Thematic study

Education change, leadership and the knowledge society

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Overview

This short paper builds on the premise that the emergence of knowledge societies—accelerated by information and communications technologies (ICT)—pressures education systems to help students develop 21st-century skills for life and learning. These challenges are especially daunting for schools in Sub-Saharan Africa.

However, elements of any comprehensive program of school improvement are consistent: learning resources and curriculum; teacher education and development; assessment; management and information management; and policy and planning. First-step improvements in these components can be channeled to support eventual participation in knowledge societies.

Schools—and education systems—in almost all instances are structured in ways that are antithetical to knowledge societies. Information moves generally from the top down (teacher to student) or from the center to the field (the ministry to schools), while information in knowledge societies is shared freely among groups and individuals and across national boundaries.

Education systems must address all five of these components in a coordinated fashion to achieve meaningful improvements in traditional schooling, or to achieve change that supports knowledge-society participation. To enable students to participate in knowledge societies, however, education change must transform school systems into learning organizations. The key point of distinction is that transforming education systems into learning organizations—organizations that reflect the dynamic flow of information in knowledge societies—requires support for bottom-up and multi-leveled communication, as well as leadership that responds effectively to new information. To achieve "system-wide/system-deep" change, then, is time-consuming and difficult, disrupting the status quo and provoking resistance among stakeholders at all levels.

This thematic study includes brief profiles of two national education-change programs. The first of these programs is comprehensive and well-founded, but has been started too recently to bear system-wide results; the second program was launched over 50 years ago and has achieved international success:

Rwanda

The Government of Rwanda has over the past decade launched a coordinated array of initiatives to realize the goals of its *Vision 2020* plan. In education and in other sectors, these initiatives

have relied heavily on technology, increasing both challenges and opportunities at the central and the school levels.

Singapore

The approach to education change in Singapore—which has one of the world's leading education systems—is in many ways similar to Rwanda's. Emerging from colonialism in the 1960s, the government prioritized providing high-quality education to all students, then integrated education change into a broader deployment of technology under the framework of *IT2000: The Intelligent Island.* Responsive leadership throughout this period ensured that learning was incorporated into all levels of the education system, and that processes of ongoing development and innovation were mainstreamed.

Key practices that evolved in Singapore can be adopted by African and other education systems, regardless of whether they have built the capacity to immediately open themselves to participation in knowledge societies. These key practices include:

- Commit to inclusivity
- Integrate teaching practices, learning objectives and content
- Link the outcomes of change to policy goals
- Focus on changing practice, not on technology

Leadership in systems engaged in change must be prepared to tackle problems that have unknown solutions and unpredictable outcomes. Key characteristics of change-focused leaders include moral purpose, understanding of the change process, and the abilities to build relationships, to create and share knowledge and to make the change process coherent to others in the organization.

Education Systems and the Knowledge Society

As knowledge societies become more important, schools are challenged to prepare their students to take part. In many schools—in African and in developing countries around the world—barriers such as lack of books, lack of skilled teachers and lack of school leadership make building students' 21st-century

skills seem like pipe dreams. However the key steps needed to improve lagging schools and school systems also form the building blocks for more far-reaching changes.[1]

The connection of knowledge societies to the global economy adds to the pressures on schools to help students develop the skills that are most elusive. For graduates of Sub-Saharan African schools, competency in English and other foreign languages will become increasingly important; technology skills will also gain value. And some students in some schools will meet the challenge of building abilities in these areas. But even many privileged students won't build the capacities—problem-solving, creativity, empathy—that will be most valued as the connection of the global economy to African development deepens. Without significant transformation of national education systems, even our most talented students in elite schools will find themselves lagging graduates of more equitable and more advanced school systems.

Changing the educational system to enable all schools to build new workplace, social and technical skills is necessary both to increase economic competitiveness and to spur innovation at all levels.

> There's lots of exciting potential for African countries in terms of the knowledge society as a result of their youth demographic, the natural diversity of the continent, and the fact that Africa is the only untapped market left.
>
> -- Robert Hawkins
> Senior Education Specialist
> The World Bank[2]

Why "knowledge societies"?

To serve as an effective guidepost for education change benefitting social and economic development, the Knowledge Society is best viewed as inclusive of multiple, dynamic "knowledge societies."

The idea of the Knowledge Society first appeared in the 1960s, but gained importance in the mid-1990s as the potential power of the Internet and digital information began to be widely realized. Since then, many thinkers and several key organizations, such as UNESCO, have extended and expanded the

[1] For an accessible but comprehensive framework describing 21st-century workplace and life skills, and providing a good selection of background articles on each skill, refer to the Partnership for 21st Century Skills (www.p21.org).

[2] Many thought leaders in the fields of ICT for education (ICT4E) and ICT for development (ICT4D) have shared their insights in interviews. Information that these leaders have provided has shaped this paper; direct quotations generally appear in boxes. A complete list of interviewees appears in *Annex A.*

implications of the Knowledge Society beyond the framework of a single, enveloping phenomenon with primarily economic impacts. [3]

Three key factors underpin the use of the term, "knowledge societies," in this paper:

- Knowledge societies involve profound and varied relationships to data, facts and figures—they're not only about information, and they don't result automatically from the introduction of technology.
- Knowledge societies encompass a broad set of networked relations and interactions, including social and cultural, political and personal interactions; these relations and interactions extend beyond the boundaries of a "Knowledge Economy."
- There are many knowledge societies, not one Knowledge Society, and individuals will participate in different groups, in different ways, and at different times depending on their needs, interests and access.

These knowledge societies emerge in response to demand among social networks, and cross national and cultural boundaries in response to such demand with the aid of a wide range of technologies. The goal for any country in Africa then—at least from the perspective of this paper—is not to transform itself *into* a Knowledge Society, but to open itself to knowledge societies of all kinds.

Education Change and Knowledge Societies

For such an opening to happen, and for the entry of knowledge societies to lead to social and economic development, students and eventually all citizens must have the skills, opportunities and imagination required for a lifelong engagement with self-directed learning.

Schools and school systems, however, aren't organized like knowledge societies. In the traditional classroom model, knowledge (the right answer) travels from the teacher to the student. Teachers work independently, without connections to their peers, especially to their peers in other schools (or other countries). Information that's collected by the school and sent to the district or ministry—attendance

[3] The term "Knowledge Economy" was coined by the business thinker, Peter Drucker, and emerged into prominence the 1980s—along with other characterizations of a post-industrial global economy reliant on information and on technology. Related terms include "information economy" and the "information society," as well as the "informational society," the coinage of the noted social thinker Manuel Castells. The term "Knowledge Society" was explored in depth by the social thinker, Nico Stehr, in his 1994 book of that title. As the term was brought into dialogs surrounding economic development and developing countries, UNESCO, the World Bank and other organizations began to discuss "knowledge societies," in part to ensure that the potential emergence of diverse and heterogeneous networks was recognized.

records, grades, exam results, audits of school finances and school facilities—isn't analyzed and shared, so school heads and parents committees often don't know how their schools stack up against neighboring schools or schools elsewhere in the country. And at the central level, decision-makers, implementers and policymakers attempt to manage schools by launching single-issue programs, by reforming curricula (while teachers lack knowledge of their subjects or of teaching methods), or by issuing policies and directives without providing adequate resources to fulfill them. Whereas in knowledge societies information is shared freely and collaboratively, in many school systems information does not move effectively either from the bottom up or from the top down.

