

Ezin, H.E. Jean-Pierre et al.

**Conference Paper**

## Improving educational infrastructure through emerging technologies

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## The Global Economy

# Improving Educational Infrastructure through Emerging Technologies

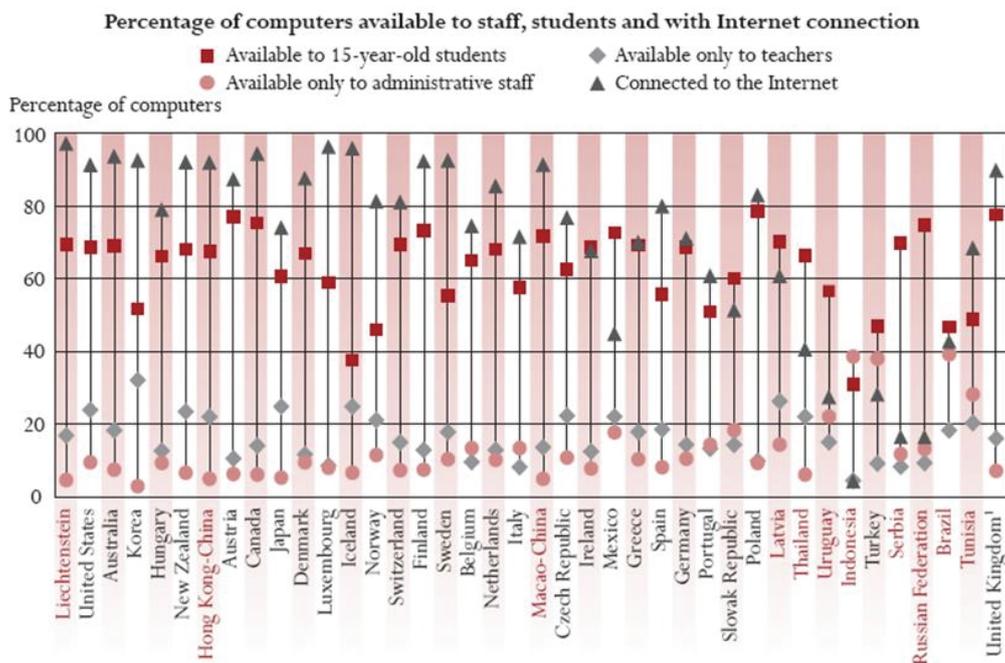
### The Challenges

According to the OECD (2001) the growth of the knowledge society and the development and pervasiveness of the emerging information and communication technologies (ICT) represent a major challenge and a major opportunity for education. Over the past decade, many countries have made large investments in improving their educational infrastructure by providing more computers and better internet access to schools.



Yet, economically backward regions or countries are less capable of investing as much money as more developed regions to integrate ICT into education; moreover, qualified teachers are often hardly available. To help children to gain access to education and to enable a more independent self-learning process, some private initiatives such as “One Laptop per Child” are trying to mitigate such deficiencies.

However, providing computers or access to internet alone to students does not automatically increase educational quality and learning effectiveness. Complementary measures and policies such as adapting teaching curricula to e-learning and providing interactive learning software are indispensable.



Note: <sup>1</sup> Response rate to low to ensure comparability.

Source: OECD (2005), Are Students Ready for a Technology-Rich World? What PISA Studies Tell Us, p.27.





How could an effective curriculum be designed to combine the e-learning supported by ICT and the traditional teaching and learning materials? How could ICT be effectively used to support the further education of teachers especially those from the economically backward regions and countries? What are sensible ways toward connecting students, teachers and outside experts with each other and foster learner-centered knowledge outside formal structures? Would financial incentives or e-learning courses for adults increase parents' (families') capabilities and motivations to be more active in helping to establish an effective e-learning environment for children? How could the assessment of students' performance achievement be made compatible with e-learning to motivate students to make use of ICT for learning? How could private sectors interact with schools and teachers to provide adequate and interactive learning software to enhance students' learning interests and efficiency? How could the international community help in those cases where government corruption and control of ICT has held back several countries immensely?

