Improving the quality of education in low-income countries: Advice from cognitive psychology research

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Abstract

The international Education for All initiative to bring about universal primary education has resulted in large enrollment increases in lower-income countries, but learning outcomes are limited. The available resources and methods often fail to teach basic skills to all but the better off. To improve performance within the very limited capacities of low-income educational systems, it is useful to design instructional interventions according to the ways people are set up to retain and recall information. Without this research-based line of reasoning, donor and government staff may overestimate students’ ability to learn from complex methods and scant practice. Applicable concepts include the role of working memory, automaticity, and formation of cognitive networks in long-term memory. However, this domain of knowledge is little known among staff who make decisions about education policies. It is also rarely taught in faculties of education. The applicable concepts are somewhat complex, so training donor and government staff has been challenging. A systematic effort is needed to popularize cognitive psychology concepts pertinent to basic skills for staff working in the education sector of lower-income countries. A better understanding and application of learning research is urgently needed if universal primary education is to succeed.

The 1990 declaration of the Education for All (EFA) initiative has resulted in an explosion of activity that has continued unabated in the last two decades (UNESCO 2000). It has resulted in establishing a United Nations Millennium Development Goal of universal primary education. The “for all” expression means that countries ought to educate not just the best or even the average students, but practically everyone, aside perhaps from certain special cases. The emphasis to educate all children has challenged the educational systems of poorer countries to accommodate many additional students with severely limited budgets. In these new circumstances, dilemmas are encountered that pose decision challenges for government staff as well as for donor staff who often advise them. What choices should be made and why? Some examples are below:

- Countries with limited infrastructure and teacher availability, like Senegal, Niger, or Mozambique were advised to reduce class sizes by halving instructional time and instituting multiple shifts. Common sense would suggest that most students would not master the intended curricula, particularly given the need to learn French, English, or

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Portuguese first. Some educators and donor staff protested, but they could not offer convincing arguments or alternatives. Eventually the presumption was accepted that students would somehow “absorb” the curricular content (World Bank 1999 p. 29). Subsequently an article of a Nigérien newspaper stated that to succeed in school a student had to be either gifted or well off (Boubakar 2003).

-To prevent massive dropout and repetition resulting from limited instruction, policymakers in low-income countries were advised to institute automatic promotion, sometimes up to the end of primary school. Again, some educators sensed that children would not learn in higher grades what they did not learn in the lower ones. But without a clear line of reasoning on how people learn, social promotion has become a worldwide policy. It has resulted in widespread illiteracy among graduates of some countries, such as Togo and Niger (Mingat 2003).

-A Minister of Education in Central America decided to change reading textbooks from phonics to the whole language approach. The Minister thought that it was worth waiting for the new textbooks because students ought to learn reading through generative words and authentic texts. Similarly a donor agency advised an African country contemplating curricular changes to save money by not reprinting existing textbooks until new curricula and new textbooks were available. Without textbooks, much of classroom time is spent copying from the blackboard. Many students sketch letters, whose meaning they do not understand or may copy text too slowly to make sense of it.

How could solutions to the above problems have been optimized? How could classroom time be used so as to enable basic skills acquisition? Staff in government offices and donor agencies often have no clear answers. And staff working in the education departments of various donor agencies have varying academic backgrounds, from literature to economics. Often they only have their own schooling experience as a frame of reference. They may thus recommend general practices such as “redefining goals and targets, curricular design and content, educational methods and classrooms, partnerships to address equity and inclusion.” Further specificity is lacking.

Thus, international organizations have plentiful and valuable advice regarding financing and organizational matters, but they have been reticent with respect to instruction. The World Bank’s “Learning for All” (World Bank 2011) strategy promotes a model of autonomy, accountability, and assessment in expectations that school authorities will find means for teaching students efficiently if they are held accountable. In fact, the classroom is sometimes referred to as a “black box”. Instructional strategies are often viewed as details and are left up to the discretion of teachers and local authorities. It is they who ultimately determine the effectiveness of billions of dollars in aid.

However, many of the teachers are not suitably qualified. In the lowest-income countries they may have the equivalent of 4th grade education. Efforts to train them based on techniques imported from high-resource countries have given poor results (Craig et al. 1998). Due to a multiplicity of languages, instruction in many countries takes place in English, French, or Portuguese. These languages must be learned during class along with
their complex spelling systems. Teacher absenteeism is often around 20%; overall, less than half of the allocated instructional time may be used for instruction (e.g. Abadzí 2006, Shuh Moore et al. 2010). Parents are often illiterate and cannot help their children. Textbooks are usually imported, so they tend to be expensive and scarce. Thus, class time may be largely spent copying incomprehensible texts on the blackboard for students to reproduce. In addition students face a host of obstacles known to compromise skills acquisition, such as malnutrition and infectious diseases (Grantham-McGregor et al. 2007).

