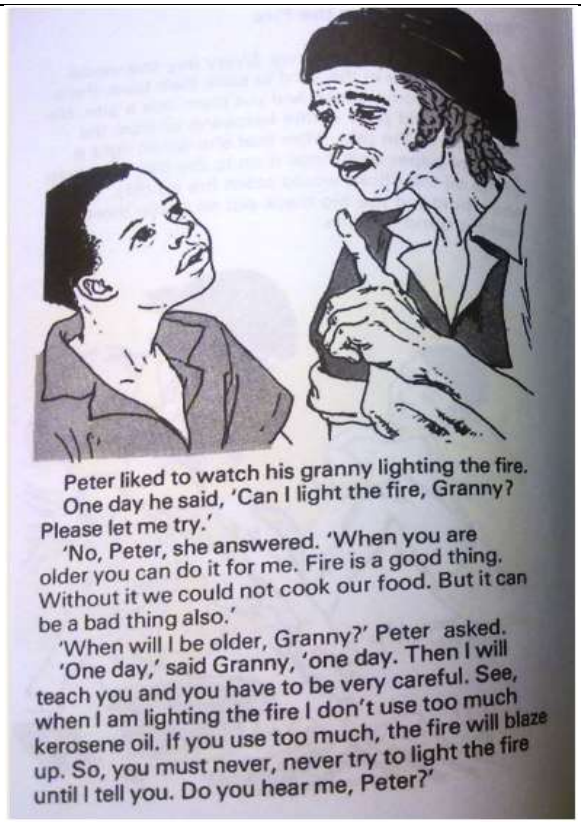
Literacy could become much more efficient if students learned to read their dialect letter by letter in grade 1. The goal should be to get all students to identify the letters in milliseconds. This ought to be possible in fewer than 100 lessons, even considering absenteeism and the need for reviews. At the same time, students ought to be learning standard English orally. After becoming fluent readers, perhaps in the middle of grade 2, students would receive a bridge course of 1-2 years of how to spell English explicitly. With better knowledge of standard English, they ought to make a transition with less effort than it takes to learn English reading from the start.

Literate students immigrating to the US and UK from countries like the Philippines, Vietnam or Latin America rely on prior reading automaticity and learn English spelling easily. Similarly one pilot conducted by Dr. Devonish in Jamaica showed that students performed better if they if they start from the consistent spelling system of the local dialect and transfer fluency to standard English.

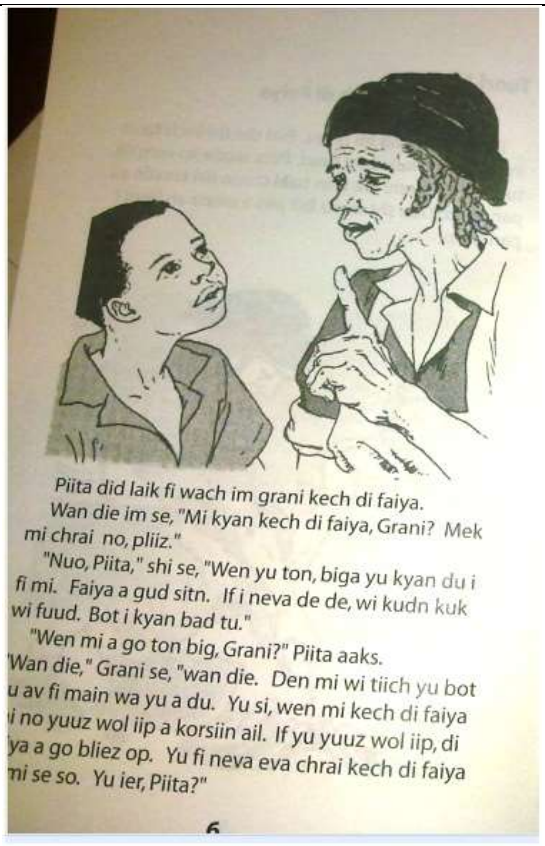
Culturally these issues are sensitive, because the Creole dialects have low social status. 9 http://newsandviewsbydjmillerja.wordpress.com/2012/09/12/the-patoispatwa-wars/) Also several issues with spelling need research. For example, efforts must be made to write the Creoles so as to maximize contrasts with standard English while facilitating common spelling patterns. However, the potential is significant. This method could be piloted in counties where Creoles are spoken in hopes of

[5] Helen Abadzi is a Greek psychologist, who has worked since 1987 as a senior education specialist in the World Bank (currently at the Global Partnership for Education; habadzi@gmail.com). She explores cognitive neuroscience applications that may improve the education of the poor. For her work she has learned many languages and is fluent in Arabic.

giving students the same advantage as obtained by the speakers of consistently written languages using the same alphabet.



Peter liked to watch his granny lighting the fire.
One day he said, 'Can I light the fire, Granny? Please let me try.'
'No, Peter, she answered. 'When you are older you can do it for me. Fire is a good thing. Without it we could not cook our food. But it can be a bad thing also.'
'When will I be older, Granny?' Peter asked.
'One day,' said Granny, 'one day. Then I will teach you and you have to be very careful. See, when I am lighting the fire I don't use too much kerosene oil. If you use too much, the fire will blaze up. So, you must never, never try to light the fire until I tell you. Do you hear me, Peter?'



Piita did laik fi wach im grani kech di faiya.
Wan die im se, "Mi kyan kech di faiya, Grani? Mek mi chrai no, pliiz."
"Nuo, Piita," shi se, "Wen yu ton, biga yu kyan du i fi mi. Faiya a gud sitn. If i neva de de, wi kudn kuk wi fuud. Bot i kyan bad tu."
"Wen mi a go ton big, Grani?" Piita aaks.
'Wan die," Grani se, "wan die. Den mi wi tiich yu bot u av fi main wa yu a du. Yu si, wen mi kech di faiya i no yuuz wol iip a korsiin ail. If yu yuuz wol iip, di ya a go bliez op. Yu fi neva eva chrai kech di faiya mi se so. Yu ier, Piita?"

6

Standard English and Jamaican Creole: kids succeed if they start from the consistent spelling system of the local dialect and transfer fluency to standard English (H. Devonish, University of the West Indies)