SURVEY OF ICT AND EDUCATION IN THE CARIBBEAN

VOLUME I: REGIONAL TRENDS AND ANALYSIS

A Summary Report Based on 16 Country Surveys: Anguilla, Antigua and Barbuda, Aruba, Barbados, British Virgin Islands, Cayman Islands, Dominica, Grenada, Jamaica, Montserrat, St. Kitts and Nevis, St Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, U.S. Virgin Islands

An *info*Dev PUBLICATION PREPARED BY:

Edmond Gaible, PhD
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ICT AND EDUCATION SERIES

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Acronyms

ABHTI	Antigua and Barbuda Hospitality Training Institute
ABIIT	Antigua and Barbuda International Institute of Technology
ADSL	Asymmetric Digital Subscriber Line (also DSL)
BSSEE	Barbados Secondary School Entrance Exams
BVI HS	British Virgin Islands High School
C & W	Cable and Wireless Corporation
CAI	Computer-assisted Instruction
CAPE	Caribbean Advanced Proficiency Examination
CARADOL	Caribbean Association for Distance and Open Learning
CARICOM	Caribbean Community
CASE	College of Agriculture, Science and Education
CDB	Caribbean Development Bank
CIC	Community Information Center
CKLN	Caribbean Knowledge and Learning Network
CMC	Community Media Center
COL	Commonwealth of Learning
COTS	Commercial Off-the-Shelf
CREMIS	Caribbean Regional Education Management Information System
CSEC	Caribbean Secondary Education Certificate
CUPIDE	Caribbean Universities Project for Integrated Distance Education
CXC	Caribbean Examination Council
DBMS	Database Management System
DE	Distance Education
DFID	Department for International Development
DOE	Department of Education
ECCB	Eastern Caribbean Central Bank
EDF	European Development Fund
EEC	Education Evaluation Center
EFA	Education For All
ELJAM	e-Learning Jamaica
EMIS	Education Management Information Systems
ETRC	Education Technology Resource Centre
FCC	Federal Communication Commission
GCE	General Certificate of Education
GeSCI	Global e-Schools Initiative
GIS	Geographic Information System
GOB	Government of Barbados
GER	Gross Enrolment Ratio
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH
HDI	Human Development Index (UNDP)
HEART Trust/NTA	The Human Employment and Resource Training Trust/National Training Agency
HLSCC	H. Lavity Stoutt Community College
ICCI	International College of the Cayman Islands

ICDL	International ComputerDriving Licenses
ICT	Information and Communications and Technology
IDB	InterAmerican Development Bank
IDRC	International Development Research Centre
IGCSE	International General Certificate of Education
IEARN	International Education and Resource Network
IP	Internet Protocol
IPA	Pedagogical Institute of Aruba
ISTENETS	International Society for Technology in Education National Education Technology Standards
IT	Information Technology*
ITALIC	Improving Teaching and Learning in the Cayman Islands
JCSEF	Jamaica Computer Society Education Foundation
JSAS	Jamaica School Administration Software
JSEP	Job Skills Education Program
LAN	Local Area Network
LDC	Least Developed Country
LRC	Learning Resource Center
LMS	Learning Management System
MIT	Massachusetts Institute of Technology
MOE	Ministry of Education
MOE Barbados	Ministry of Education, Youth Affairs and Sports
MOEY	Ministry of Education and Youth (Jamaica)
MOEYC	Ministry of Education, Youth and Culture (Jamaica)
MOEYS	Ministry of Education, Youth, and Sports
NCU	Northern Caribbean University
NIHEST	National Institute of Higher Education, Science and Technology
NHP	New Horizons Project
NQR	National Qualifications Register
OAS	Organization of American States
OCAD	Ontario College of Art and Design
OCW	Open CourseWare Project
ODL	Open and Distance Learning
OECS	Organisation of Eastern Caribbean States
OER	Open Education Resource
OERU	OECS Education Reform Unit
OISE	Ontario Institute for Studies in Education
OLPC	One Laptop Per Child
PBL	Project-based Learning
PBX	Private Branch Exchange
PDU	Professional Development Unit
PSEP	Primary Education Support Project
PMT	Performance Management Tool
PPP	Pillars for Partnership and Progress: The OECS Education Reform Strategy 2010
PPMR	Project Performance Monitoring Report
PTA	Parent Teachers Association

* While the acronym "ICT" is the term of art used most commonly among donor and development agencies, MOEs and other educational institutions in the Caribbean (and elsewhere) use "IT," especially in relation to curricula, exams, departments within ministries, and technology teachers. To the extent possible, IT will be used similarly in this report. ICT will be used more generally.

SALCC	Sir Arthur Lewis Community College
SASI	School Administrative Student Information
SBA	School-based Assessment
SEMP	Secondary Education Modernization Program
SETAR	Servicio di Telecomunicación di Aruba
SIDS	Small Island Developing States
SIF	Schools Interoperability Framework
SIFA	Schools Interoperability Framework Association
SITES M2	Second Information Technology in Education Study: Module 2 report
SJPP	Samuel Jackman Prescod Polytechnic
SMU	St. Mathews University
TCO	Total Cost of Ownership
TIMS	Training Information Management System
TLI	Tertiary Level Institution
TPD	Teacher Professional Development
TVET	Technical and Vocational Education and Training
UCCI	University College of the Cayman Islands
UNDP	United Nations Development Program)
UNICEF	United Nations Children's Fund
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States of America
USAC	Universal Service Administration Company
USAID	United States Agency for International Development
USED	United States Department of Education
UTech	University of Technology
UVI	University of the Virgin Islands
UWI	University of the West Indies
UWIDEC	University of the West Indies Distance Education Centre
UWISCS	UWI School of Continuing Studies
VIDE	US Virgin Islands Department of Education
VOIP	Voice Over Internet Protocol
VSAT	Very Small Aperture Terminal
VTC	Video teleconference
VUSSC	Virtual University of the Small States of the Commonwealth
WAN	Wide Area Network

Please note that a glossary of technology-related and educational terms appears at the end of this volume.

Limitations of this report

The following limitations should be noted:

- The data presented in the individual *Country Reports* should be regarded as illustrative rather than exhaustive. This *Survey* was not an exercise in primary data collection. The guidelines given to country researchers regarding report length were deliberate in order to ensure a focus on the more salient information and to enable the completion of the project within the established time frame and the available resources.
- Focus on regional trends and national profiles have no doubt failed to identify effective small-scale projects. Review methodology focused on secondary research and on interviews with respondents in positions that enabled them to knowledgeably discuss system-wide aspects of Information and Communications Technology (ICT) in schools and education systems, and recent or significant government projects and programs.
- Consideration of the cost effectiveness of ICT use in education has not been undertaken in the course of the *Survey*. While such analysis is critical to understand decision-making especially in relation to opportunity costs, this analysis is beyond the scope outlined for the *Survey*.
- The main focus of research for the *Survey* has been the use of ICT use in primary and secondary education, with additional investigation of ICT use in tertiary, vocational, and non-formal education. Many important aspects of the use of ICT in schools and in other learning-related contexts have not been addressed in the Survey. These include topics that cover services for special-needs students, assistive technologies, and providing ICT access to isolated and vulnerable populations, among others.
- ICT use in education is at a particularly dynamic stage in the Caribbean, which means that there are new developments and announcements happening on a daily basis. Therefore, these reports need to be seen as "snapshots" that were current at the time they were taken; it is expected that specific facts and figures presented in the *Country Reports* may become dated very quickly.
- It is anticipated that these reports will serve as the building block for an on-line database that will be updated collaboratively over time, based on additional research and feedback received through the *info*Dev web site. It is expected that individual *Country Reports* will be updated in an iterative process over time based on additional research and feedback received through the *info*Dev web site. For more information, and to suggest modifications to individual *Country Reports*, please see www.infodev.org/ict4edu-Caribbean.

Project background

This report synthesizes the findings from research that was initiated by the Information for Development Program (*info*Dev), a multi-donor partnership housed at the World Bank that investigates issues related to the effective and appropriate use of information and communication technologies (ICT) in developing countries. Research was undertaken in response to needs expressed by international donor and development agencies, private-sector organizations, governments, and NGOs for consolidated information focused on the following key questions:

- How is ICT currently being used in Caribbean countries, and what are the strategies and policies related to this use?
- What are the common challenges and constraints faced by Caribbean countries in this area?
- What is actually happening on the ground, and to what extent are donors involved?

Similar surveys were completed in 2003–2004 by the United Nations Educational, Scientific and Cultural Organization (UNESCO) (*Metasurvey on the Use of Technologies in Education in Asia and the Pacific*) and in 2007 with support from *info*Dev (*Survey of ICT and Education in Africa: A Summary Report, Based on 53 Country Surveys*). It is hoped that this *Survey* will also contribute to the building of a global database on ICT and education issues in developing countries, regularly updated with the cooperation of project stakeholders.

More complete background information on this project is available on the *info*Dev Web site at http://www.infodev.org/ict4edu-caribbean.

Methodology

The *Survey* is intended as a broad presentation of fact overlaid with observations made by people involved in educational ICT efforts within the region and by the author's analysis. The main methods of gathering information for the *Survey,* then, were face-to-face and telephone interviews with respondents, email communication, and a survey of literature including policy documents, project reports, news articles, Web pages, and other resources. Original research—surveys, for example, leading to quantitative analysis or descriptive statistics—was not undertaken.