How can schools, with their traditional hierarchies and processes, transform themselves into breeding grounds for skilled and engaged participants in the exchange of knowledge and the development of information-rich relations?

Implementation slumps and the slow pace of change

The accelerating rate of change in the global economy and the emergence of knowledge societies highlights the widespread resistance to change in education systems.

> We need radical and disruptive innovation. The school system is like an oil tanker, it takes a long time to change. But the world outside of the classroom walls is changing at a much faster pace.
>
> --Steve Vosloo
> Fellow, 21st-century Learning
> The Shuttleworth Foundation

Although disruptive change is critical (and fashionable), even change initiatives that are successful in the long run incur short-term failures. As Michael Fullan, the noted researcher of education change, states:

> …*All* successful schools experience 'implementation dips' as they move forward. The implementation dip is literally a dip in performance and confidence as one encounters an innovation that requires new skills and new understanding…. People feel anxious, fearful, confused, overwhelmed, deskilled, cautious, and—if they have moral purpose—deeply disturbed."[4]

[4] *Leading in a culture of change,* San Francisco: Jossey-Bass; 2001, p. 40.

On a system-wide level, implementation dips in combination with electoral cycles and impatient leadership can doom reform. At the school level—and remember, communication with leadership is not friction-free—implementation dips and accompanying resistance can shove efforts to change teaching and learning to the bottom of the list of priorities.

These and other factors make education systems extremely resistant to change. These factors have led to a decade of:

> …[P]romising innovations that existed only as outliers and failed to spread, of watching pilot projects be replicated only poorly when their designs were then mandated across a system, and of seeing that early implementation of changes rarely turned into full-blown, widespread and effortless institutionalization…[5]

In many instances, and for many reasons, change-initiatives are ill-conceived in relation to pressing needs and current capacities; in other instances they are abandoned before they can bear fruit.[6] As discussed in the profile, *"Education change in Singapore,"* the transformation of a low-performing education system to one that is world class demands years of clear-sighted, focused effort.

System-wide and System-deep change

The history of education change over the past 50 years suggests that success can be achieved, and that successful transformation share several characteristics that can be replicated.

David Hopkins, one of the leading researchers of education change in the United Kingdom, states that:

> There is now an increasingly strong research base to suggest any strategy to promote student learning needs to give attention to engaging students and parents as active participants, and expanding the teaching and learning repertoires of teachers and students respectively.[7]

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[5] *Second international handbook of educational change,* London: Springer Dordrecht; 2010. Editors of this two-volume landmark compendium on education change include Michael Fullan and David Hopkins, both of whom are quoted in this study. Other editors are Andy Hargreaves and Ann Lieberman.

[6] The editors of the *Second international handbook of educational change* cite efforts by England, Australia and New Zealand in the early 1990s to return to "traditional models" of "closely prescribed curriculum," high-stakes testing and accountability; these same elements were later adopted in the United States-based program, No Child Left Behind. In the United Kingdom and the United States, outcomes include being ranked 21 and 20, respectively, on the UNICEF 21-country list of child well-being. In the U.K., at least, the "back to basics" movement has been scrapped.

[7] "A short primer on system leadership," by David Hopkins (presentation to the Building Leadership Capacity conference at the Regional Training Unit for Northern Ireland, 2007 – http://www.rtuni.com/blc/page.php?page_id=26, accessed October 21, 2010).

Hopkins maintains that change must be both "system wide," affecting all aspects of the education system consistently and coherently, and "system deep," with coordinated efforts that extend from education policies through central and district administrations all the way to schools and classrooms.

What are the elements of system-wide/system-deep change?

As Hopkins suggests, comprehensive approaches are more likely to achieve meaningful change to the extent that they introduce a coherent array of initiatives that reach into all appropriate areas of the education system. Counterbalancing influences, which might build resistance in the system, can be incorporated into change initiatives so that they support—rather than impede—the system's transformation.

Key elements in comprehensive change will vary according to program goals and system capacities. The education reforms made by England in the 1990s and later incorporated into No Child Left Behind in the United States emphasized high-stakes testing, with changes to other elements such as curricula and learning resources contoured by the over-arching goal of increasing students' scores on newly important national tests. Because competition among schools was a main principle of these reforms, changes were also required in school admissions and catchment protocols—to provide families and students themselves with a greater degree of choice among the competing schools.

But *any* effective change in education requires a comprehensive approach, an approach that starts with effective planning, that links policy to classroom practice (and to everything in between) and that directly involves teachers, parents and students. Change leading to broad performance improvements—and eventually to the building of 21st-century skills—should address five key elements that influence and are influenced by school-level management, teaching and learning:

- Learning resources and curriculum
- Teacher education and development
- Assessment
- Management and information management
- Policy and planning

These elements are the parts of education systems that focus most directly on teaching and learning.

> The key is to educate around the full range of digital literacies, including 21st-century skills. There isn't an agreed-upon set of what that is, but it's things like online communication with different audiences, networking, the ability to credibly problem-solve, being creative in this digital space.
>
> --Steve Vosloo
> Fellow, 21st-century Learning
> The Shuttleworth Foundation

Addressing these components via a single, integrated plan can help achieve a system-wide/system-deep approach.[8] Other elements of national public school systems, such as finance, school facilities, transportation, meals and so on, affect student learning, but their primary intent is elsewhere. And outside of these key and secondary elements, any change-focused program should be supported by impact evaluation appropriate to the program design.

The role of new technologies

In relation to these five components, technology can be considered a cross-cutting input, spanning all key areas of educational operations and forming part of a school system's "education infrastructure." However the full consideration of technology in relation to education change and knowledge societies must also account for inherent challenges, costs and risks.

> When implemented well, ICT can be disruptive, it can open up schools and teachers to new approaches and new perspectives.
>
> --Robert Hawkins
> Senior Education Specialist
> The World Bank

Considered as part of the infrastructure of education—not just as a set of skills or tools for students to master—technology has the potential to support system-wide change. When schools have computers and Internet connections, teachers can access subject-focused information and higher-quality learning resources to support classroom activities, and they can participate cost-effectively in professional development. Students can of course also find a nearly limitless reservoir of knowledge, via the World

[8] The components discussed here were developed in collaboration with Professor Lim Cher Ping, currently of the Hong Kong Institute of Education, among others (c.f., *Strategic Plan for ICT in Education in Papua).*

Wide Web, they can engage in tele-collaborative learning, and they can use computers (as adults do) to create reports, presentations, web sites, blogs and animations.

> One key measure is to use ICT to help education systems make data-driven decisions, …decisions based on what works and what doesn't.
>
> --Michael Trucano
> Sr. Specialist in ICT in Education
> The World Bank

In addition to supporting teaching and learning, however, technology can also support system-deep change extending "vertically" from the level of the individual school to the district, provincial and central levels. With networked communications and simple data-management tools, principals and head teachers can "upstream" school management information more efficiently, increasing the information available to system managers and to decision-makers, and enabling policy to reflect real conditions and its own real (and revealed) impacts. Further extending the reach of education change, school heads can access a broad base of information to compare their schools with others, and use graphing and presentational tools to share those comparisons with parents associations and their communities.