## **Proposed Solutions**

### **H.E. Jean-Pierre Ezin**

*Commissioner for Human Resources, Science and Technology, African Union Commission*

### **Pan-African University: A force for Africa's regional integration**

As we already know the fundamental difference between the North and the South is the lack of science in the South and the over abundance of science in the North.

In Africa, which a continent in the southern hemisphere as we also know, that problem is concretely translated into a crucial lack of human resources. How can you address the economic growth if you have no researchers to create knowledge, no engineers to innovate, no qualified teachers in universities and schools to disseminate knowledge and no scholars to reflect peace, security and policy? The top priority urgency of Africa is the constituency of a quality human capital.

Aware of that necessity, the African Union Commission has initiated since 2008 the idea of creating a Pan-African University (PAU).

The PAU will consist of one Rectorate located in an African country to be determined and managing five differentiated thematic institutes hosted by a university institution performant enough, identified in each of the five geographic regions of Africa. Each regional institute will be required to network as a Hub up to ten centers of research and doctoral training over the continent.

In July 2010, the African Union Assembly of Heads of State and Government formally decided to establish the Pan-African University with the regional thematic areas designed and allocated as follows:

- Water and Energy Sciences (including Climate Change aspects) in Northern Africa
- Governance, Humanities and Social Sciences in Central Africa
- Basic Sciences, Technology and Innovation in Eastern Africa
- Life and Earth Sciences in Western African
- Space Sciences in Southern Africa

In the today's world no continent is any longer an island: Africa's difficulties have consequences on Global Economy and the World Economy constraints affect adversely Africa. Then the PAU will appeal the international community for a specialized cooperation: A lead thematic



partner will be identified and solicited to support one regional institute jointly with the African Union Commission and the host country in a long term cooperation agreement. Other benefits of the PAU are the African Diaspora mobilization for Higher Education in Africa and Africa's regional integration enhancement.

The PAU will be made more efficient by connecting the regional thematic institutes amongst themselves and to the thematic partners' home through Higher Education institutions' emerging technologies.

## **Edilberto C. de Jesús**

*President, Asian Institute of Management*

Address secondary education issues. Progress on elementary education, though short of MDG targets, raises the pressure to improve access to, and quality of, high schools. Diagnosed by the World Bank as the weakest link in the educational cycle, secondary education offers the last chance for developing countries to equip students with the basic literacy, numeracy and life skills they need for the world of work.

Consider mobility over bricks-and-mortar to expand access. Existing schools will need additional classrooms, facilities and more teachers with higher level of training. Provide transport to bring students to centrally located high schools and equipping these schools with better ICT facilities as an alternative to establishing additional schools. The higher costs of secondary education underline the importance of gaining economies of scale.

Explore learning applications for mobile phones. Lower costs and the growing capacity and versatility of mobile phones, combined with older TV and DVD technology, offer opportunities for their expanded use in the classroom. The latest, higher-priced hardware is neither necessary nor appropriate for learning needs of elementary or secondary students.

Retool and recycle older models of mobile phones and computers. Taking this approach will reduce the cost of expanding the use of technology in schools, it will also reduce the environmental hazards posed by discarded electronic products. The technology package should make it possible to supplement textbooks with materials drawn from other sources, including the web. It may also be possible to produce an affordable version of the ebook that will contain the textbooks required of students for the subjects at their grade level.

Focus on teachers. Ensure that pre-service education prepare the teachers for the use ICT as learning tools. Beyond learning the use of the computer and the basic programs, the course should cover the design and development of curricula and subject modules that exploit ICT facilities and include the study of models or examples that have been successfully implemented. Normal schools should also adopt ICT-based pedagogy in the delivery of their teacher education programs, Teachers should also get priority in the access to whatever ICT hardware is made available to schools.