Information has been compiled from many, often duplicative and occasionally informal, sources. A list of works consulted, appearing at the end of Volume 1, includes formal sources such as reports, policies and other documents, but does not include government-maintained Web sites or other more evanescent sources. Citations within sections have been kept to a minimum.

Small Island Developing States

The *Survey* focuses on the region's small island developing states (SIDS) so as to maximize understanding of areas of commonality in terms of scale, economic factors, and other conditions. SIDS can be characterized as island states that typically are confronted by the following conditions:

- Small populations
- Limited natural resources
- Susceptibility to natural disasters such as hurricanes
- High reliance on international trade
- Vulnerability to international economic events

The economies of SIDS tend to be conditioned by their limited scale and by high transportation and communication costs. Their typically undiversified economies increase their vulnerability to natural, economic and other shocks. All of these conditions apply, in varying degrees, to Caribbean SIDS.

Many Caribbean countries, in addition, comprise archipelagos or parts of archipelagos, meaning that their populations are distributed on several islands, frequently with disparities of wealth and opportunity among them.

Interview respondents

The following people responded generously to requests for interviews regarding ICT in education in the Caribbean, and for review of the country profiles that appear in Volume 2 of the *Survey.*

- Cathy Augier-Gill
  Ministry of Education, Human Resource Development, Youth and Sports
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- Worrell Brooks
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  Anguilla

- Leo Cato
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  Ministry of Education
  Grenada

- Albert Corcho
  Principal, Tarrant High School
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- Chris Gilbert
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- Kathleen Greenaway
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  Ministry of Education and Labour
  Montserrat

- Hon. Girlyn Miguel
  Minister of Education, Youth, and Sports
  St. Vincent and the Grenadines

- Hon. Dr. Carlton Mills
  Minister of Education, Youth, Sports and Culture
  Ministry of Education
  Turks and Caicos Islands

- Quinton Morton
  Director EMIS
  Ministry of Education
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- Marlon Narcisse
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  Ministry of Education, Human Resource Development Youth and Sports
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- Tyrone Smith
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  Department of Education
  British Virgin Islands

- Clinton Stapleton
  Director
  Territorial Office of Instructional Technology
  Department of Education
  US Virgin Islands

- Hassan Syed
  President
  University College Cayman Islands
  Cayman Islands

- Denzil West
  Director for Government Information Systems
  Ministry of Finance
  Dominica

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About the author

Edmond Gaible, Ph.D., president of The Natoma Group, is a consultant in ICT for development based in Oakland, California, specializing in teacher development, technology integration, and in appropriate technology and sustainable solutions. Over the last ten years, he has worked with governments, development agencies, foundations, and local NGOs on projects in Africa, Asia, and Latin America. In 2006, with Mary Burns, he wrote the *info*Dev guide, *Using Technology to Train Teachers.*

Additional research for the *Survey of ICT in Education in the Caribbean* was conducted by Mary Burns and by Clarisse O. Lima, Ph.D.

At *info*Dev, the project was managed by Michael Trucano.

Findings

Findings in primary and secondary education

The findings below represent an overview of analysis and observations regarding primary and secondary education in Volume 1 and Volume 2 of this *Survey*. The situations in specific countries within the Caribbean will of course differ from these broader observations. More nuanced discussion of these findings and the relationships among them occur throughout the *Survey*.

Findings related to policy

- Most governments have drafted or approved ICT policies in education.
- ICT policies in education have had limited impact on practice.

Findings related to institutions and management

- Organizational understanding of issues surrounding ICT in education is low.
- Many individual government personnel have strong understanding of issues surrounding ICT in education.
- ICT-supported education management information management (EMIS) remains challenging; several countries have promising initiatives in process.
- Learning by organizations from national, regional, and international experiences in ICT in education is low.
- Institutional capacity is not adequate to plan and implement comprehensive projects using ICT to support transformation of management, curriculum, and classroom practices.
- High capital and operational costs of ICT projects are cited as barriers to impact.

Findings related to ICT infrastructure

- Most secondary and many primary schools enable teachers and students to access computers and the Internet.
- Internet connectivity to schools is in many cases adequate to meet current needs.
- Hardware quality and maintenance pose critical challenges.

Findings related to the curriculum and to assessment

- Most ICT initiatives target basic technology skills and support for students on the Caribbean Examination Council Information Technology (CXC IT) exams.
- Student scores on CXC IT exams are high relative to scores in other subjects.
- Student scores on CXC IT exams do not correlate with workplace-ready skills.
- The IT curriculum and the IT-teacher position as currently staffed pose barriers to the use of technology to support learning in other subjects.
- High reliance on CXC exams for assessment limits the potential for changes in classroom practice.

Findings related to teacher professional development

- In-service teacher professional development (TPD) relies on "pull-out" workshops, which produce limited change in classroom practice.
- Participation in technology-focused TPD falls short of goals.
- TPD models tend to teach ICT skills separately from pedagogical skills.
- Pre-service teacher education does not provide adequate introduction to ICT and does not address use of ICT to support teaching and learning.

Findings related to teaching and learning in the classroom

- Student access to ICT for learning in non-IT subjects is limited.
- Support for integration of ICT across the curriculum has not influenced teachers' activities.
- The impact of technology on learning outcomes in the Caribbean has yet to be demonstrated.

Findings related to regional cooperation

- Cooperative efforts by the Organisation of Eastern Caribbean States Education Reform Unit (OERU) and education ministries have influenced policy development.
- Cooperative efforts by the OERU and education ministries to support information management have not had impact.
- There is limited direct support by regional organizations for teachers or students to use technology to collaborate, access learning resources, or otherwise use ICT to support mastery of the curriculum.

Findings in tertiary education

The following findings represent an overview of analysis and observation regarding the use of ICT in tertiary education in the Caribbean.

- Student access to computers and the Internet at many tertiary level institutions (TLIs) is adequate, and in some instances above adequate.
- Many TLIs offer degrees and/or certificates in technical skills (e.g., autoCAD (Computer-aided design) and subjects (e.g., computer science).
- Access to ICT and ICT-focused education at teachers colleges and other teacher-education institutions is significantly lower than in other TLIs.
- Establishment of region-wide ICT infrastructure supporting increased collaboration and wider use of ICT-supported distance education remains a challenge.
- UWIDEC is expanding use of ICT to meet geographical obstacles to student access to higher education.
- Regional organizations such as Caribbean Knowledge and Learning Network (CKLN) and Caribbean Universities Project for Integrated Distance Education (CUPIDE) have yet to significantly impact operations or delivery of education by TLIs.

Chapter 1

Overview

Introduction

The *Survey of ICT and Education in the Caribbean* is intended to meet the need for a comprehensive representation of the current state of ICT[1] use in education in the Caribbean. For SIDS[2] in the region, the study addresses:

- The state of policy and planning
- Current usage of ICT in the primary, secondary and tertiary systems
- Pre-service and in-service TPD
- Critical challenges

For each country, the review also presents information about the incorporation of ICT into non-formal and community-focused ICT education and into technical and vocational education and training (TVET).

In general, the experiences and situations among the countries examined vary only within a limited range. Countries differ in terms of their goals for the introduction of ICT and in the pathways they have chosen to achieve those goals. And, certainly, some governments and some institutions have invested more, attempted more, and achieved more than others. However none of the countries included in the *Survey* have "lapped the field" by achieving either system-wide adoption of ICT or the ICT-supported transformation of teaching and learning.

The importance of the introduction of ICT into Caribbean education systems is linked—as it is in other regions, both developing and developed—to the pressure on societies and economies to respond dynamically to globalization. In many Caribbean countries, globalization has brought increased competition in formerly protected agricultural-export markets, plus increasing economic reliance on service-oriented sectors such as tourism and financial services. These factors have in turn led to increasing fluidity of cultural information and exchange, taking forms that range from the out-migration of the highly educated to the importation of mass media. The region's SIDS, moreover, struggle against the challenges presented by their geographies, such as small and distributed populations, and vulnerability to both international economic and local climate events.

ICT occupies a complex position in relation to globalization. ICT facilitates the entry of foreign elements of many types—by simplifying tourists' travel, lowering barriers to capital flows and business expansions, by delivering Web pages to screens. And ICT is at least in terms of its origins foreign to the region, an imported product. As a suite of tools, however, ICT also strengthens the abilities of local populations to participate in the international economy as workers and as consumers, and as exporters of culturally (and personally) linked goods, services and information, thus accelerating the pace of globalization.

Understanding ICT as a paradoxical, "double-edged" factor in globalization is reflected in the wide range of goals attached to the use of ICT in Caribbean schools. Computers and the Internet are presented as tools—or subjects—to be mastered, with that mastery promising enhanced productivity and economic success. They are also presented as solutions to the challenges of ensuring that students have adequate literacy, numeracy, and other basic skills. And ICT is presented as enabling teachers and students to engage with learning in new ways, ways that transform their relationships to mathematical problems, history, culture, and art, and to innovation and creativity. This continuum, stretching from

1 "Information and Communications Technology," or ICT, has become a term of art in the field of development. One definition, of many possible, is "Any technology that allows users to create, store, display information in all its forms or communicate with others over a distance; such as computers, television, handheld computers, radio, audiocassettes, DVD and CD players, cell phones, networks, and the convergence of any of these technologies" (from the glossary of this *Survey*).
2 A glossary addressing relevant education, technology, and other terms is included at the end of this volume.

rote learning of ICT-as-tool to ICT-enhanced building of knowledge and the ability to wield it, frames the efforts Caribbean countries have made and continue to make in this regard today.