The framework that follows indicates the deployment of information tools and Internet connectivity in a comprehensive system that targets improved teaching practices and enhanced learning outcomes.

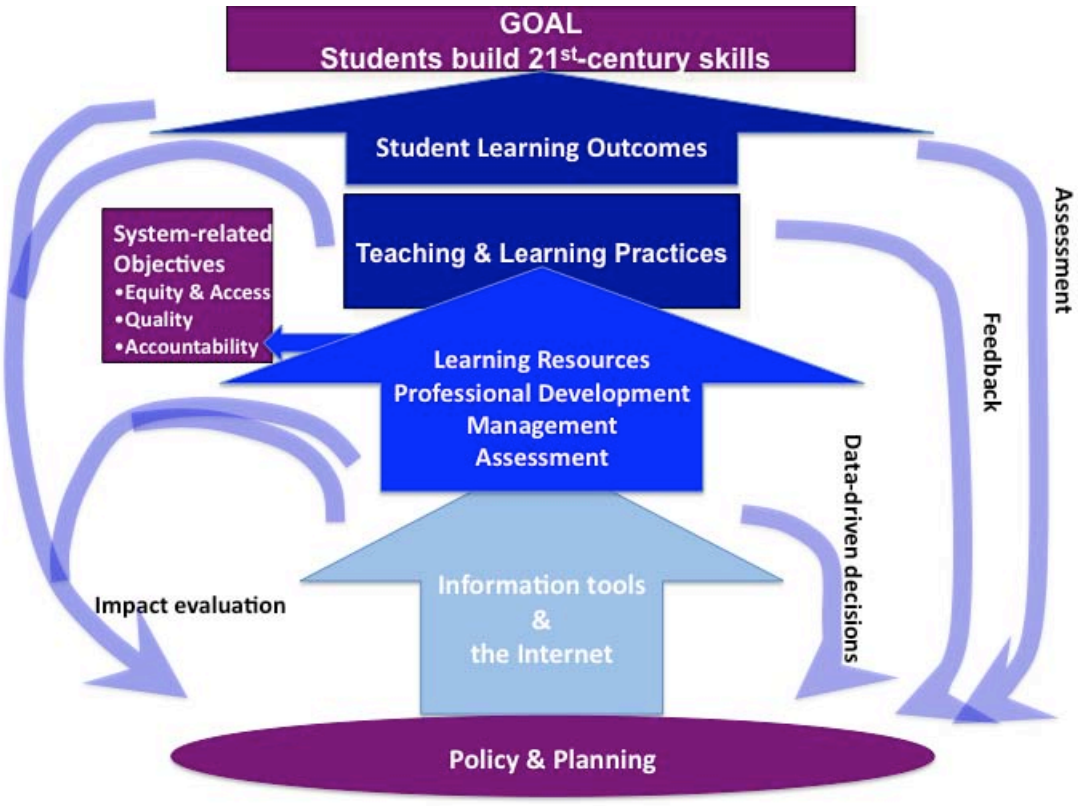

Figure 1: Framework for outcomes-based educational improvement[9]

The key components in this framework are the "education inputs" that drive change in classrooms and throughout the system: These include improvements in learning resources, teacher development, management at all levels and assessment. The technology resources serve as infrastructure that extend the reach of those inputs to all schools, teachers and students. This use of technology—to extend education-related inputs—also has the potential to support critical objectives surrounding inclusivity, such as educational equity, system-wide improvements in quality, and increased accountability.

However when these inputs and related information all flow in one direction, from policy and the central administration to schools, the education system replicates and reinforces its antiquated traditional structure. To support education change that transcends school improvement, and that increases the system's openness to knowledge societies, information must also from the bottom up and be used by all.

[9] Earlier versions of this framework were developed in collaboration with other members of the World Bank's team on ICT in education in Indonesia: Natasha Beschorner, Tak-Wai Chan, Wen Chuan Hung, Lim Cher Ping, Mohamed Ragheb and Jan Van Rees.

It is in this arena, the arena of ongoing improvement cycles—of feedback, school-based management and impact evaluation—that technology exhibits the greatest potential to help schools and school systems transform themselves to mirror the characteristics of knowledge societies.

ICT and change in education in Rwanda

The Government of Rwanda and MINEDUC, the ministry of education, demonstrate the potential and the challenges arising from the use of technology to support change in schools. MINEDUC has launched an array of initiatives leveraging ICT to transform teaching and learning. However limited funding, poor grid-based electricity, slow-to-emerge telecommunications networks and lack of capacity in schools pose major obstacles.

Over the last ten years, MINEDUC has launched efforts to reform curricula and localize learning resources, improve teacher development, coordinate planning and policy, and extend information management—four of the five components that are critical to comprehensive approaches. (The framework component that is not addressed, at least insofar as information is available, is assessment.) All of these initiatives are coordinated with the national *Vision 2020* plan.

Challenges

Several factors, however, impede implementation and limit impact on school improvement.

School-level challenges. The use of ICT as an "engine" of change requires high levels of student access and teacher capacity. Such levels are difficult to achieve in one rural school, let alone an entire system. Recent research[10] suggests that given limited computers in schools, only 50 percent of students use computers one hour or more per week, and that computer resources are largely used to learn basic ICT skills. They have limited impact on teaching or learning in other subjects.

Government-level challenges. Efforts to address the hardware gap via partnership with the One Laptop Per Child organization have stalled, in part due to the estimated expense of procuring, delivering and maintaining the organization's low-cost Children's XO laptops. Initial plans to purchase 120,000 laptops have been scaled back and delayed.

Infrastructural challenges. Broad economic and social factors, such as Rwanda's low level of ICT penetration and chronically inadequate infrastructure, also limit impact on schools and the school system. As of 2006-2007, only 7 percent of the population had used the Internet, and 71 percent had never heard of it; there were four personal

[10] "Bridging the digital divide?: Educational challenges and opportunities in Rwanda," by Were, E., Rubgiza, J., and Sutherland, R. (EdQual working paper, presented to the 10th UKFIET International Conference, University of Oxford,15-17 September 2009). See page 12 for a description of the group's findings.

computers for every thousand people.[11] Lack of experience of computers and the Internet increases the burden on in-service professional development and learning-resource development. These challenges are intensified by chronically inadequate grid-based electricity.

Education change, in every case, is slow, and is only one part of the process of economic development; it is too soon to guess how Rwanda's comprehensive effort will turn out.

Bottom-up communication and education change

The first steps toward preparing students to participate in knowledge societies are the same as the first steps required to improve schools' traditional instruction.

The array of ICT-based education-reform initiatives in Rwanda is expressly focused on laying the foundation for participation in knowledge societies. However these efforts—encompassing four of our five components for comprehensive reform *and* deploying technology to extend the reach of these interventions—have equal, or greater, potential to improve traditional teaching and learning.