## **Wan-Hsin Liu**

*Kiel Institute for the World Economy*

## **Rüdiger Soltwedel**

*Kiel Institute for the World Economy*

- 1. Equip schools with adequate hardware, software and internet connections and establish institutions such as "SchoolNets" and "Open Universities" to support the integration of ICT in education, taking inequality in financial and human capital endowments between different regions or/and countries into consideration.**

In order to improve educational infrastructure through emerging technologies (ICT), first of all schools and learners should be equipped with adequate hardware, software and internet



connections. Nowadays many economically backward regions/countries still strongly lack financial and human capital, and supportive institutions to enable them to build telecommunication nets, and to procure and efficiently apply ICT products for their education system. Here (international or/and national) public financial aid and private donation focusing on overcoming financial deficiency of these backward regions and countries are strongly needed. In addition, supportive institutions such as “SchoolNets” and “Open Universities” are needed to overcome human capital deficiency in these regions and countries.

**2. Redesign curricula and integrate the usage of ICT in learning materials for as many subjects as possible in addition to only providing computer courses.**

Individual learners should be enabled to construct their own understanding based on their previous related experiences. Thus in order to enhance the digital literacy and learning efficiency, learners should be provided with more chances to use ICT for learning so that they can collect own experiences for further development. To this end, it would help if curricula and learning contents can be redesigned to integrate ICT into learning processes in addition to traditional paper-based learning materials, e.g., interactive encyclopedias can be provided in classes to entice students to deepen and visualize their understanding of certain topics by searching for more information immediately after teachers introduce some fundamental concepts.

**3. Enhance teachers’ incentives, qualification and familiarity to use ICT as teaching tools through training workshops and online e-teaching fora.**

The efficiency of learner-centered e-learning depends strongly on the incentives, qualification and familiarity of teachers to use ICT for teaching. Incentives for teachers are especially crucial for overcoming the major barrier for progress in education reform, i.e., the resistance to change. In a world of e-learning, teachers’ role is changing from being the main knowledge source in class to a guide for introducing topics and promoting learners to learn and think independently. For teacher candidates, ICT can be intensively integrated into their education programs. For incumbent teachers, local training workshops can provide them regular access to the up-to-date e-teaching materials and enable them to exchange their e-teaching experiences with their colleagues. For teachers in remote areas, online training programs make further training in distance possible and online e-teaching forum enables them to learn from and discuss with their more experienced colleagues elsewhere.

**4. Reduce the weight of paper-based exams in students’ performance assessment and integrate ICT-based performance into the assessment portfolio.**

In order to enhance learners’ incentives to use ICT adequately for learning, the ways how their performance is to be assessed should also be made consistent with the redesigned and more ICT-integrated curricula. Paper-based exams should not be emphasized as strongly as before. Instead, learners should be promoted to work strongly with their e-learning materials and submit some exploratory reports or experimental outcomes for assessment. To enable a more interactive learning process, learners may be asked to submit reports or outcomes several times a semester. ICT makes it easier for teachers to give responses to students’ work more frequently than before. In this way, learners may consider both the responses they received and new information collected to improve their later reports or experimental outcomes.

**5. Establish public-private partnerships, e.g., between learners, teachers and the private sector, to develop adequate software for learning, teaching and performance assessment.**

Software for teaching, learning and performance assessment can be developed and made more consistent with the education goals and needs if learners and teachers can be integrated into the developing processes as earlier as possible. For example, software needed for educating out-of-school learners or learners from remote places may differ from the software



needed for education in schools in cities. For out-of-school learners and learners from remote places, virtual instructors and online discussion fora are more essential to compensate the loss of feedbacks directly from teachers and peers. However, to ensure a fruitful cooperation, mutual interests of parties involved should be considered in a balanced way and open discussions are required.

## **6. Found an independent monitor agency to promote efficient usage of education funds for e-learning.**

For many countries, in particular for developing countries, deficiency in ICT-based education is certainly a result of lack of financial resources for investment in ICT. However, the deficiency is often also a result of inefficient governance and usage of education funds. Founding an independent agency to monitor the usage of education funds may increase the information transparency, reduce corruption risks and enhance efficiency in engaging in ICT-based education reforms. The international community and NGOs may also play an important role in this respect.

### **Carlos Ivan Simonsen Leal**

*President, Getulio Vargas Foundation*

## **1. Strategic planning in the public education sector**

Fundação Getulio Vargas has a long tradition of aiding public and private sector institutions in strategic planning. This tradition has been bearing fruit in recent years with the implementation of various successful projects, particularly in the context of the Brazilian public education system.