It is not surprising, therefore, that students who entered school at great expense often fail to attain even minimal competencies (UNESCO 2005, Filmer et al. 2006). Reading fluency tests in the primary grades show that in some countries 90% of the students cannot read even individual letters (RTI 2010a). Many drop out or even graduate illiterate.

One would expect important insights from government and donor staff with who have graduate education degrees. Those interested in international education often get masters degrees or doctorates in fields such as policy, educational sociology, finance, or comparative education. However these programs often focus on topics peripheral to learning; students may not be required to take courses in instructional methodology or obtain teaching experience. 2 Graduates may be hired for positions of “education specialists”, but they may have little specialized knowledge. Some are whole-language enthusiasts, intent on literacy through authentic texts and primitive writing. They may recommend a child-friendly classroom climate, innovative methods, constructivist classrooms where students do not memorize, individualized instruction despite class sizes. Citizens of low-income countries who receive advanced degrees from education faculties of Europe or the US similarly lack clear advice for their governments. They may espouse policies that are unrealistic for low-income students, such as whole-language grade 1 textbooks.

In some respects the difficulties in determining the effectiveness of teaching methods or activities are not surprising. In higher income countries, the educational services are usually of sufficient quantity and quality to help even lower-performing children acquire basic skills. In poorer countries, however children may start school without having seen a book or held a pencil, and they may have limited vocabulary even in their own languages (e.g. Hart and Riesley 1995; Paxson and Schady 2005). A line of reasoning and an evidence base are needed to explain how skills develop. This line of reasoning should predict likely outcomes for various classroom events and advise how to optimize instructional methods given the realistic limitations in capacity and instructional time.

2 For example, the masters degree in international and comparative education of Stanford University states: “Students in the program examine educational policy issues in an international context. Working closely with professors from a variety of disciplines, they study such problems as educational planning in comparative perspective, the dynamic relationship between school and community, equity and education, and the political economy of underdevelopment.”

http://ed.stanford.edu/academics/masters
The most viable framework for these tasks is provided by cognitive psychology research (or more broadly cognitive science and cognitive neuroscience). Memory evolved to help organisms survive over the millennia, so humans everywhere are genetically prepared to process and organize information through the same general processes (Huitt 2003). Teaching humans in the ways they were set up to learn may also efficiently deliver education to the poor.

There have been some exemplary efforts in applying the relevant knowledge to schools, (e.g. Mayer 2010, Rosenshine 2006), but these have focused on high-income countries and the relevant skills levels. Furthermore, this knowledge is largely the domain of psychology departments. Education faculties rarely teach it, and even many educational psychology textbooks teach little about memory (e.g. Davies 2007). To serve the poorest beneficiaries of the EFA initiative, there is a need to understand better the available research and adapt its implications to the poorer populations. This article discusses the main concepts, research needs, and potential opportunities for future research that may improve outcomes for low-income countries.

**Cognitive Science Research Applicable to Early-Grade Basic Skills**

The psychology concepts most useful for guiding low-income countries pertain to fairly basic functions: Working memory capacity, feedback, the chunking process that packages related concepts together, perceptual learning of script features. Students in higher-income countries often spend very little time on them before progressing to higher levels. But due to limited parental education, instructional time wastage, scarce feedback, and perennial lack of materials, students of poor countries need extra practice in those low-level skills. Without it, they may need years to attain skills that students in higher-income countries often attain in a few weeks (Abadzi 2006, 2008). Some examples are shown below.

The most important area where learning falters is reading. In many low-income countries, students lack textbooks and get reading practice only from the blackboard. But the blackboards are often small and scratched, and those sitting at some distance may not perceive letters as distinct entities or learn how to differentiate among them (Pelli and Farell 1999). Typically the teacher writes a few words or a sentence and calls upon individual students to read them. The rest of the class repeats. But after a few runs, children memorize the order of the words and may repeat without knowing any of the letters. A visitor who changes the order of the words finds out that only two or three students in the class can in fact decode them. Given that only the better off and brightest can learn in these conditions, teachers tend to focus on those few and may interact just with them. The rest of the class may get no teacher attention or feedback, and they may gradually drop out (Llambiri 2004).