In most school systems, the "education infrastructure" needs to be substantially improved in general terms at the outset of any realistic effort to build capacity to develop students' 21st-century skills. This infrastructure includes, among other components:

- Active school leadership
- A professionalized cadre of teachers
- A well-designed curriculum
- Adequate learning resources
- Formative and normative assessment
- Community involvement
- Effective information management

These elements are essential whether the goal of education—as reflected in policy—is to use a "back-to-basics" approach to improve students' performance or to transform learning into a student-centered

11 Sources include: The CIA World Factbook; the World Bank (devdata.worldbank.org) and Rwanda Development Gateway, all cited in "ICT in education in Rwanda," by Glen Farrell (Washington, DC; The World Bank, Survey of ICT and education in Africa; 2006).

process developing creativity, collaboration skills, and emotional understanding. Short-term initiatives that develop these components and processes should in all cases be designed and supported in ways that build toward long-term goals.

> The countries [attending the conference] that went beyond the others in those discussions were the ones with strong leadership, there was strength coming from the top in Rwanda and a few other countries. These leaders really see their roles as pushing new ideas and empowering people... Empowering other people to lead.
>
> --Robert Hawkins
> Sr. Education Specialist, The World Bank

What factors distinguish change that builds toward participation in knowledge societies from basic improvement of the education system?

Listening. Feedback. And responding to that feedback.

Inasmuch as the flow of information in traditional models is from the top down, or from the center outward, the refocusing of education systems on participation in knowledge societies requires *reversing* information flows so that they run from the bottom up or from the field to planning and policy. Profound education change requires *ongoing* analysis of results and outcomes and the revision of plans and programs on the basis of that analysis.

> I think the heart of politics is with local government, because you are there with the people, you can't avoid seeing what is happening, you as a resident have to go pay your municipal bill, you stand in a queue, people meet you and people talk to you. You see how people feel, because you don't sit in your office, so that is why they (government leaders) must come out of their circle of advisors.
>
> --Frances Ferreira
> Specialist in Open Schooling
> The Commonwealth of Learning

Figure 1: Framework for outcomes-based educational improvement includes four key avenues for bottom-up information flow:

- Assessment or examinations, the results of formative and normative testing
- Direct communication with teachers, students, families and other local stakeholders

- Education data, such as completion and grade-retention rates, that support data-driven decision-making
- Impact evaluation, analyzing the outcomes of specific programs

All four of these channels of information and communication should be mainstreamed into education operations. To start to channel education change toward preparing students (and teachers) to participate in knowledge societies, the capacity to respond with agility to these bottom-up inputs should be developed over time, and should be considered a core capacity of the education system.[12]

Education change in Singapore

The recent history of Singaporean education shows that a comprehensive approach to change can lead to world-class results even when the starting point is chaos.

Singapore's results are impressive: Singaporean students ranked first in each of the three Trends in International Math and Science Skills (TIMSS 1995, 2003 and 2007).[13] As recently as the 1950s, however, the country's school system was in a post-war and post-colonial shambles.[14]

Japanese occupiers during World War II, however, introduced the idea of inclusivity and the importance of an educated workforce. These concepts launched an education-change program that continues today.

Establishing learning organizations

In the 1960s, Singapore's massive curriculum-reform initiative became the starting point for ongoing change. Dr. Ruth Wong, founding director of the National Institute of Education, recognized that new approaches were always needed, and that these approaches should be based on understanding of the challenges at the grassroots level: she spent three months visiting schools and talking to teachers and principals.[15]

Wong was a middle-level administrator, not a member of the political leadership in the Ministry. However she determined "that curriculum development should commence from the first level of education upwards and that it

[12] For additional information about the study of bottom-up communication and systems engineering, refer to *Annex C: Engelbart's augmentation cycle.*

[13] In the 2007 science test, Singaporean eighth-grade students, averaging 593, ranked third, behind Taiwanese (598) and South Korean students (597).

[14] During the 1950s, there were four languages of instruction in Singaporean schools: English, Malay, (Mandarin) Chinese and Tamil. These were eventually consolidated, with English as the language of instruction (except in mother-tongue lessons) in all schools today.

[15] Ibid. The Government of Singapore now issues an annual Dr. Ruth Wong Gold Medal for the Diploma in Education.

would be a continuous series of specify-implement-evaluate-improve cycles."[16] She then launched the process of continuous curriculum reform, developing the techniques that would effectively yoke learning objectives, course content and pedagogy in a process of co-evolution.[17]

Singapore's educational transformation, as exemplified by Wong's activist leadership, has been distinguished first and foremost by actions intended to remake the educational system top-to-bottom into a *learning system*—a system that employs research, that rewards innovative leadership, that

promotes teachers' development, and that focuses all of these learning activities on improving student outcomes.[18]

Educational uses of ICT in a knowledge-society context

Starting in the 1980s, the government has engaged in increasingly vigorous, multiphase efforts to infuse technology into all aspects of Singaporean life. Keys to this effort were the ten-year *IT2000: Intelligent Island* program and Singapore ONE, an island-wide fiber-optic network. These two initiatives were intended to position Singapore as a global hub, improve the overall quality of life, improve the economy, link local and global communities, and enhance the creative potentials of citizens.

Singapore's ICT-in-education initiatives linked directly to *IT2000* and Singapore One. The *Masterplan for ICT in Education* mandated student-computer ratios; the 2002 update outline the use of ICT for personalized learning by students and teachers. And education-technology has been integrated into all aspects of school culture.[19] Singapore has deployed technology to support the education system's ongoing process of "system-wide/system-deep" change.

Making progress in African countries

What steps should African governments undertake if they plan to open their countries to participation in knowledge societies?

[16] Ibid, p. 46.

[17] Wong used expert volunteers, as the Ministry of Finance would not approve her yearly requests for budget for staff.

[18] Much of Wong's leadership would not bear fruit—in the establishment of an adaptive, change-oriented education system—until long after her retirement and her death in 1982.

[19] The SITESm2 study (or Second Information Technology in Education Study: Module 2) was a landmark study that profiled the use of technology in 174 innovative classrooms in 28 countries around the world (International Association for the Evaluation of Education, 2003).

It takes capacity to build capacity.

--Thomas Hatch

"What's happening when multiple improvement innovations collide"

The efforts made by Rwanda have yet to show system-wide results, but some of them, at least, have the potential to drive change in education and to link up with the government's efforts to transform Rwandese society across the next several decades. The *Vision 2020* plan links policy and public awareness and—to the extent that citizens are aware of it—creates a context for school change. The development of a national fiber-optic network promises to provide students and all citizens with access to telecommunications. The establishment of institutions to lead change, such as the Kigali Institute of Education, the Kigali Institute of Science and Technology, and the Rwanda Development Gateway can help build capacity in research, technology and education. The value returned by these measures might thus far be limited, but the potential is high.

But even the experience of MINEDUC in Rwanda might not be applicable to ministries of education in other African countries. Much as Singapore did in building capacity for system-wide change, the Government of Rwanda has launched an array of initiatives focused on increasing capacity in telecommunications, in higher education, and other areas that bracket efforts to lift school performance. In countries where education change is unsupported by such bracketing initiatives, what critical practices can be adopted from the Singaporean experience to accelerate system-wide/system-deep change?

Our education system hasn't really changed for 100 years. There's a crisis of relevance. Is what we are teaching relevant for the world that we live in? Are we adequately preparing people for roles and jobs in the 21st century?

--Steve Vosloo

Fellow, 21st-century Learning

The Shuttleworth Foundation

Key processes in education change

The Singaporean process can't be replicated by many countries—in Africa and elsewhere—however specific lessons from the Singapore experience can be elaborated to yield guidelines for education change that can be applied more broadly.