This first volume of the *Survey* presents information on region-wide trends in relation to policy, management of information, ICT use in schools, and other topics. Common challenges are also described, and where appropriate, opportunities for regional action to address these challenges are identified. The final section presents profiles of selected ICT projects in Caribbean schools.

The second volume of the *Survey* comprises individual studies of the countries, protectorates, and departments selected for inclusion in the *Survey.*

Context: ICT in Caribbean schools

The Caribbean's investment in ICT in education has led to significant incremental achievements and to the emergence of active regional organizations. Increases in students' technology skills are the most concrete outcome. Changes in curricula, teaching practices, and learning behaviors have proven much more elusive.

Caribbean countries have in many instances built systems that provide adequate access to computers and the Internet, and have developed capacity to design, implement, and manage educational technology projects. To cite progress in four countries: Anguilla now ensures that all primary students have ICT skills; Barbados and Trinidad and Tobago have conceived ambitious and comprehensive technology projects for their secondary schools (see "Profile: EduTech 2000" and the relevant country profiles in Volume 2); Dominica—which as of this writing hasn't adopted an ICT-in-education policy, and has yet to pass 90 percent gross secondary enrolment—has provided Internet-enabled computer labs in over 50 percent of both primary and secondary schools; the Jamaican Human Employment and Resource Training Trust/National Training Agency (HEART Trust/NTA) has established ICT support, including e-learning, for its 80,000 TVET students (see "Profile: HEART Trust/NTA"). While a great deal remains to be done to integrate ICT into operations and classrooms, Ministries of Education (MOEs) are seeing returns on these and other investments: region-wide performance on the hands-on portion of the Caribbean Secondary Education Certificate (CSEC) IT exam increased by 32 percent between 2004 and 2005.

At the regional and tertiary levels, organizational strength in ICT is also emerging. Support for ICT policy development by the OERU has been successful. OERU efforts at sparking use of EMIS have achieved less. But as an active, regionally focused strategic partner—with a unit wholly devoted to ICT—OERU is well positioned to assist Caribbean MOEs as they strive to increase ICT access and effectiveness. Organizations such as the CKLN and CUPIDE have the potential to leverage existing content and operational structures, such as the very effective programs managed by UWIDEC, to meet the increasing demand for local tertiary learning.

(See the sections, "Selected regional ICT initiatives in education" and "Regional and national EMIS initiatives" for more information.)

Challenges: Education, technology, and economic development in the Caribbean

Poverty and economic development remain critical issues for the countries of the Caribbean, despite economic growth during the 1980s and 1990s that averaged 4 to 6 percent per year in real terms. Over 30 percent of the populations of countries such as Dominica, St. Kitts and Nevis, and St. Vincent and the Grenadines are unable to finance basic consumption, with slightly smaller percentages of populations in Anguilla, British Virgin Islands, Jamaica, St. Lucia, Trinidad and Tobago, and the Turks and Caicos Islands also living in poverty.

In the later 1990s and the first years of the 21st century, economic growth has slowed, and Caribbean economies have demonstrated increased volatility. Factors impeding growth have included the September 11, 2001, attacks on the United States, loss of protected markets for agricultural exports, increasing oil prices, and hurricanes (e.g., Ivan in 2004). Expatriate remittances, including those from unskilled and semi-skilled workers moving within the region to find jobs, are vital to individuals and to national economies, surpassing exports of goods and services in several countries. Overall, the economies of the region lack resilience,

demonstrating the high vulnerability to external and internal events that typify SIDS.

As discussed in the recent report, *School and work. Does the Eastern Caribbean Education System Adequately Prepare Youth for the Global Economy?,*[3] demand for skilled labor exceeds capacity in OECS countries, limiting economic competitiveness, while unemployment among low-skilled workers continues to grow. Concurrent with the steady-growth years of the 1980s and 1990s and continuing through the present, OECS economies have increased their reliance on services, while agricultural sectors have steadily declined in importance. Tourism is among the fastest growing industries in most national economies in the Caribbean. However, tourism's positive impact on poverty reduction is limited by foreign ownership of hotels and airlines, the skill levels required for employment, and tourism's effect on inflation.

School and work finds that inadequate ICT skills among Caribbean school leavers combined with the lack of employer-sponsored professional development limit both the employability of individual youth and the competitiveness of businesses.

As discussed in the Volume 1 section of this *Survey*, "Regional trends: Trends in ICT in Caribbean education," Caribbean MOEs tend to address the gap directly, channeling their ICT-related efforts primarily toward the introduction of IT curricula and preparation for the CXC IT exams. The exams themselves focus on hands-on and theoretical development of workplace-appropriate ICT skills. School labs operate at capacity, with schools frequently challenged to meet demand for IT classes.

Results from the 2007 CSEC IT exams, however, suggest that even students completing IT curricula and sitting for IT exams do not demonstrate mastery of workplace-level computer skills and knowledge. Students' hands-on skills generally surpassed their mastery of theoretical or abstract sections. While student performance has improved, the skills gained do not match up with skills required by the workplace. (Additional information about the CXC exams appears in the section, "Regional trends.")

To address the more complex, non-technological skills required by business, ICT-in-education policies call for integrating the use of ICT into standard curricula.

However, foundational elements of many ICT implementations in Caribbean school systems amplify the obstacles to technology integration posed by low levels of teacher education and lack of ICT skills. As discussed in the section, "Regional trends: Trends in ICT in Caribbean education," factors such as test-based curricula, lab-based IT curricula, and lack of incentive for IT teachers to engage in integration limit the potential for technology to support changes in teaching and learning.

Among prior and current projects in the Caribbean, the designs of the Barbadian project EduTech 2000 and the Trinidadian FastForward project most closely approach the systemic transformation required for ICT integration. However, the history of EduTech 2000 reveals that the strains that large-scale, multi-component technology projects place on education ministries and their partners.

Overall, countries included in the *Survey* have progressed in terms of providing access to computers and the Internet, and in learning of basic computer skills. Efforts to support students' development of workplace-appropriate ICT skills and the higher-order skills related to collaboration, communication, and problem solving have been less successful.

Key questions: Integration or innovation?

Two factors call into question the value placed on technology integration by Caribbean MOEs. As noted, the challenges that confront integration efforts are to a large extent systemic, and; the effectiveness of the curriculum itself in terms of the needs of students as individuals and in relation to economic development appears to be limited. *School and work* cites the use of education as a screening mechanism for civil-service jobs and frames the resulting problem as follows:

> There seems to be a general disconnect between education and the world of work

3 World Bank, 2007, Regional Brief. Additional information is drawn from "Trends and circumstances in Caribbean tourism," by David Timothy Duval, in *Tourism in the Caribbean: Development, management, prospects* (London: Routledge, 2004) and from Prof. Compton Bourne's "Economic challenges in the Caribbean community," a presentation delivered at the Twelfth Conference of Montreal, Canada, on 8 June, 2006. Professor Bourne is president of the Caribbean Development Bank.

> in the Eastern Caribbean…. The over-emphasis on academia leads to an education system that does not necessarily impart skills related to the labor market.[4]

Given this disconnect, and given the limited success of skills-based IT programs thus far, three questions should perhaps be asked:

- Will system-wide efforts aimed at integrating technology across the curriculum improve student learning and educational relevance if and when they succeed?
- What other approaches and tools might better enable students to develop the skills required in today's workplace?
- Can those alternative approaches also enhance the relevance and practical value of education?

Important alternatives for consideration include introduction of "distributive" approaches to ICT implementation, and Web 2.0 tools such as blogs, wikis, and podcasts.

Distributive approaches focus on school and classroom transformation at the local level by supporting motivated school leadership, faculty, and students. Examples of the success of distributive approaches to educational change can be found in countries as disparate as the United States—where early ICT implementation, charter schools, and home schooling all reflect distributive frameworks—Singapore, and Uganda.[5] In these and other instances, the experiences of early adopters can lead to "ecosystems" of innovation into which other teachers, students, and schools can enter and thrive.

Web 2.0 tools and other alternatives to productivity software and IT classes can complement distributive support for pedagogical innovation—in many instances by facilitating teachers' and students' activities as producers of knowledge (and educational content) in contrast to their more traditional roles as, respectively, suppliers and consumers of information.

Regional and national initiatives that can support use of alternative tools and activities include the hosting of wiki, blogging, and file-sharing Web sites for images or audio, developing newly-started teacher resources for educational blogging, and providing incentives for participation in international contests, such as ThinkQuest (www.think.com) or theoneminutesJr video network (www.theoneminutesjr.org).[6] Hypothetical examples of local innovations that might emerge from such initiatives include student-created pod-casts to develop reading fluency among early-language learners or teachers' collaborative development of an image repository of local and regional plants.

(Discussion of the educational use of alternative approaches, tools, and other current developments in learning-related ICT occurs in the section, "Global trends in education and ICT.")