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3 Cognitive psychology is the study of how people perceive, remember, think, speak, and solve problems. Cognitive neuroscience includes research on brain states which directly correlate with mental states. Interdisciplinary subject of cognitive science, which attempts to integrate a range of approaches in research on the mind and mental processes (Sun 2008).
Staff of various agencies who visit such classrooms may state that students should not memorize. However, programs would be more effective if organizers understood the roles of perceptual learning, working memory, chunking, and automaticity in bringing about comprehension. Students must first learn to detect and discriminate among multiple letter features (Pelli et al. 2006). Recognition is greatly facilitated when features are few and when the letters are well spaced. Practice results in rapid adaptation, but early on detection and discrimination are crucial tasks. This is one reason why synthetic phonics, which present individual letter forms linked to sounds, teach basic reading efficiently in English and in other languages. (See a review of various studies in Share 2008.)

To make sense of text, students must read it fast enough to fit it in their working memory. Practice helps chunk letters together and reduces reaction time (Miller 1956). Eventually, the visual word form is activated; this is a part in the brain which facilitates the recognition of entire words (Shaywitz 2003). Speed increases, and significant amounts of text can fit into working memory. The relationship between speed and comprehension has been documented repeatedly (Laberge and Samuels 1974, Breznitz 1997, Snow et al. 1998), but without an understanding of working memory functions, it makes no sense. As a result, some grade 1 reading programs in low-income countries aim to teach comprehension through text interpretation rather than practice for increased speed. The reading textbooks that are procured tend to have large colorful pictures and small amounts of text. So, even in well-resourced countries like Brazil, low-income children taught through the whole-word approach may remain functionally illiterate for years while surrounded by beautiful books (OED 2002). Those who manage to decode after years of schooling read slowly, often too slowly to make sense of sentences within the capacity of their working memory. They cannot answer many comprehension questions and cannot learn much information from texts (e.g. RTI 2010b).

Insights about working memory lead to a realization that basic skills must be executed rapidly (Cooper and Sweller 1987). The intertwined concepts of chunking and automaticity are crucial in understanding how to teach these students. Basic skills must be practiced to fluency, so that students can carry out the steps needed to process text, solve problems, or write ideas without thinking about them too much. Longer and complex chains of skills can only be developed after smaller chains have been formed through practice and use (Keele 1973; Schmidt and Lee 2005).

Some governments and donors expect students to acquire flexible, “21st century skills (World Bank 2010): to read and understand text quickly, calculate quickly, rapidly adapt at a job and learn the needed new content. However, years of learning and practice are needed to form and automatize the simpler components, and no easy shortcuts are known. Ignorance about the progressive size of information chunks leads to unrealistic expectations about students’ capacity to learn from complex methods and scant practice.

Since many students inevitably fail, governments must deal with extensive grade repetition. Automatic promotion is frequently recommended as a policy. But will students who get promoted to the next grade master the prerequisites just by being exposed to more advanced topics? To be remembered, items must be laid into a bed of closely
matching information (Katona 1940, p. 162). Also, the path followed when information is encoded must also be used when information must be retrieved (Reisberg 2009). Broadly, the research implies that kids promoted automatically to the next grade usually cannot learn what they missed without extra help. Remediation is needed, but tutoring is a private cost (Bray 2007). Unfortunately governments and donors rarely finance public remediation programs.

Many instructional issues could be ameliorated with teacher training. However, teachers in lower-income countries often fail to improve classroom practices despite massive investment in inservice training by donor agencies (Craig et al. 1998). Curricular and knowledge issues aside, memory research helps make some predictions. For example, cognitive research would predict that teacher practices may not improve after a dense three-day course at a teacher training center. Content is encoded partly through environmental cues, so when teachers return to their classrooms, it may become a vague memory (state-dependent learning research; Marian and Kaushanskaya 2007). Also, long-term retention is based on distributive learning and review over a considerable long period (spaced learning research, Pashler et al. 2006). Thus when teachers go home and stop reviewing new concepts, the memory of the needed classroom improvements may fade as work urgencies take over. By contrast, observational learning research would predict that behavioral sequences would be more likely to be executed if shown explicitly, particularly if visualized as being done inside the teacher’s classroom (Dowrick 2011, Liu and Park 2004). Thus, videoclips of the desired behaviors may prove a potent tool for the training of teachers with limited education. Preliminary tryouts have started in countries such as Liberia, and a methodology is under development.

One obstacle to improvement is a difficulty in discussing the formation of learning. The concept is often viewed as abstract and amorphous, without clear principles for its formation (e.g. Pigozzi 2010). Therefore the research which shows the network-based structure of memory has considerable explanatory power. The semantic and propositional networks illustrate how pieces of information are linked (e.g. Collins and Quillian 1969). They can give staff a sense of how knowledge is constructed and how it can be modified. Important factors that determine whether information will be retained and retrieved on various occasions include elaboration activities (a concept that partly overlaps with “active learning”) and the transformation of knowledge from superficial encoding to the “deep” structures that may lead to critical thinking (See Reisberg 2009 for a review). Thus, knowledge can be shown to consist of relatively concrete (albeit very complex) nodes of information tied by links on the basis of some “rules”. Classroom activities can create, strengthen, modify, or erase the links.