If you believe that innovation is a collective activity, as some studies show, then the greater the velocity of the exchange of ideas, the higher the potential for innovation.

--Michael Trucano
Senior Specialist in ICT in Education
The World Bank

These guidelines notwithstanding, programs of change should be based on accurate assessments of needs and especially of capacities.

Invest consistently. If securing adequate funding for basic education is an ongoing struggle in many countries, securing consistent funding for school-improvement programs is still more challenging. Although fixed costs such as teacher salaries and facilities maintenance might be budgeted consistently, funding for initiatives focused on change is typically drawn from the discretionary portion of the education budget, typically between 15 and 20 percent of total per-student spending.

The discretionary allocation is generally the source of funding for all professional-development initiatives, ICT initiatives, development of new learning resources and other activities that might be linked to improving schools. Programs funded by the discretionary budget, then, typically involve trade-offs; other valuable programs will *not* be funded. In systems with limited budgets (which includes almost all education systems!), building long-term processes that support education change requires plans for "mainstreaming" successful initiatives into the education budget.[20]

[20] Using technology to support change can be cost-prohibitive. With an annual per-student budget of US $200, per-student discretionary spending might be US $40. Such an amount *could* fund procurement of one computer for every student (i.e., a netbook and 3G modem for US $200, with that cost amortized over five years). However that expense would likely gut funding for professional development, digital learning resources, and new lesson plans that make the computers useful, and might not leave funding for mobile-broadband Internet or for repairs when they are needed.

Estimates for annual expenditures on computers, Internet and other technologies vary; older studies suggest that expenditures cluster around US $70 per student per year (Michael Potashnik and Douglas Atkins, "Cost analysis of information technology projects in education," Washington, DC: The World Bank; 1996, and François Orivel, "Finance, costs and economics," in *Basic education at a distance,* edited by Yates and Bradley, London: Routledge; 2000.) The advent of lower-cost, lower-power hardware alternatives—such as netbooks—and wireless networks, such as mobile broadband, *might* have reduced these costs slightly in the past five years.

GeSCI has developed a very effective tool for estimating the "total cost of ownership" (TCO) of educational technology (http://www.gesci.org/knowledge-tools.html#tco).

Put your money where your mouth is. Support your own policies, create an enabling environment, ensure that you bring these people to the level that you want them to achieve.

--Frances Ferreira
Specialist in Open Schooling
The Commonwealth of Learning

Assuring that successful activities are not only sustainable, but are *sustained,* is assisted by linkage between policy, programs and evaluation.

Synch up policy, the public and practice. From its first policy statements in the mid-1950s, the Singaporean government cast its efforts to improve education as part of a national mission, a mission to ensure the economic and cultural survival of a tiny city-state with a turbulent emergence from colonial rule. Media campaigns, including programs on broadcast television, were consistently used to enlist support of parents and of community groups.

Education policy can valuably establish goals and objectives to guide budget allocations, empower education leaders at all levels, and point to benchmarks for assessing program impact. However many ministries fail to craft effective policies. Poorly crafted policies frequently announce "performance objectives," such as connecting 70 percent of schools to the Internet, rather than broader goals and objectives that are meaningful in terms of educational outcomes, such as building 21st-century skills or improving teachers' pedagogical capacities. Performance objectives, in particular, are also easy to over-state: If Internet backbone only extends to major cities today, announcing the objective of connecting all schools in three years, or even five years, is meaningless unless that objective is embraced by the Ministry of Telecommunications. Educationally meaningful objectives that frame broader outcomes, on the other hand, can serve as focal points for action, especially if they are supported by leadership and resources.

Commit to inclusivity. Inclusivity in education should be seen as one of the most beneficial, high-value goals of education change. Among other factors, there is strong correlation between inclusive education and economic competitiveness.[21] The Singaporean government first moved to increase education equity

[21] The City of Pittsburgh, grappling with education change, determined that "the hard numbers show that equity and inclusion are directly tied to a regions' economic health and falling levels of poverty improve metropolitan economic performance." Among the studies cited, one examined 118 cities to determined that "the less segregated the region, the stronger the economy," whereas "inequity causes urban economies to 'drag'" (Muro, M., et al, 2004, "Investing

in the 1950s, introducing minimum standards for schools regardless of their languages of instruction; increasingly successful efforts to ensure equitable access to high-quality education accompanied the country's explosive economic growth. The history of education in the United States—a larger, more decentralized and more mature education system—also demonstrates the strong tie between the increases in productivity resulting from new technologies and increased equality of opportunity in education.[22]

> High stakes testing eliminates large numbers of potential human resources in a given country, it excludes too many young people from participating in education in ways that let them fully develop their potential.
>
> --Robert Hawkins
>
> Sr. Education Specialist, The World Bank

What does inclusivity in education mean? At a minimum, it means ensuring that all eligible youth have opportunities to participate in effective schooling. Programs that increase inequality decrease inclusivity, and decrease equity—and so, over time, decrease economic competitiveness. Common practices that increase inequality include clustering elite students in highly resourced schools, launching Internet-based initiatives without ensuring connectivity for rural schools, and establishing pilot programs or model schools that are too expensive or too resource-intensive to be rolled out subsequently to all schools.[23]

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in a better future: A review of the fiscal an competitive advantages of smart growth and development patterns," Washington DC: The Brookings Institution).

[22] Lawrence Katz and Claudia Gilpin, in *The race between technology and education,* demonstrate among other things that the US economy throughout its history has introduced new technologies to increase the cost-efficiencies of production, but that widespread adoption of these technologies and economic growth from their use has lagged development of an appropriately educated workforce. Essentially, technology creates demand for skilled workers and schools are expanded or re-structured to meet that demand.

[23] The clustering of elite students is a common trap that increases inequality. This strategy can satisfy political pressures, in part because the practice produces local "success stories." Frequently, however, the progress of students in elite schools is held back by the limitations of the rest of the school system: national exams, for example, might maintain focus on traditional learning and skills, and also be structured to ensure that a majority of students pass, and so would limit the challenges and opportunities for elite clusters. Failing to improve the quality of education in all schools via change initiatives impedes the development of all students, including students in the best schools.

The "international schools" program (SBI and RSBI) has received increasing media attention coupled with public outcry in Indonesia, precisely because this program creates "education enclaves" for elite students (with some, but not a majority, of students enrolled based on merit). The language of instruction is English, students in many schools are required to have their own laptop computers, school leadership and faculty are better educated, while neighboring schools might lack electrical power, text books, computers or even certified teachers. Ironically,

System-wide/system-deep education change marches in lockstep with inclusivity and educational equity.

Integrate teaching practices, learning objectives and content. Twenty-first century skills are not built on content. To build these skills—such as self-direction and resilience, media literacy, creativity and innovation, among others—learners must engage in activities and relationships. To help students build such skills, classroom practice must provide opportunities for these critically important interactions; class time cannot be devoted to mastery of a set body of information. To transform classroom practice, supporting components of the education system must be reformulated in ways that remove barriers (e.g., too much content to be mastered) and that strengthen the ability of the system to support teachers who are positioned to engage in change.