A salient Caribbean example of the results possible with local implementation of Web 2.0 tools is the School of Tomorrow (www.schooloftomorrow-ipaaruba.com) at the Pedagogical Institute of Aruba (IPA). Sparked by the enthusiasm and leadership of one teacher, the School of Tomorrow has engaged in group-blog collaborations with Dutch students and others, and incorporated ICT—including Web-page development—into many aspects of teaching and learning. The program and its relation to Aruba's overall progress in ICT in education is described in detail in the section, "Profiles of selected projects: School of Tomorrow."

Over the course of the past decade, many countries included in the *Survey* have made significant efforts in relation to educational ICT. Resolving from the two intrinsic challenges, such as the exam-focused orientation of instruction, and extrinsic challenges, such as limited private sector ICT capacity, these

4 *School and work*, pages 10–11.

5 Distributive initiatives such as Singapore's "Thinking skills, learning nation," and the Uganda Rural Schools Very Small Aperture Terminal (VSAT) Connectivity project have succeeded as a result of the empowerment of local teachers and schools to adjust curricula and pedagogy to achieve impact. The Singapore initiative was congruent with other steps by the Singaporean MOE to devolve control of learning, including the 1988 creation of "independent schools," comprising high-performing private secondary schools, and later of analogous, public "autonomous schools" that were to serve as leaders in the development of a high-skills workforce. In Uganda, where other priorities supercede computers in schools, the MOE's initial support for ICT took shape as an elective IT curriculum and exam launched in 2002. Substantial inputs by local NGOs, the private sector, and development agencies, partly in response to these measures, led over 54 schools to acquire VSAT broadband Internet capacity and to develop sustainable computer labs by 2004. Key factors included the leadership of SchoolNet Uganda, emergence of a private sector ISP motivated to provide broadband to client schools, and committed teachers and head teachers.

6 A contest and collection of one-minute videos by youth, theoneminutesJr was co-founded by the United Nations Children's Fund (UNICEF) in 2002. The website features over 1,500 videos from youth in over 80 countries, including LDCs such as Burundi, The Gambia and Sierra Leone. Although a theoneminutesJr videography workshop was held in Barbados in 2005, neither Barbados nor any other Caribbean country is represented by youth videos on the Web site.

efforts have not yet been rewarded by substantial impact. However much has been done to increase student access to ICT at the secondary level; in the process knowledge, capacity and experience have been gained by the region's education personnel, especially among those now responsible for moving forward with ICT. At this juncture, ICT has if anything become more important to the region's economic development, and both more affordable and more flexible in terms of its potential use in schools. To disregard the Caribbean countries' achievements in terms of educational computing would be no less dangerous than to disregard the limitations of these achievements.

Overview of sections

The *Survey* is intended to address the information needs and interests of personnel at donor organizations as well as Caribbean education policymakers, strategists, and implementers. Accordingly, sections include:

- **Regional trends**
  Broad factors conditioning ICT use in education in the region; trends in connectivity, maintenance and other program areas; challenges commonly cited by respondents; barriers to technology integration; e-waste disposal
- **Global trends in education and ICT**
  Current international developments in the use of ICT for education, ranging from lease-based procurement, to active-learning pedagogies, to one-to-one computing
- **Selected regional ICT initiatives in education**
  Profiles and discussion of six initiatives intended to increase ICT access and/or capacity among education systems and educational institutions: OERU policy initiative; CUPIDE; CKLN; UWIDEC blended learning project; Caribbean Association for Distance and Open Learning (CARADOL); Virtual University of the Small States of the Commonwealth (VUSSC)
- **Regional and national EMIS initiatives**
  A brief history of EMIS implementation in the region; chart of current status of EMIS in individual countries; discussion of three current (2007) EMIS pilot tests
- **Profiles of selected projects**
  Brief discussions of four country-based ICT projects in education: EduTech 2000 from the Barbados Ministry of Education, Youth, Sports and Culture (MOE) Barbados Learning Management System (LMS) and National Qualifications Register (NQR), from Jamaica's HEART Trust/NTA; Voice Over Internet Protocol (VOIP) network from the US Virgin Islands Department of Education (VIDE); School of Tomorrow from Aruba's MOE

Volume 2 of this study presents:

- **Profiles of ICT in education in Caribbean countries**
  Profiles of ICT in education in each Caribbean country included in the *Survey,* addressing: policy and planning; ICT in primary and secondary schools; TPD; tertiary education; non-formal learning and TVET; EMIS and MOE capacity; barriers and challenges

Chapter 2

Regional trends

Introduction

Tourism and financial services play increasingly important roles in the economies of many Caribbean countries. While the tourism and financial sectors are growing, prior mainstay sectors, such as export agriculture are shrinking in response to shifts in market conditions, the end of trade protections, and increased international competition. This dynamic is magnified when emerging sectors out-compete established sectors for labor, and as out-migration of both high- and low-skilled labor continues.

How does this broad picture bear on the use of ICT in education?

Over the past decade, goals for education in Caribbean countries have shifted in response to successful progress toward universal education made during the 1990s, and to perceived opportunities for higher-skilled labor. Prior emphasis on expanding access has given way to emphasis on improving educational quality in relation to both traditional standards of assessment and to the nurturing of an "ideal Caribbean person" as described in the CARICOM (Caribbean Community) Charter for Civil Society. Both the Charter and the broad drivers of economic growth—tourism and financial services—benefit from development of human capacity in general and from ICT skills in particular.

ICT, especially as it is framed in national policy documents, is widely viewed as a means of effecting change in schools that connects directly to increased participation in both the national culture and the national economy. These projected changes, then, form the gross standard against which not only the effectiveness of ICT in schools, but also the measures taken by education systems to implement ICT, should be viewed.

The regional ICT environment

The 2003 Georgetown Declaration and release of the CARICOM connectivity strategy began a significant enhancement of the enabling environment for ICT on a regional basis. However, change resulting from these measures, following a decade or more of only limited deregulation and market liberalization, has been slow. Institutional capacity in the public sector remains under-developed; technical capacity in the private sector, and more specifically "home-grown" IT-entrepreneurialism, is low in many countries. Limited enrolments at domestic TLIs coupled with out-migration of citizens educated abroad compounds the situations in the civil and private sectors by limiting the potential for the emergence of a cadre of ICT professionals.

Among consumers, high costs of electrical power, Internet connectivity and computer maintenance may be effective barriers to adoption of ICT, despite the categorization of countries in the region as middle-income. Lack of education, or of confidence in the ability to learn, may also bar widespread computer use by the general population.

These conditions—limited institutional and private-sector ICT capacity coupled with low penetration among the general public—likely influence the broad direction of ICT implementation in schools in terms of its most visible characteristic: the centering of instruction on basic computing skills and ICT use. Policy directives notwithstanding, absent a climate of fluent and even creative use of ICT in at least one other area of society, the introduction of computers and the Internet in schools will be seen as having value for its own sake. Integration of ICT into a reformed curriculum may lead to deeper change in teaching and learning, however access to ICT as it is currently provided is unlikely to prompt needed changes in the curriculum or to lead to profound transformation of learning behaviors. Within the context of

Caribbean ICT capacity overall, current levels of implementation in schools are significant, as is their impact on the development of at least vocational-level ICT competencies.

The regional education environment

Access to education within the region increased during the 1990s and after, due to substantial effort. Universal primary education has largely been achieved; matriculation to secondary school continues to improve, and exceeds 90 percent in Aruba, Barbados, the British Virgin Islands, the US Virgin Islands, and other countries.[7] At the primary level, efforts have been made in many countries to address antiquated facilities and shortages of trained or certified faculty. Management of educational information, while critical to systemic improvement, remains challenging.

Although secondary enrolment is increasing, secondary completion continues to be an issue in many countries. In Jamaica, 20 percent of students leave school following completion of grade 9, while one in three students completing grade 11 do not take CXC exams.

As implied in the preponderance of the region's education plans and strategies, the quality of instruction is not uniformly high, and instruction remains weakly linked to higher education, national cultures, and the globalizing economy. Viewed in terms of the CXC CSEC exams—the yardstick acknowledged at least implicitly by both schools and students—the effectiveness of instruction across the region is moderate at best, and may be declining. In 2004, 69.5 percent of returned exams achieved grades I through III (passing), while in 2005 49 percent of returned exams achieved these grades. With equivalent numbers of exams returned (29,119 in 2005; 30,069 in 2004), student performance declined significantly in subjects such as biology, chemistry, English, and to a lesser degree mathematics.

Student performance in the IT portion of the CSEC exam, however, improved from 42 to 62 percent in the same period.

The CXC IT exams

The high-stakes CXC IT exams, administered to 5th- and 6th-form students exert significant influence on teaching and learning activities in OECS countries; the CXC IT exams are a primary determinant of educational uses of ICT.

The CXC stages two levels of examination: the CSEC for 5th-form students (11 years of schooling) and the Caribbean Advanced Proficiency Examination (CAPE) for 6th-form and community college students.