The network-based nature of memory also helps define quality of education. This quintessential concept has been hard to define. For example, a 2009 working paper defined quality as something that "... unleashes the natural capacities of living beings to learn" while further stating that "good learning contexts enable quality learning, and bad learning contexts do not". However, cognitive network concepts help specify its

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4 Connectionist networks could be used to simulate instructional conditions in low-income classrooms and estimate educational outcomes, but this topic is beyond the scope of this paper.
characteristics. Often "low quality" schools teach a small amount of information, mainly memorized in series that have limited connections to other knowledge; thus the students may retrieve the items only through direct questions about them. By contrast, "high quality" schools teach more items, help attach them to multiple parts of the network, and give reasoning activities that result in new conclusions. The result is students with dense and connected knowledge networks, whose knowledge pops up fast through multiple paths. These students tend to score well in achievement tests, and can perform in the labor market. The activities that produce such organized knowledge can be monitored through observation instruments. With additional research, quality can be operationally defined and measured as a composite variable.

The information processing line of reasoning therefore has policy implications for governments and donor agencies. Some recommendations seem commonsense, but others are counterintuitive. Examples are:

- **Speed and automaticity for basic skills**; thus students can devote their working memory to more complex cognitive tasks; therefore investment is needed in teaching the early grades, which are often neglected;

- **Reading instruction through synthetic phonics** and use of transparent orthographies if possible; in multilingual societies this implies use of local languages, that usually have consistent spelling;

- **Need for prior knowledge in order to encode subsequent information**; therefore publicly funded and effective remediation strategies are needed for those who fall behind aside from private tutoring;

- **Provision of textbooks or a structured set of materials per student to practice at home** (rather than merely a few copies in the class); therefore a priority on ensuring sustainable, affordable, and regularly replaced textbooks;

- **Use of allotted class time for instruction, practice, elaboration**; a policy focus on maximizing time on these activities and reducing teacher absenteeism and school closures;

- Effective training of teachers so that they can carry out the above activities; greater **reliance on observational learning methods**, particularly for teachers of limited education;

- **Supervision of the relevant teaching activities**; therefore frequent feedback and reinforcement from supervisions, partly trained also through observational learning methods.

To improve outcomes, policies must support the required actions. Low-income governments have limited implementation capacity, but many receive strong donor support and are undertaking multiple initiatives. The challenge is to convince education
staff to promote policies consistent with the information processing chain of causality rather than policies promoted with little evidence by various philosophical schools of thought.

**Challenges in Using Cognitive Science for Education Policy Guidance**

Most of the concepts used to clarify the problems of lower-income classrooms are old. They were developed in the 1940s-1980s and are found in undergraduate cognitive psychology textbooks. However, they do not stand out among the topics covered in those treatises. For example chunking often just gets a passing mention. (More is available from procedural learning studies, Schmidt and Lee 2005). To some extent this is not surprising; textbook contents ought to be relevant to the realities of high-income countries and emphasize more complex cognition. But as a consequence, there is little organized content to teach university students about the cognitive concepts pertinent to millions of low-income students. Even graduates of psychology programs may have a limited understanding of these.

A related problem about some of these building-block variables (such as chunking or state-dependent learning) is limited research that uses educational paradigms. Some concepts are better known as insights from popular authors, such as Pinker (1997). For example, it is clear from research (e.g. Katona 1940) that to retain information, there should be pre-existing closely matching items that would serve as “hooks”. A partially fitting term seems to be Vygotsky’s “zones of proximal development”, which could be adapted as “nodes of proximal encoding”. Also research on some concepts seems insufficient for instructional advice. For example, reading automaticity has been researched in conjunction with the visual word form activation (Shaywitz 2003; McCandliss et al. 2003), but there is little research to specify how and when automaticity is attained for various skills. Given students’ risk for low performance, governments need benchmarks to monitor national progress. Approximate benchmarks in reading speed have been computed using working memory capacity (Abadzi 2008), but there seem to be no clear means of developing benchmarks for evaluating progress of fluency in writing or basic math calculations.