> The objective of the school should be to push someone to fail. By the same token, failure shouldn't be seen as failure, but as a learning opportunity, a chance to fill in knowledge gaps. You look at the most innovative companies, their mantra is "fail faster," because then you are learning faster.
>
> --Michael Trucano
> Sr. Specialist in ICT in Education
> The World Bank

Singaporean education specialists observed early on that teachers focused on "covering" their curricula, not on supporting student learning. Support for innovation in Singapore includes formal programs, such as "Thinking Schools, Learning Nation" and "Teach Less, Learn More," and informal programs, including directing primary teachers to eliminate a few units of study at their own discretion.

Link the outcomes of change to policy goals. In an effective cycle of system-wide improvement, policy establishes long-term goals, programs are designed to make measurable progress toward those goals, and impact evaluation determines the extent that such progress has actually occurred.

Effective assessment of change requires concurrent efforts on several levels. Broad understanding of the education system can only be accomplished when school data are routinely collected and analyzed. At the same time, specific activities are best understood through smaller-scale assessments. Outcomes-based or impact evaluation, appropriate for assessing single initiatives, is designed to determine

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however, the quality of instruction, especially as it pertains to 21st-century skills, is not high—except in relation to those nearby schools in which no students pass the national exams!

whether specific inputs have led to measurable differences related to improved school management, teaching or learning.

Focus on changing practice, not on technology

It's been stated many times that technology can enable change, not cause change. But a review of experiences in Singapore bears that out: The government focused on the development of the education system as a learning system, long before computers and the Internet were available to schools. Today, while these tools are available to most students in schools in developed countries, Singaporean schools demonstrate that their students' strengths stem from the system in which these tools are used, not from the tools themselves.

> Take ICT out of the box, and throw the box away. You can use ICT to teach any subject.
>
> --Anthony Bloome
>
> Education Technology Specialist
>
> USAID

Leveraging ICT for change

Technology in schools is cross-cutting: Students can use computers to browse websites and share their findings; teachers can download short videos to kick off lessons; school heads can share school data in slide shows with parent committees; the system as a whole can function via clusters of knowledge networks, with information moving in *all* directions to ensure transparency and support inclusivity and data-driven decisions. All of these activities and more should be supported by school-based hardware and networking. Such assets are expensive to procure, difficult to implement, and challenging to maintain; they cannot be funded sustainably or rolled out system-wide unless they are intended for use in all areas of school operations.

For many country governments in Sub-Saharan Africa, even cross-cutting deployments of ICT are too expensive, or too vulnerable to unforeseen challenges arising outside the education sector. If local businesses and national vendors can't provide effective on-site technical support, for example, investments in hardware will be wasted. If government and the private sector provide only high-cost

connectivity to rural areas, Internet-based programs will grind to a halt in rural schools when funding for Internet use is withdrawn.[24]

ICT support for education change, then, must leverage installed and appropriate technologies to the fullest extent possible. Breakthrough technologies that extend the potential of ICT in schools include low-cost netbooks, 3G mobile-broadband networks, personal solar panels, and pico projectors—tools that have made off-the-grid computing a reality in post-earthquake Haiti and in the remote highlands of Papua, Indonesia.[25] Education leaders incorporating technology into programs should support comparison (and even field research) of all appropriate options.

> Education leaders need to really look at mobile phones. We've been trying for years to put PCs into school labs with limited success. But the mobile phone is so pervasive, it's not an issue of access, it's an issue of effectiveness. The key is to form good, solid partnerships and start testing solutions.
>
> --Steve Vosloo
>
> Fellow, 21st-century Learning
>
> The Shuttleworth Foundation

Leadership and education change

The transformation of education requires leaders unafraid to launch their organizations toward unknown destinations. Ron Heifetz, co-founder of the Center for Public Leadership at Harvard University, suggests that tackling problems that have unknown solutions and unpredictable outcomes is the true role of the leader. Problems with known solutions simply require effective management; problems for which there is no known solution, and no clear outcome, Heifetz calls "adaptive challenges," the challenges that cannot be addressed without real leadership.[26]

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[24] The SchoolNet Uganda / World Links VSAT Rural Connectivity project contracted with a mainstream VSAT provider to provide connectivity to 20 rural secondary schools around Uganda. At the end of the project's first year, that provider went bankrupt, and the costly VSAT transceivers went dark. Almost an entire year was required to find an appropriate local provider, but the new service ran on Ku-band frequencies, as opposed to C-band frequencies. After a struggle to identify a source of funds, the first-year transceivers were junked, and Ku-Band transceivers were purchased and installed. Teachers in the rural schools missed a year of online professional development that was delivered to their colleagues in Kampala, who had reliable connectivity.

[25] http://www.inveneo.org/cgi-building-haiti-back-better (accessed on 4 November, 2010).

[26] *Leadership without easy answers,* Ron Heifetz (Belknap Press), cited in "A short primer on system leadership," by David Hopkins.

You don't need a qualification or a training to become a politician. Unfortunately, when you *are* a politician you need a qualification, to make an act. You need to read, how do you do that. So there should be capacity building for you as a politician. You have an advisor, but that advisor might not be exposed to the wider world either, so he or she isn't qualified to advise you.

--Frances Ferreira
Specialist in Open Schooling
The Commonwealth of Learning

Michael Fullan has identified five elements necessary for effective leadership of dynamic systems[27]:

- Moral purpose
  Leaders' actions should be guided by the desire to make a positive difference in the lives of individuals in the organization.
- Understanding change
  The change process is complex, involving resistance, apparent dips in performance, and many other factors. Leaders must understand change in order to lead their organizations through it.
- Building relationships
  In successful change processes, relationships throughout the organization improve, frequently as top-down structures give way to increased participation, communication and exchange.
- Knowledge creation and sharing
  Turning information into knowledge is a social process; the creation of knowledge within the organization results from a shared sense of purpose, from security in the midst of dynamic events, and from deepening trust in relationships.
- Coherence making
  As change progresses, individuals can lose sight of the value of their contribution; it is the responsibility of leadership to see patterns, channel actions and highlight positive impact when it's achieved.

[27] *Leading in a culture of change,* Michael Fullan (San Francisco: Jossey-Bass; 2001).

Equally important, according to Fullan, leaders need to shift their styles of leadership away from strictly "coercive" or "authoritative" styles to include more receptive and responsive interactions. If the goal is to transform the education system into a learning system, education leaders must be among the first to make learning—from feedback, from bottom-up communication—a regular activity.

The effective leader, then, is not only the agent of transformation but is among the first to be transformed.

> Good leaders lead from inside... The privilege of true leadership is given to those whose energy derives from deep within, in the spiritual dimension of the self, rather than in managerial or technical expertise
>
> --Nelson Mandela

Annex A

Interviewees

The following individuals generously contributed their time and expert opinions to the development of this thematic study:

Anthony Bloome

Education Technology Specialist, USAID

In addition to USAID, Mr. Bloome has worked for the Peace Corps as ICT specialist and for the World Bank as distance-education specialist, during which time he lived in Zimbabwe.

Christopher Coward

Director, Center for Internet Studies, University of Washington

Mr. Coward's work focuses on investigating the impact of ICT diffusion in developing countries. He is currently leading, among other research projects, a global study of community-access technology centers.

Frances Ferreira

Specialist in Open Learning, The Commonwealth of Learning

Prior to joining COL, Mrs. Ferreira was director of the Namibian College of Open Learning. She has been a teacher and a school principal. She was the first female mayor of Grootfontein, Namibia.