The CSEC IT syllabus is intended to "provide a coherent view of the significance of information in a socio-economic context." The syllabus offers certification via General Proficiency and Technical Proficiency exams. The former, the General Proficiency exam, is designed for candidates continuing with post-secondary studies, the Technical Proficiency Exam is for candidates who will be pursuing entry-level employment. Topics include:

1. Fundamentals of hardware and software
2. Introduction to programming
3. Applications and implications
4. Productivity tools
5. Word processing
6. Spreadsheets
7. Database management
8. Information processing
9. Programming

General-proficiency candidates are examined on topics 1–4 and 8–9; Technical-proficiency candidates are examined on topics 1–7. Any of eight introductory textbooks can be used to cover most of these topics, with additional texts required for programming in most instances.

In the School-based Assessment (SBA) of practical skills for the Technical Proficiency exam, students are assigned activities designed by their teachers; each activity is to be based on "a cohesive scenario" requiring the use of office-productivity applications to import graphics, sort databases, generate reports and perform similar activities. Topics suggested as examples for these activities include school enrolment or calculation of sick days, analysis of accident data, analysis of data derived from sports.

SBA for the General Proficiency exam engages students in the use of programming and information-management skills to develop computer-based

7 Based on gross secondary enrolment reported for 2002–2003 (UNESCO, 2006, Education for All Global Monitoring Report).

solutions to meaningful problems. Timeframe for the SBA component is 35 hours distributed over a 25-week period. Suggested topics include education games and drill-and-practice activities, crop-rotation systems, hotel-reservations systems, and expert systems in medicine and agriculture, among others.

As noted previously, student performance in the CSEC IT exam improved markedly in 2005 while performance in most other subjects declined or remained stable. CXC states that improvement in comparison with 2004 scores occurred primarily in the practical or hands-on section of the IT exam. Declining performance typically occurred in essay or long-answer sections of the exam, while scores on multiple-choice sections were unchanged.

Tertiary education

Tertiary education is in short supply in the Caribbean. Capacity on many islands is limited to community colleges, teachers colleges, and UWIDEC learning centers. Including the 12 learning centers and its three campuses, UWI annual enrollment is approximately 36,000 students, with 5,800 graduating per year. A high proportion of students completing higher education do so outside of the Caribbean. UWI and UWIDEC, however, meet the needs of working professionals in many communities on many islands.

Trends in ICT in Caribbean education

ICT use in the education systems of Caribbean countries exhibits several shared characteristics:

- **ICT in primary schools**
  Some but not all primary schools have computers with Internet access. These are mainly used for skill building with educational software, and for the development of basic computing skills. Teachers may have some computer skills, but rarely have sufficient access or TPD to make use of ICT to improve teaching and learning. Computers are both older and in need of maintenance.
- **ICT in secondary schools**
  All or almost all secondary schools have computer labs with Internet access, however neither the number of computers nor Internet bandwidth are adequate to meet student demand for IT classes. Preferential access is given to upper-secondary students, and if resources are severely constrained access is apportioned based on student exam scores in disciplines such as math and science. Both upper- and lower-secondary students use ICT to prepare for the CSEC IT exam, with some upper-secondary students also preparing for the CAPE exams.

School systems deviate from these general profiles by, for example, using cart-based laptop computers and wireless networks to provide ICT access in classrooms or by introducing alternative technologies, such as the digital white boards used in the US Virgin Islands. Although these technologies and configurations may support some teachers and their classes as they explore innovative approaches to teaching and learning, they will be used in most instances to support traditional curricula and pedagogies.

Trends in primary and secondary education

Complementing the preceding snapshots are three trends directly related to ICT infrastructure and capacity:

- **Asymmetric Digital Subscriber Line (ADSL) Internet connectivity (with no cost to schools)**
  In most primary and secondary schools with computer labs, student computers are connected to the Internet, typically via broadband ADSL. In countries in which frame-relay methods have been the norm for connectivity such as Barbados and St. Lucia, these systems are in the process of being replaced. In most instances, respondents considered the data-transfer speeds provided by ADSL to be adequate. Concerns about the capacity of ADSL connections center on main secondary schools, which can have several computer labs and higher levels of Internet use.

  Typically, costs of Internet connectivity are paid by the MOE to Cable & Wireless (C & W). School budgets are not affected by connectivity costs.[8]

8 While connectivity costs are not typically passed on to schools—and while MOEs themselves may receive discounted rates for school connectivity—communications and Internet costs in the Caribbean remain high, at least in part because of lack of competition. By impeding economic development, investment in communications infrastructure, and ICT adoption, these high costs and the prevalent anti-competitive environment negatively influence the use of ICT by teachers, students, and school leavers.

- **School-site ICT maintenance by MOE IT unit**
  As hardware ages and goes off-warranty, maintenance of school-based ICT installations is being assigned to MOE IT units that were established to support computing in ministry or department offices, LANs and in some cases WANs, and education databases. Respondents in these units typically suggest that they are under-staffed and over-tasked. Unsurprisingly, maintenance is the most frequently cited problem for school-based computing. (See the next section, "Challenges to the use of ICT in schools")
- **Wireless networks, computer carts, and laptops**
  When school systems introduce or upgrade ICT, especially in primary schools, they increasingly deploy school-wide wireless (802.11) LANs. Although less frequent, laptop computers stored on carts are often introduced as well—usually as complements to older computer labs—to take advantage of the network coverage.

  Benefits of wireless networking that were cited include lower cost and increased flexibility, ability to put connected computers in classrooms, and increased security. Savings gained by wireless networking may be greater in the older school facilities common in many countries. Respondents also cited lack of available space for lab-based ICT as a factor in the selection of cart-based ICT.

  Respondents did not cite examples of small-group or project-based learning (PBL), or of teacher innovations resulting from the use of cart-based ICT in classrooms. Time, plus support in terms of curriculum reform and TPD, may catalyze outcomes in this area.

  Although they characterized computers on carts as less vulnerable, respondents did not cite theft or vandalism as challenges, and the prevalence of theft and vandalism is not known.

Note that respondents did not provide information about use of ICT to serve specific populations, such as special-needs students, isolated and vulnerable populations, students from economically disadvantaged communities, or others.

In addition to these school-level trends, many MOEs have drafted or adopted ICT policies in education, as discussed in the *Survey* section "Selected regional ICT initiatives in education," and have attempted to implement EMIS, as discussed in the section "Regional and national EMIS initiatives."

Use of school-based ICT by community adults

The use of school computer labs and Internet connections by community adults is not widespread, but is reported in many countries in a small sub-set of schools. Typically, community access to school ICT facilities results from decisions by school leadership, including the local Parent-Teachers Association (PTA), often made in collaboration with local NGOs. In some instances (US Virgin Islands), access may be offered to parents and family members only.

Limitations on the value returned by investments in ICT in education typically arise from various factors related to deployment and operations activities, or to the education environment—encompassing students, teachers, school facilities, curricula, policy and much more. In many instances, focus on the IT curriculum in schools limits the use of computers and the Internet to support learning in the broader curriculum. This section identifies several challenges commonly faced during deployment and operations or in relation to the educational environment, and offers suggestions to address these.[9]

Problems that arise in deployment and operations or in relation to the educational environment, however, also indicate problems in planning. Many respondents contributing to the *Survey* cited unforeseen events as limiting factors. As machines have gone off warranty and required repairs, for example, IT units and in some cases other ministries have been over-burdened by maintenance and support responsibilities. In the case of EduTech 2000 in Barbados, computer-lab installations were halted when additional time for renovation was required by school facilities, leading to problems in relation to funding deadlines and hardware contracts. Within the educational environment, failures to plan are at least as pervasive: Pilot testing of an EMIS product in St. Lucia encountered resistance among school administration and faculty who had not previously performed such extensive

9 Suggestions included here are provisional. Development of more concrete—and less provisional—recommendations requires systematic investigation in relation to needs and feasibility, as well as stakeholder input. A systematic approach of this kind is beyond the scope of the *Survey*.

data-entry and management as part of their jobs. Planning challenges increase when MOEs and other government institutions lack experience with large-scale, distributed computer projects and when these projects take place in the absence of a robust and thriving technology sector within the economy.

The quality of project design and implementation also suffer inasmuch as Caribbean governments have failed to learn from regional and international experience in the use of computers and the Internet to support education. (Again, respondents, reviewers, and others involved in the field have cited this problem directly to the author.) Several country governments have initiated relatively large-scale projects early in their commitments to ICT in education, experienced difficulties, or lack of impact from those programs, and subsequently designed additional programs that feature many of the same characteristics. Most broadly, the challenges posed by the IT curriculum and by the position of IT teacher were and are foreseeable based on the experiences of projects in other countries.

Although not mentioned by any respondents contributing to the *Survey,* e-waste disposal has the potential to become a significant problem as deployment of computers in schools continues in the Caribbean. A separate sub-section briefly addresses this issue.

Challenges in deployment and operations

While the challenges of planning in relation to organizational change may be profound—and clear to the outside observer—the most widely cited challenges among Caribbean countries are more specific and more closely tied to the "nuts and bolts" of ICT-focused project management and operations. Challenges related to operations and deployment of computers and networks communications include:

- **Procurement**
  Large-scale procurement of ICT hardware, software, and services presents substantial challenges to organizations of all kinds. Among Caribbean MOEs, lack of experience on the part of responsible parties has led on some occasions to over-reliance on vendor sales representatives, and has resulted in contracts that lack flexibility, foresight, or protection for the purchasing organizations. Respondents identified situations within the last decade in which: hardware was purchased without a service contract; software licenses—outside the United States only—had to be renewed every two years; EMIS software was inappropriate for the networking and connectivity situations of schools; contracts did not include "update" clauses, so delays in project implementation resulted in delivery of out-of-date hardware and software.