Another obstacle in the use of cognitive research concerns the vocabulary available to express various concepts. The terminology has evolved over time without clear conventions, and some concepts seem minimally different from others. For example there is short-term memory and working memory; generative learning (Soraci et al. 2003) and Paulo Freire’s generative words (Freire 1973); there is also cognitive psychology vs. cognitive science and cognitive neuroscience; there are neural networks, associative networks, connectionist networks, memory nets, cognitive networks. The overlapping terms confuse staff who have no knowledge of the discipline and reduce the chances that they will devote time to learn the material.

**The Challenges of Knowledge Transfer to the Education Sector**
The limited learning outcomes raise pressures for accountability. For example, an audit of the effectiveness of the British bilateral aid (DFID 2010) showed a limited impact of donor financing and recommended aid reductions. Some organizations like the Center for Global Development, urge donors to stop financing mere inputs and expect results first.

Departments which prepare students for international education work should respond to this crisis, but thus far changes have been limited. The knowledge discussed in this article could be discussed more broadly, but education professors and experimental psychologists rather rarely collaborate (Dempster 1988, Metcalfe 2006, Ansari and Coch 2006, Ronstadt and Yellin 2010). Some education professors may espouse beliefs which run counter to cognitive research findings. When discussing learning topics, they often use the term “theories of learning”, which implies that the concepts are merely beliefs. The term harks back to the times when great educators conceived brilliant ideas about learning. This tendency may lead to the oft-heard opinion that there are many models of learning and that universal guidelines simply do not exist.

Furthermore, modern education has taken the position that everyone is different, and the neuropsychological school of thought may be viewed as too behaviorist or deterministic. Some philosophical questions are raised regarding cultural diversity and uniqueness. This is unfortunate because the information processing rules work with all cultures. Memory is an amalgam of actual events and specific experiences which constitute people’s cultural heritage, and studying one does not invalidate the other.

Lack of updated knowledge pushes faculty members into a time warp. They seem interested in memory only from the viewpoint of thinkers from bygone centuries. And they nurture their students in this cocoon of ancient knowledge. Graduate students spend years studying and passing tests on such these issues, so their line of reasoning becomes automatized and resistant to modifications. Thus the next generation graduates with outdated knowledge, and the vicious circle goes on.

One reason for the limited dissemination of relevant learning research may be the information-processing problems of faculty. Some of them lack the necessary background to follow cognitive research and interpret it for students. Just like the cognitive networks of students who are missing basic skills, some educators’ cognitive networks lack the necessary prior knowledge to retain the needed information and use it in decisions. The author has conducted many training events for donor and government staff and has seen the difficulties inherent to this body of knowledge. The concepts seem complex and confusing. Staff seem particularly baffled by working memory and automaticity implications; they tend to fall back on generic explanations from their experience and to smooth over inconsistencies. They may entertain the new concepts for a brief period and quickly return to their usual decision algorithms. Formulating training to change the decision algorithms of adults who have used different concepts for a long time is in itself a significant problem that requires research.

A more intensive effort could be made to train staff who work in the education sector. Attractive publications and e-courses could be aimed at international audiences and at teacher trainers with modest levels of education. These could include animated graphics and videoclips from relevant classrooms. Some concepts could be “popularized”. For example, memory functions can be depicted as a large bottle with a narrow neck in lieu
of complex diagrams; chunking processes could be presented as railcars being connected into long chains, and cognitive networks could be depicted as Lego blocks that can be manipulated. There may be tradeoffs between precision and popularization, but the advantages could be considerable.

There is also a need for extensive research. The studies cited to elucidate the education of the poor are used translationally, and various parameters must be verified. Other topics require study, such as the minimum number of instructional hours that governments must ensure for the acquisition of reading automaticity in various languages and scripts. In principle funding can be available from bilateral agencies and foundations that specialize in the education of the poor.

In conclusion, an information processing framework may be a valuable tool for explain students’ performance in basic skills. It may also help determine which policies are likely to promote basic skills acquisition. But its concepts are relatively unknown and difficult to communicate to the public. Adapting the terminology presents challenges, but these are worth taking up.

Insights from educational theory and practice have reached their limits in low-resource environments. Inspiration from common sense also seems to be running out. Surely Lev Vygotsky, John Dewey, Jean Piaget, and even Paulo Freire would not want the education of the poor to remain in a time warp. They would bless the adoption of cognitive research findings if they could communicate with us. Quality of education and rights to education are really based on dense and well-connected networks of knowledge, with automatized basic skills.

References


Miller, G. 1956. The magical number seven, plus or minus two: Some limits on our capacity for processing information. The Psychological Review, 63, 81-9.


Pigozzi, Mary Jo. 2010. What is the ‘quality of education’? In Kenneth Ross and Ilona Jurgens Genevois (eds). Cross-National Studies on the Quality of Education. IIEP.