The FNDE, an autarchy that provides funds and technical support for implementing federal education policies, has been effectively introducing a new model for purchases of goods and services in public schools and universities, through the institution of the national electronic price registry. Fundação Getulio Vargas has been instrumental in this process, through its participation in designing the auctions so as to induce competition, avoid collusion among suppliers, take advantage of economies of scale and competitive advantages in order to minimize the inefficiencies in public expenditure. To this date, FGV has aided the FNDE in designing the registry auctions for school buses, student laptops, computer labs, school furniture, antibiotics for university hospitals, bicycles and student uniforms.

FGV is also aiding the Ministry of Education in restructuring the National High School Exam (ENEM). This exam, implemented in 1998 with the goal of evaluating students' performance at the conclusion of basic education, is currently used as a complementary or exclusive criterion for admission into hundreds of higher learning institutions nationwide. The federal government aims to modernize and improve the test in all its aspects, from contracting the exam-administering institutions to developing and selecting questions and improving the scoring methods.

## **2. New ICT**

The digital inclusion of more disadvantaged sectors of the population, as well as the incorporation of new ICTs into schools, may result in significant shifts in economic outcomes, although these have not yet been fully assessed. Some results of pilot programs in Brazil are available (World Economic Forum, 2005).

From the individual point of view, familiarity and competence with ICTs represent entry to the ever-growing range of job positions requiring this kind of know-how, in all sectors of the economy. Thus, closing the digital gap is a fundamental part in making the job market open to



all sectors of the population. It is interesting to note that competence with ICTs may represent either a complementary or substitute good to traditional (school) education.

The potential benefits of introducing ICTs into schools include allowing more (and more diversified) content to be delivered to students at greater speed, providing the basis for new teaching and student-interaction formats, and, in some cases, reducing the costs usually incurred by schools in distant locations, such as isolated communities (e.g., in the Brazilian Amazon Forest). In this sense, ICTs may be able to shift the production possibility frontier of education (average versus worst-off) of a given country upwards.

### **3. Incentives and outcomes**

To ensure that access to education translates into social and economic benefits, it is necessary to alter the incentive structure associated with the school system. This involves providing incentives not only to teachers and school managers, but also to students and their families (through exams such as the National High School Exam, or ENEM). The appropriate incentives can be achieved only through performance evaluation and compensation.

### **4. Social choice and education**

National school systems often incorporate policies aimed at promoting universal access to education, as well as incentives targeted at specific groups or subjects (in the form of competitions, awards and scholarships). Furthermore, many countries have implemented policies that are explicitly targeted at affecting the distribution of education among social and ethnic groups. This raises the issue of how to evaluate these policies, not only in the technical sense of how to assess outcomes, but also in the political-philosophical sense of what is considered a desirable outcome (social choice theory).

There are many different schools of thought regarding social choice (Stiglitz 2000, and Sen 1999). Among the most notable of these are utilitarianism and Rawlsianism. In the utilitarian perspective, an outcome is considered desirable as long as it propitiates a positive shift in average individual welfare, even if it leaves some individuals worse off. On the other hand, for Rawlsians, social welfare should be measured exclusively as a function of the worst-off individual, and outcomes are desirable only as long as they improve that individual's well-being.

It is a trait of many social choice theories that an outcome can be considered acceptable even if it increases inequality. For instance, for utilitarianism, a policy that increased the educational level of the richest, while holding constant the education provided to other groups, would be considered acceptable. Some theories attempt to incorporate "social justice" by postulating an explicit link between social welfare and inequality (as measured, e.g., by the Gini index of the welfare distribution).

Thus, social choice admits many different mutually-exclusive definitions, which lead to contradictory evaluations of outcomes as "desirable" or not. Furthermore, no theory is demonstrably "correct" as their adoption is ultimately based on personal moral judgments.

However, it is likely that, in developing countries, there will often be proposals for educational policy which will benefit from increasing the welfare both of the worse-off and of "average" individuals at the same time. This calls into question the issue of how to identify such proposals in advance.