  Other procurement-related issues were reported in relation to donor funding and to inter-ministry coordination. Delays or changes in procurement required renegotiation of timetables, project extensions, and other adjustments to funding agreements. The tasks of procurement and payment are frequently distributed among several ministries. Problems have been reported as arising from differing accounting timelines and priorities: in some instances, funds have been "trapped" in ministries of finance until deadlines have nearly passed. The frequency of delays connected to procurement and finance led several respondents to suggest that typical project timelines be lengthened by one year or more.
- **High cost**
  Both expressly and indirectly, respondents cited the high costs associated with ICT programs as a significant barrier to the increased effectiveness of those programs. Although acquisition costs were often cited, the level of operating expense, including maintenance, supplies, and replacement costs among other items, may be a more significant concern. In some instances planning and budgeting did not accurately estimate these costs. Familiarity with Total Cost of Ownership (TCO) models varies. (Many respondents are not responsible for key aspects of planning and budgeting.)
- **Unlicensed software**
  Several respondents identified illegal copying of software as a problem at the school and ministry levels. The extent of illegal copying is unclear. When it occurs, however, software piracy may have several negative effects: system-wide maintenance is increased by the use of unlicensed and non-standard software products; and students observing adults and role models using or copying software illegally may have reduced respect for the rule of law and may be more

likely to plagiarize. Nonetheless, the challenges of introducing software-license compliance—especially given the distributed topographies of many Caribbean countries, and mixes of out-of-date hardware in school labs—are significant.

- **Delays in policy adoption**
  Several respondents cited slow adoption of ICT policies in education, suggesting that such delays caused unnecessary barriers to increasing the effective use of ICT in schools. Respondents citing delays in policy adoption also suggested that the process is compounded by policymakers' lack of understanding of ICT issues. In St. Lucia, an ICT-in-education policy was drafted based on the 2002 OERU template, yet the completed policy has not been adopted as of mid-2007.
- **Computer maintenance**
  Almost all respondents identified computer maintenance as a critical problem. In some instances, respondents estimated that as few as 40 percent of computers in primary schools were functional. In addition to lack of capacity within a given MOE, maintenance problems frequently result from aging hardware. In Jamaica, among other countries, the need to service a wide range of models adds to the problem. In many cases, school IT teachers provide frontline maintenance, despite their limited skill and access to parts.

  Maintenance issues have been compounded by problems in procurement—and implementation—in Barbados, Trinidad and Tobago, and other countries.

Suggestions in relation to deployment and operations

There are a number of measures that national governments or regional organizations can take to address challenges in relation to ICT deployment and related operations. These include:

- **Develop maintenance contract templates**
  A standard maintenance contract can enable MOEs to negotiate more effectively with private-sector providers. Such a template would stipulate levels of service, response time, costs, and other issues, but might also address special situations in relation to remote school sites (e.g., travel expenses, response-time exceptions). Many Caribbean school systems are too small to warrant establishment of a maintenance department solely devoted to school computers. However, the tendency to keep older hardware in service increases both the need for and the complexity of maintenance. In countries with geographically distributed or isolated communities and schools, and low overall penetration of ICT, private-sector providers may be preferred alternatives if terms are cost-effective and accountability is supported contractually.
- **Conduct a regional workshop on ICT procurement**
  Effective procurement has proven difficult in relation to school computers, EMIS, and other systems. The level of experience within Caribbean education and finance ministries may be sufficient that focused sharing of experiences and recommendations will adequately increase capacity throughout the region. Sessions should address, among other topics, hardware and software contracts, plus experiences and best practices in working with vendors, donors, and other ministries. Exploration of lease contracts, which may allow hardware acquisition to be booked as operating expenses rather than capital costs, may also be effectively discussed.
- **Support TCO calculations**
  TCO calculations of ICT acquisition, operation, and disposal are routinely conducted in OECD countries using relatively elaborate tools and templates. One or more of these resources should be adopted by OERU or another regional organization and adapted, with support by appropriate training and job aids, for use by Caribbean MOEs.
- **Conduct small-scale testing of alternative hardware platforms**
  The cost savings of alternatives to standalone PC workstations in education are largely unproven. However several such alternatives—such as the use of thin-client networks—have the potential to reduce acquisition and operating costs. School-based field tests should be conducted to enable comparison of costs and effectiveness among these alternatives and in relation to standard platforms.

Suggestions regarding e-Waste disposal

No respondents identified the problem of computer recycling and disposal. However, school

systems are often among the earliest large-scale public-sector adopters of ICT. As a result, the need for low-cost and effective solutions for the disposal of e-waste may confront MOEs as a result of legislation—and mounting waste—well before a comprehensive government-wide recycling and disposal solution is crafted.

An "e-Waste Symposium" was held in Trinidad and Tobago in August 2006. The symposium pointed to the need for regional solutions for e-waste recycling and disposal. Although not addressing school computer installations directly, the symposium pointed to the need for "guiding principles" for e-waste in the region, and for the overall need of regional solutions. The symposium also affirmed the value of working with private sector disposal companies whenever possible.[10]

The distributed Caribbean topography and small populations of many countries greatly increase the difficulties entailed in recycling or disposing of computers. Some multinational hardware vendors operate "global" recycling programs. However, most of these programs do not extend to the Caribbean, with the exception of some of the territories of OECD nations, notably Puerto Rico.

Although e-waste solutions lie well outside the scope of this report, several measures appear immediately applicable. While these measures *might* not be appropriate to education organizations *per se*, those organizations should seek to influence appropriate bodies proactively through these and other steps. Potential measures include:

- Development of a white paper addressing best practices in e-waste management
- Development of a guide to "green procurement" practices and national or regional disposal services
- Inclusion of "green procurement" stipulations in funding agreements
- Inclusion of full-cost accounting (FCA) in TCO models and tools[11]

In addition, every effort to establish regional solutions—whether in the form of guidelines or as container-rate shipping to Puerto Rican recyclers or another measure—should be made in relation to the e-waste problem.

Challenges in the educational environment

The educational environment itself poses challenges to the use of ICT in schools. To some extent, computer-lab installations in combination with IT curricula and exams finesse these challenges by sequestering the use of computers and the Internet from classroom teaching and learning. Efforts to integrate ICT into subjects outside the IT curriculum typically run afoul of focus on the IT curriculum and of IT-specific elements that have evolved in the education environments of many Caribbean countries.

This sub-section outlines several of the major challenges that stem directly from efforts to introduce computers and the Internet as resources supporting student learning. There are many potential sources of challenge, however, that are related indirectly to the use of ICT and that fall outside the scope of the *Survey.* These potential challenges include education-specific issues such as teachers' levels of professionalism and commitment, teacher compensation, and school facilities, as well as conditions that are external to schools, and that range from the limited scope of private-sector technology activities to the high emigration rate of talented and educated Caribbean natives. Development of effective ICT programs in education both contributes to and depends on a complex network of other social and economic factors.

Challenges in Caribbean education environments that frequently influence the use of ICT include:

- **Focus on the IT curriculum and exams**
  The tendency of ministries of education in the Caribbean to orient use of computers and the Internet in schools is discussed throughout the *Survey.* Such efforts in many cases run counter to national policy statements and to the goals proposed by CARICOM and other regional organizations. Schools and school systems have in many countries provided students adequate

10 Puerto Rico and perhaps other countries in the Caribbean have private sector recycling and disposal operators, however Jamaica and many smaller countries do not.
11 FCA is the practice of including in capital acquisition the cost of all resources at the time that they are committed rather than when the money is spent. FCA in terms of computer hardware acquisition involves, among other things, including the cost of recycling or disposal in accounts at the time of purchase.

access to technology and to courses. Despite students' performance on exams, these efforts typically fail to develop a strong base of technology skill and use among students. Focus on the IT curriculum, then, does not deliver the value expected and at the same time limits use of potentially valuable technology resources to support student learning in other subjects.

- **Focus on exam preparation in all curriculum areas**
  As discussed in the Introduction to the *Survey,* the tendency among the region's education systems to equate education with preparation for exams, and the CXC exams in particular, limits the overall performance of education systems and also limits the potential contributions of ICT. The skills that computers and the Internet build among the general public—centering on discovery, development and exchange of information, and more elaborate resources—are not captured in national assessments as these are currently structured. The mastery of facts and of specific skills that *are* assessed in national exams is not well supported by ICT.
- **Lack of (or ineffective) technology-focused TPD for subject teachers**
  Pre-service and in-service teachers rarely receive effective TPD in relation to basic technology skills or in relation to using technology to improve student learning. In some instances, such as EduTech 2000 in Barbados, the technology-focused TPD program does not ensure teachers' participation; separation of basic skills and teaching-related uses of computers and the Internet into separate courses increases the negative impact of this separation. More broadly, a region-wide lack of standards for teaching with technology hampers development of effective TPD.
- **Few initiatives focusing on technology integration**
  Few ministries have undertaken significant efforts to support integration of ICT on either systemic or individual levels. The level of ICT resources in most Caribbean education systems is adequate to support individual teachers and students integrating technology on an *ad hoc* basis. Several simple steps, however, could be taken to increase support for the integration of ICT sufficiently to enable enthusiastic teachers and students to take maximum advantage of the ICT resources available to them.[12]

IT teachers limit use of technology in schools
Many respondents, including Chief Education Officers, heads of IT departments and others, identified challenges to ICT integration that centered on the role and capacities of IT teachers. These include:

- Resistance to reducing the importance of IT classes
- Lack of capacity or willingness to collaborate effectively with other teachers
- Lack of familiarity with active-learning pedagogies
- High turnover
- Scheduling conflicts and limited interaction among IT teachers and faculty

One respondent also suggested that IT teachers tend to expropriate new hardware intended for ICT integration, using that hardware in their IT classes.