Robert Hawkins

Sr. Education Specialist, The World Bank

Mr. Hawkins recently served as the executive producer of EVOKE, the World Bank's first effort in online gaming for development. He worked previously for the World Bank Africa region, promoting ICT connectivity, policy and capacity building, and serving as World Bank team lead for the African Virtual University.

Michael Jensen

Independent IT, Internet and Telecom Consultant

Mr. Jensen specializes in ICT infrastructure and policy planning, national and international backbone development and other areas in telecommunications. He has worked on projects in over 40

countries including Botswana, Cameroon, Ghana, Malawi, Nigeria, Senegal and South Africa.

Michael Trucano

Sr. ICT and Education Policy Specialist, The World Bank

Mr. Trucano leads several initiatives at the World Bank, including 'new-economy skills for Africa.' At infoDev, he guided development of the *ICT in Education Toolkit for Policymakers, Planners & Practitioners* (with UNESCO) as well as many other resources on ICT in education.

Steve Vosloo

Fellow, 21st-century learning, The Shuttleworth Foundation

Mr. Vosloo explores innovations in the use of technology to support development of 21st-century skills. He is the developer and director of m4Lit, the publisher of Yoza Cellphone Stories in South Africa.

Wayan Vota

Senior Director, Inveneo

Mr. Vota leads the education effort at Inveneo, including design and deployment of sustainable technology systems in rural and underserved schools. In addition, he moderates the World Bank's Education Technology Debate and publishes the OLPC News.

Annex B

Follow-up activities

This Annex presents a few short activities that can help readers engage with several of the concepts or practices mentioned in this study. These activities are *not* intended as substitutes for in-depth assessment or planning processes. The activities can be explored by small groups working together if all group members are familiar with the same education system or if the entire group focuses on the education system from the country of one member of the group.

Each activity is linked to a specific section of this thematic study.

Activity 1: Assessing capacity for change

"Change leading to broad performance improvements—and eventually to support for the building of 21st-century skills—should address five key elements…," p. 7

"It takes capacity to build capacity."—Thomas Hatch (p. 20)

This activity is intended to guide rapid (or "short-hand") assessment of key components in education change. The activity is linked to Activity 2.

For your country's education system, address each of the five key components in the education-change process. List the component's strengths and weaknesses. The five components are:

- Learning resources
- Teacher education and development
- Assessment
- Management and information management
- Policy and planning

Review your lists of strengths and weaknesses and, based on it, rank the components, from 1 to 5. ("5" indicating "best," "1" indicating "worst.")

For each component, assign a value to the "organizational infrastructure" that is in place to support that component. Use a five-point scale, with "5" indicating "well-developed" and "1" indicating "non-existent."

Example 1: Teacher education is provided by three colleges, and the faculty at these colleges is motivated and skilled – Score: 5

Example 2: Primary schools lack science resources such as charts and tables, maps and displays. – Score: 1

(Note that several components could receive the same score.)

At the completion of this activity, you should have a list of all five key components, with each component ranked according to its relative strengths and weaknesses, and assigned a value based on its organizational capacity.

Example:

Component	Rank	Capacity
Teacher education	4	5
Assessment	2	1
Learning resources	1	1
Management	5	3
Policy & planning	3	3

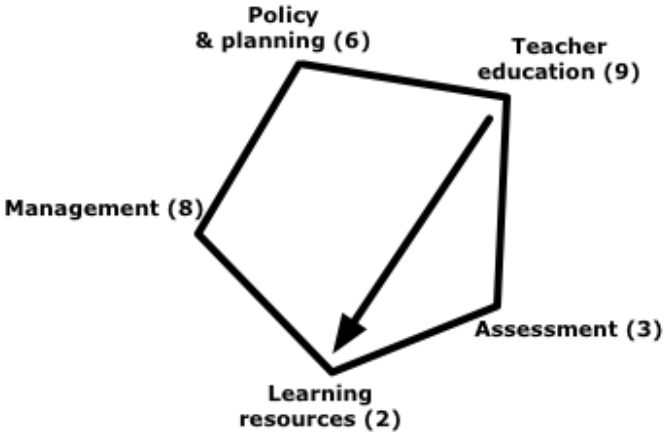
Activity 2: Finding an entry-point for comprehensive change

> "Hopkins maintains that change must be both "system wide," affecting all aspects of the education system consistently and coherently, and "system deep," with coordinated efforts that extend from education policies through central and district administrations all the way to schools and classrooms." (p. 7)

This activity is intended to guide readers from a short-hand assessment of capacity (Activity 1) to identifying ways of leveraging existing capacity to address current problems. This activity is linked to Activity 3.

- Referring to your scoring from Activity 1, tally the total score of each component. Arrange the five components nodes in a circle (or a pentagram), listing each component's total points.
- Which component is highest scoring? Which is lowest scoring? (If there are ties among the low or high scorers, select the component that has the highest "capacity" score from Activity 1.)

- Draw an arrow from the highest-scoring component to the lowest-scoring component.



- In two minutes, list all the new activities that could be carried out in (or by) the high-scoring component that could improve the low-scoring component.

Example: The strong teachers' colleges could improve primary science resources by: 1) requiring education students to take courses in learning-resource design; 2) including units on

using local materials as learning resources in those courses; 3) preparing student teachers to develop resources in conjunction with lesson planning and the curriculum; 4) publishing the resource designs developed by each class as a compendium for graduating students; 5) distributing the compendiums to schools each year via DVD.

Activity 3: Moving from the short-term to the long-term

> "Short-term initiatives that develop these components and processes should in all cases be designed and supported in ways that build toward long-term goals." (p. 15)

This activity is intended to enable reflection on the transition from short-term activities to sustainable processes. This activity is linked to Activity 4.

- Review the list of potential ideas for change that you created in Activity 2. Identify one idea or series of ideas that you consider to be feasible and valuable. What specific problem or challenge does that idea address?
- Frame the idea that you've selected as an objective.

Example: "To develop a compendium of designs for science-learning resources that are linked to the primary curriculum."

- List the tasks that are required to achieve this objective:

Example: "Revisions of diploma-in-education curriculum and degree requirements; design of new course units; recruitment or training of faculty capable of delivering new units; review, judging and cataloguing of students' learning resources; awarding prizes for best resources; layout and publishing of resource compendia; publication of DVD; distribution of DVD."

- List the organizational capacities or outcomes that might emerge from these actions. (Focus on process-oriented capacities or outcomes. "High-speed copying of DVDs" might be a new capacity in some organizations, but it isn't germane to this activity.)

Follow-up questions for consideration:

How might these capacities or outcomes support ongoing processes of change and development?

What kinds of support are needed to ensure that these capacities are sustained and fully utilized?

Activity 4: Assessing demands on leadership

"Equally important, according to Fullan, leaders need to shift their styles of leadership away from strictly "coercive" or "authoritative" styles to include more receptive and responsive interactions. If the goal is to transform the education system into a learning system, education leaders must be among the first to make learning—from feedback, from bottom-up communication—a regular activity." (p. 27)

This activity is intended to help build understanding of concepts in leadership in change-based organizations. This activity is linked to Activity 5.