There is ample literature on the technical issue of how to evaluate outcomes, but the various conclusions must be put into perspective by the continual development in methodological approaches for measurement and analysis. One particularly clear-cut conclusion, however, is that economic returns to schooling are unequally distributed among the population.



Therefore, in an environment with limited resources, an adequate strategy for optimizing gains in public access to education is to focus on those sectors of the population that have the highest potential gain. For Brazil, returns to schooling for different groups were estimated by Simonsen Leal and Werlang (1991).

Nevertheless, it seems advisable also to ponder the duality between maximizing the aggregate return of investing in education and reducing social inequality. Moreover, it seems plausible that a situation can exist in which a change in the characteristics of the educational system will benefit from the possibility of improving both at the same time (inside the production possibility frontier, or PPF). Information and communication technologies (ICTs) may contribute to weaken or even circumvent this duality.

## 5. Evaluating quality

An individual's level of formal educational achievement, as represented by years of schooling, is not an accurate measure of his effective cognitive ability. Assessing the quality of education is essential to understand its links to economic outcomes at the individual and aggregate levels.

The quality of education can be evaluated at three levels:

- a) In terms of the cognitive ability with which it endows students. This can be measured through tests such as the PISA.
- b) In terms of to what extent it provides training to students, thus producing workers that satisfy the demands of the job market. This can be measured directly through surveys with companies and employment agencies, or indirectly through such measures as salaries and number of job openings.
- c) In terms of the increases in productivity that it brings to the economy. Arguably, endowing students with the ability to think creatively and to innovate is the ultimate goal of the educational system. It is a near-consensus in growth economics that these abilities, along with technological advance, form the basis of productivity growth. However, isolating the contribution of education to the economic development of a country is a difficult task.

These three levels of evaluation are not mutually exclusive, but rather represent different proxies or correlates by which to assess the quality of education received by students.

## 6. Strategy in the long run

The deepening and prolongation of the economic crisis, especially in developing countries, may reduce the flow of resources to education and divert these investments toward social programs with more evident short-term results.

The long-run implications related to these decisions are not always clear for policymakers. This is especially true in cultures where the concept of intellectual capital is not taken to heart by government leaders, and where education is all too often viewed as a current expenditure, not as an investment.

To ensure that decisions in this area are taken in a consistent manner, based in sound economic principles and in an accurate evaluation of the long-term costs and benefits of different policies, requires the development of a strategic plan to serve as a guideline and decision-making framework.

## 7. Demographic opportunity

The level of schooling attained by the economically active population (EAP) of a country is strongly linked to its productive and innovative capacity. Many emerging countries are going



through major shifts in the structure of their age pyramids. In Brazil, projections for the next decades point toward a far greater participation of the EAP in the total population, as the birth rate declines and today's children and adolescents join the workforce. This represents a demographic window, an opportunity to ensure that a better income distribution will be achieved, provided that there is enough investment in education and, at the same time, that this investment is correctly focused. If the necessary actions are not taken now, the window will be progressively closed as the falling birth rate makes it more difficult to educate the EAP.

## **Stefano Venturi**

*Vice President of Public Sector European Markets, Cisco Systems*

Public-private-partnerships play a powerful role in creating a truly transformative learning environment to improve effectiveness through remote teaching, to increase access, and to create career opportunities by being closely connected to changes in the workplace. Engaging with students outside the classroom can be a challenge. We need to innovate to explore new ways to engage students in a remote setting, for example, by creating online communities and using immersive technologies such as video. ICT must also become a core criterion in training and incentives for teachers throughout their career to maximize the potential of the resources available. We also need to raise awareness at the highest level as to why ICT is such an important element in education. ICT is the key driver of productivity growth and social change yet we face a worldwide gap in professionals with e-skills. Leaders need to create the right policy environment to enable ICT to flourish in education and to tackle social barriers such as the gender divide in ICT which serves to hamper growth. These are some of the key experiences gained from the Cisco Networking Academy, "the world's largest classroom," in which almost one million students are currently developing their ICT skills in 165 countries.