Issues surrounding hiring, training, and scheduling of IT teachers compound several of the challenges discussed here. Scheduling and overall collaboration among IT teachers and non-IT faculty is problematic, according to several respondents, even in situations where computer use is intended to support learning in specific subjects. IT teachers conduct the classes in computer labs; non-IT teachers may attend if they wish, but they can also use the period for lesson preparation or in other ways. In the labs, IT teachers typically support other curriculum areas by assigning students educational software in a particular subject, and that may be linked to specific learning objectives.

In addition to the issues surrounding the IT-teacher staff position identified above, respondents identified related issues. Hiring and retaining skilled IT teachers is difficult. To meet personnel needs, IT teachers may be hired who lack ICT skills and knowledge. In smaller countries, in particular, the majority of IT teachers are expatriates from larger Caribbean countries.

12 The importance of the emergence of a cadre of teachers who have successfully pursued ICT integration is debatable: "Leaders" such as those cited (Singapore, Costa Rica) have effected educational change through systemic transformation. In the U.S., in contrast, the primary impetus for technology integration from the 1990s to the present has been generated on the level of individual teachers, schools and school districts rather than state education systems or the national Department of Education.

Suggestions in relation to the educational environment

This section outlines suggestions that national governments or regional organizations might take to address challenges in relation to the educational environment. These suggestions are linked to two interrelated approaches to educational improvement: integration of technology across the curriculum and support for active-learning pedagogies.

The *sine qua non* of educational transformation and of effective integration of ICT into the curriculum is the coordinated review and revision of curriculum, assessment, and TPD to support active-learning strategies and the use of ICT. In countries where ICT has had the highest impact in education, such as Costa Rica, Chile, and Singapore, the introduction of computers and the Internet has been one part of the re-focusing of all pedagogical components. These technologies have been adopted and even exploited by teachers precisely because they help those teachers guide students toward new learning objectives and toward producing knowledge rather than re-producing knowledge.

Several of the suggestions in this section have the potential to facilitate the shift of teaching and learning away from memorization and test preparation, however their effectiveness is dependent on the overall structure and effective functioning of national education systems. At the point that such a shift becomes an explicit objective—as it has in Barbados, Trinidad and Tobago, and the U.S. Virgin Islands, among other countries—ministries of education should commit themselves to whole-cloth reworking of the relationship of assessment, curricula and the professional development of teachers. While such reforms would open many more possibilities for the effective use of ICT in schools, those possibilities are best positioned as objectives in the service of the more profound goal of the transformation of teaching and learning.

Development of comprehensive approaches to supporting the use of ICT in the service of educational change is a complex and far-reaching task. A few of the many possibilities include:

- **Identify best practices in TPD**
  Professional development of teachers, in relation to technology use and all elements of the teaching profession, requires long-term commitment of resources and activities. Effectiveness of TPD increases when workshop formats are deemphasized in favor of cluster-based models and communities of practice that link teachers with their peers, and when teachers are engaged in activities such as action research. To increase the effectiveness of ICT-focused TPD, ministries of education—and teachers themselves—must be well informed about successful models and program designs.
- **Identify and adopt national or region-wide standards for teaching with technology**
  ICT-focused TPD should rely on comprehensive and well-founded standards for teaching with technology. Such standards might be newly developed for use in the Caribbean or adopted from a pre-existing set such as International Society for Technology in Education National Education Technology Standards (ISTE NETS). Development, review, and adoption of such standards should take place in concert with review (and development of standards) for IT teachers.

  In some countries, it may make more sense to establish robust standards for all teachers' technology skills and to deemphasize the role of the IT teacher; in countries with well-established IT staff in schools, standards for other teachers may be less focused on technical aspects.
- **Develop and disseminate lesson plans for active learning**
  Among the obstacles that teachers face when they attempt to integrate technology into lessons are limited information about Web and other resources, poor understanding of good instructional design, lack of appropriate assessment tools, and difficulties connecting student activities to the established curriculum. Professionally developed lesson plans that address these and other concerns will channel the use of ICT toward support of active learning.

  (Such lesson plans should introduce simple projects with short timeframes and limited use of ICT. The effectiveness of such resources is directly related to the availability of in-service TPD, mentoring, and other inputs.)
- **Conduct regular national events that highlight ICT innovation in schools**
  Leadership is critical. MOEs must demonstrate their commitments to specific approaches to the

use of ICT in schools. School principals should also be tasked with supporting appropriate the use of ICT. National events—conferences, contests, publications, and media coverage—that recognize the achievements of students and teachers in relation to active learning and collaborative projects can spark additional teacher initiative. Such meetings can include recognition for innovation in education, and can serve as exchanges for new projects and collaborations.

- **Establish regional meetings on ICT innovation for ministry personnel**
  Understanding of effective use of computers and the Internet to support learning may be adequate in some Caribbean countries, but not in all. The field itself is in addition dynamic and complex. Regular regional meetings should include sharing knowledge and experiences, presentations by experts, and facilitated approaches to the development of region-wide, country-to-country, and school-to-school initiatives.
- **Develop region-wide support for collaborative projects**
  In addition to the forms that such support might take include a collaboration portal, group blogs and blogging projects, and other measures. A Caribbean-focused collaboration network, modeled on the International Education and Resource Network (iEARN) collaboration portal, could help teachers and students in different countries and on different islands work together or simply share ideas, opinions, and experiences. The School of Tomorrow in Aruba has successfully used blogs to connect Aruban students with students in the Netherlands. (See the section, "Project profile: School of Tomorrow, Aruba," for more information.) This project can be replicated by schools and on national and regional levels. Regional collaborations may, in turn, lower barriers to participation in international collaboration programs such as ThinkQuest and iEARN.
- **Establish and support regional and national SchoolNets**
  SchoolNets can be characterized as self-governing networks of member schools enabling school leadership, IT staff, and teachers to coordinate activities to meet shared objectives, and to advocate for specific measures supporting ICT in education. Although SchoolNet organizations have been founded in a few Caribbean countries, they have had very limited impact and were not mentioned as factors by respondents. SchoolNets in countries such as Uganda, Namibia, and South Africa have increased their effectiveness through recognized and coordinated relationships with the MOEs in their countries.
- **Provide appropriate TPD and incentives to IT teachers**
  As mentioned, IT teachers in many instances pose challenges to use of school computer installations to support learning outside the IT curriculum. To the extent that IT teachers are evaluated based on student performance on IT exams, this situation is resistant to change. However, with more appropriate incentives and effective TPD, IT teachers can become school-wide assets to computer use by teachers and students in all subjects.

  It may also be important to note at this point that the CXC IT syllabuses ask but do not require IT teachers to develop projects that involve the use of ICT. The syllabuses do not provide such projects to teachers, and do not suggest project topics that are correlated with curricula in other subjects. However, this situation presents itself as a potential avenue for the enlistment of IT teachers into PBL and other forms of ICT integration.

High-stakes testing, such as the CXC exams, poses perhaps the strongest barrier to ICT integration and changes in teaching and learning. In many countries in which exam performance is heavily weighted in relation to other potential assessment means, teachers and students (and parents) focus on test preparation despite significant inputs intended to change practices. Teachers are not well positioned to make changes in advance of policy or assessment reform. MOE personnel may be able over time to guide policy and practice toward incorporation of alternative assessment methods in combination with curriculum and classroom reforms and emphasis on ICT to support teaching and learning. Such efforts, however, require both time and focus. In advance of changes in assessment, project design should be shaped to the extent possible in order to minimize tension between new practices and exam performance. As an example: In well-known instances (Singapore) and less well-known (Syria), inputs intended to change pedagogical practices have been concentrated on grade levels in which students don't participate in nationwide year-end "funnel" exams.

The challenges identified in this section are intended to provide a broad overview of factors limiting technology use in schools. The suggestions provided in response are provisional. Focused research on needs and capacities combined with stakeholder discussions is in order before conclusions can be drawn or actions taken.

Chapter 3

Global trends in education and ICT

Overview

Schools and school systems have been using ICT for more than two decades to address goals ranging from the teaching of programming to increasing participation in distance education to supporting language-acquisition in early childhood. Over the course of this period, advances in hardware, software, and networking have amplified the potential that ICT holds for schools. Concurrently, the influence of systemic factors—including curricula, teacher capacity, infrastructure, and assessment—has become clearer, and has shaped both achievements and expectations.