- Review the objective, tasks and outcomes of the initiative that you have designed in Activity 3. Identify stakeholders who might be affected by this initiative.

Example: "Current faculty and deans of teachers colleges; instructional-design specialists in other parts of the Ministry; education students enrolled in teachers colleges; primary-school principals and teachers."

- Identify potential reasons for resistance to this initiative.

Example: "Current teachers-college faculty lack capacity to teach the new units; veteran primary-school teachers resent using materials developed by student teachers."

- Refer to the five elements of leadership in change-based organizations, identified by Michael Fullan. The five elements (described on page 25) are:
  - Moral purpose
  - Understanding change
  - Building relationships
  - Knowledge creation and sharing
  - Coherence making

Consider each element in relation to the proposed initiative, reflecting on ways in which the initiative might involve or link to that element.

Example, moral purpose: "The lack of proper science resources in primary school is limiting the development of children's science knowledge and skills, and is impeding their study of science in secondary school and their 'science literacy' in later life."

Example, understanding change: "Teachers just graduating from teachers college will be more comfortable and more skilled using the new resources; older teachers might be resentful, or might not achieve success right off the bat."

Follow-up questions for consideration:

What problems or challenges have you identified that might crop up during the change process?

Who will those problems likely affect?

What could be done to help minimize those problems?

Activity 5: Planning to listen and respond

"Profound education change requires *ongoing* analysis of results and outcomes and the revision of plans and programs on the basis of that analysis." (p.15)

This activity is intended to help familiarize readers with the potential range of assessment modes.

- Review the initiative that you've designed in Activity 3, and review the stakeholders you've identified in Activity 4. List three or more important outcomes of this initiative.

Outcomes, example: "Teachers colleges build capacity to support learning of instructional design; student teachers build capacity to design learning resources; designs for learning resources are completed for the entire class 1 to class 5 science curriculum within three years."

- Review the four means of information-intake shown in *Figure 1: Framework for outcomes-based educational improvement* (p. 9). Those means are:
    - Student assessment
    - Feedback from teachers and others
    - School management data
    - Impact evaluation

Describe the ways in which each of these four means can provide bottom-up information about the progress of the initiative and its overall impact.

Follow-up questions for consideration:

How will these different means help you or other leaders meet the requirements for leadership that you identified in Activity 4?

Which means will be more important in the first two or three years of the initiative?

If the initiative is mainstreamed into regular operations, how will you continue to monitor its evolution and maintain its high quality?

Annex C

Engelbart's augmentation cycle

Generally speaking, the study of self-regulating systems, in which a system elicits, analyzes and responds to signals (or feedback) takes place in the field of cybernetics, originally developed by Norbert Wiener, Gordon Pask and others beginning in the late 1940s. The computer pioneer Douglas Engelbart independently developed a conceptual framework for "boosting the collective IQ" of humanity, involving technological "augmentation" of human intelligence to better address the complex problems facing society. A depiction of Engelbart's theory by visual journalist Eileen Clegg appears on the following page. Clegg is the co-author, with Valerie Landau, of *The Engelbart Hypothesis: Dialogs with Douglas Engelbart.*

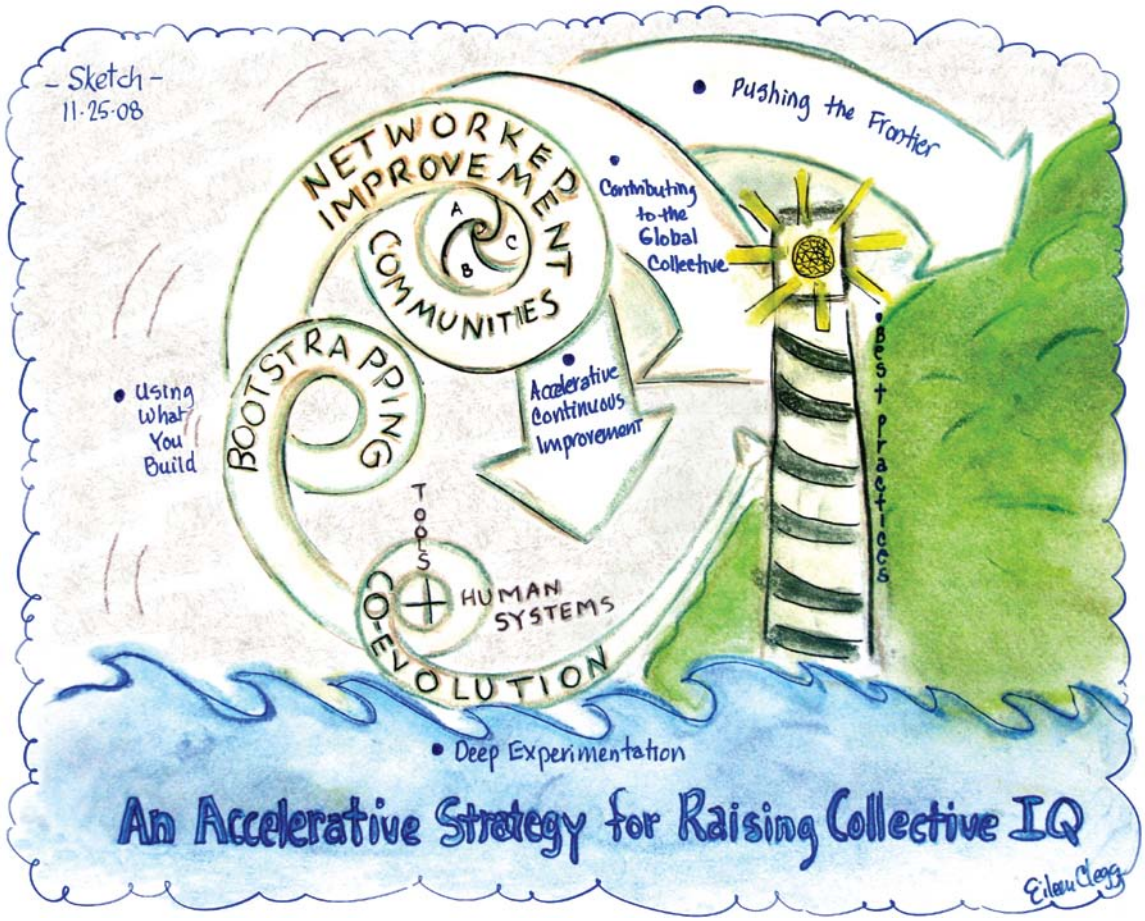


Figure 2: Conceptual rendering of Douglas Engelbart's augmentation cycle

This image[28] first appeared in a presentation by Christina Engelbart, Executive Director of the Doug Engelbart Institute, in December 2008 at the Stanford University event, "Engelbart and the dawn of interactive computing." This event commemorated the 40-year anniversary of the "mother of all demos," at which Engelbart demonstrated the mouse, windows-based computing, hypertext linking, multiple-screen videoconferencing and other innovations that today form the foundation of our computer-mediated experiences. Engelbart envisioned that these and other design affordances of technology would one day be used to support "augmentation" of the collective IQ to enable humans to improve social, economic and environmental well-being.

[28] ©Eileen Clegg; used by permission of Eileen Clegg.

Engelbart's original paper on the topic, "Augmenting human intellect: A conceptual framework" is available at http://www.dougengelbart.org/pubs/augment-3906.html