The ideas and practices identified in this section appear at this time to be gaining currency among educators and education systems worldwide. However, successful implementation of these practices is tightly linked to resources, including financial and human resources within education systems and national infrastructure, private sector capacity, and attitudes about knowledge and technology. In some cases, such as the use of networks to centralize maintenance, provision of learning resources, and data management, the virtues of a specific model may only outweigh the costs in infrastructure-rich environments. Several countries in the Caribbean have attempted to centralize computing services in schools in the absence of reliable connectivity, and have learned that connectivity becomes a chokepoint with even moderate levels of network failure.

Several of the technologies and models that are emerging at this time are unproven. Others require specific circumstances, such as highly trained teachers or authentic-assessment practices, to be deployed successfully. However, some or all of the trends identified in this section have the potential to be adopted or adapted by developing-country school systems. This section is intended to help decision-makers stay informed about trends and new developments and to enable them to gauge current practices and plans in relation to contemporary and emerging norms.

No tool, model, or idea presented here is appropriate for all educational contexts. The appearance of a tool or model in this section does not constitute an endorsement of its value or effectiveness. At the end of each entry, resources providing information that is more detailed are listed.

Trends and innovations cited in this section are focused on primary and secondary education: Global use of ICT in tertiary education has proliferated in both developed and developing countries to an extent that places it beyond the scope of this report.

On the following page is a table outlining the trends described in this section.

Trends and developments in policy and planning

The single most notable development identified in this section is emergence of ICT as an accepted and necessary tool in schools and school systems.

Confirmation of the positive impact of computers on learning outcomes remains elusive.[13] Questions about the measurable impact of technology remain, as do questions about its costs in comparison to other kinds of inputs or intervention.

However school systems with critical needs to improve student outcomes—and with shortfalls of high-quality learning resources, trained teachers, and effective management—increasingly choose to

13 Cuban, L. 2001. Oversold and underused: Computers in the classroom. Harvard University Press.

Current International Trends in ICT in Education

Trend	Description	Current status
Policy facilitation	Provision of technical assistant and other support to MOEs for the development of ICT policies in education	■ Demonstrated value over the past ten years ■ Resulting policies may set goals (i.e., integration of ICT) that are unrealistic or require much more time than planned
Procurement via leasing	Acquisition of large numbers of computers or software licenses through vendor-direct leases rather than purchase	■ Costs paid from operations, not capital acquisitions ■ Costs may be lower or may be spread over several years
Total Cost of Ownership	Budget forecasting that calculates cost based on all relevant factors (e.g., training, maintenance, depreciation, etc.)	■ Much more accurate for planning purposes ■ Accuracy decreases as the timeframe expands ■ TCO model enables cost comparison, does not calculate or compare benefits
Interoperability frameworks	Standards for data transfer across diverse hardware platforms and networks	■ Critical for cost-effective EMIS ■ Older hardware and software versions may not be addressed
Active-learning pedagogies	Emphasis on learning by doing (i.e., projects, activities, etc.) rather than learning by listening	■ Effective support for development of higher-order thinking skills ■ Strong linkage to integration of ICT ■ Requires changes to curriculum, assessment and TPD to be adopted system-wide
Collaborative online projects	Student teams share information, knowledge, and research results to accomplish mutual goals	■ Commonly among the first widely practiced models for ICT integration ■ Limited technology requirements ■ Rarely addresses core curriculum or lesson plans
Balanced pedagogies	Combination of holistic or semantic-level approaches to literacy and numeracy with back-to-basics methods such as phonics	■ Well-supported by research and by teacher accounts ■ Requires sophisticated approach to curriculum reform ■ Teachers must be "brought on board" the program
Blogs by teachers and students	Use of blogs to share organizational information, to promote writing skills, and to support small-group collaboration	■ Easy to use, effective means of enabling student publishing ■ High levels of student interaction ■ May appeal to students with pre-dispositions to write, while having less value for other students
Probes, digicams, and other primary-research tools	Use of portable or peripheral hardware to collect data from the environmental or lab phenomena	■ Helps students build data-representation skills ■ Makes abstract concepts more seemingly real and easily grasped
Anti-plagiarism tools, services, and activities	Software and services in response to increased potential for copying passages or whole documents without attribution	■ Many options, ranging from Web-based tools to services that check student work for teachers
Wireless networking	Use of wireless networking technologies to create LANs in schools	■ Flexible, with lower installation costs ■ May lack adequate bandwidth for intensive school-wide use
Thin-client networking	Hardware configuration in which all computing power and data reside on server (or servers) connected by network to otherwise "dumb" terminals	■ Reductions in acquisition and maintenance costs ■ Support for open-source software (Linux) and refurbished hardware
One-to-one computing	System-wide provision of laptops to students, or: Use of specific technologies (digital whiteboards, digital tablets) to support increased real-time interaction in classrooms	■ Open-source software is linguistically customizable ■ Adopted by several states and many school districts in the U.S. ■ Core pedagogical model for the One Laptop Per Child project ■ Not yet proven to enhance learning outcomes

Source: The Natoma Group

address these problems through ICT-based solutions.[14] This situation holds true for countries in almost all stages of economic development: significant efforts to place ICT in the service of learning, teaching and administration have been launched by Least Developed Countries (LDCs) such as Namibia, Rwanda, and Bhutan, as well as many others.

Policy facilitation

Policy direction in relation to ICT is critical. National ICT or telecommunications policy may determine costs to schools, access to networks, and

14 Education Week. 2004. Technology counts '04: Global links: Lessons from the world.

other issues. Education-specific ICT policy may influence budget allocations, options for ensuring the sustainability of school-based computing, or faculty roles and staffing.

In response to the importance of policy, development agencies and donor organizations, along with regional alliances of national governments, have launched policy-facilitation initiatives. These initiatives have taken the form of regional workshops, technical assistance and consultancies, and development or aggregation of resources.

Several organizations involved in supporting governments' efforts to introduce ICT in education have provided assistance with policy development. In 2006, World Links conducted a policy workshop for representatives of seven Central American countries participating in World Links pilot projects. An *ICT-in-education toolkit* was launched by the ICT in Education group at UNESCO-Bangkok via consultative needs-assessment among Southeast Asian governments in 2003. In response to demand and need, the project has been expanded internationally through a partnership of UNESCO with *info*Dev. Development of the Toolkit has coincided with drafting of ICT policies in education by more than 10 Southeast Asian governments. This initiative has broader scope and resources, but is similar in objectives to the OERU ICT in education policy template, discussed in the section, "Selected regional ICT initiatives in education."

ICT-in-Education Toolkit
UNESCO / *info*Dev
www.infodev.org/en/Project.11.html
www.ictinedtoolkit.org

Etta, Florence E. and Laurent Elder, Eds. 2005. **At the crossroads: ICT policy making in East Africa**. East African Educational Publishers Ltd. http://www.idrc.ca/openebooks/219-8/

Procurement via leasing

Procurement of hardware and software is challenging for education administrators in all countries. Among the challenges to successful implementation of ICT in schools, financing and procurement management and subsequent costs is supreme. This situation reflects the broader trend toward underfunding of education. In the United States, for example, computer purchases in school districts may be funded by the sale of bond issues approved by voters; retirement of the bonds, however, may not be scheduled until long after the computers purchased with bond-based capital have become obsolete. In other instances, education funding is simply too limited to enable ICT purchases.

Leasing supports procurement based on periodic partial payments, enabling education systems to fund acquisitions based on current appropriations or operating budgets, rather "booking" ICT as a capital expense.

Governments—including school systems and ministries of education—increasingly procure hardware and software under lease or lease-to-buy programs. Hardware vendors (e.g., Apple Computer, Dell, Hewlett-Packard Corporation) operate dedicated units providing financial services for large-scale leasers in education and other sectors.

Dell Financial Services
http://www.dellfinancialservices.com/solutions/leasing_programs.asp

Apple Financial Services Education Finance
http://www.apple.com/education/financing/

Total cost of ownership

TCO is a financial model that aggregates direct and indirect costs in relation to purchase of computer hardware, software, or any other capital item. In the purchase of computers for an education system, TCO would include projected costs of installation, maintenance, training, electricity, recycling, and so on. TCO, then, can be contrasted with analysis based on the cost of acquisition alone.

In the education sector, and in the ICT for development field overall, TCO has gained currency in part as a response to the tendency of technology-project stakeholders to focus on acquisition costs in isolation and to fail to grapple with total project costs or requirements for sustainability. Recently, organizations such as Global e-Schools Initiative (GeSCI) and *info*Dev have begun development of resources for estimating TCO. Countries such as Namibia have stipulated that their financial projections be based on TCO in their ICT policies in education.

Limitations of the TCO model include its inability to estimate benefits, its use of long timeframes that may confound cost estimations, and its omission of elements such as risk or the time-value of money.

GeSCI TCO resources (prototype tool)
http://www.gesci.org/gesci/publisher/index.jsp?aID=162&nID=116&pID=97

Value of Investment
Private sector and public sector consortium offering TCO calculator and related tools
http://www.edtechvoi.org/index.cfm

Interoperability frameworks

A central challenge to effective EMIS is the problem of data transfer among software platforms and applications. Applications that teachers use on a daily basis may not be interoperable with EMIS platforms, requiring redundant data entry, and increasing the likelihood of errors—and the likelihood of EMIS data never being entered at all.

In the United States, national, state, and large-district school systems are entering into partnerships with manufacturers and service providers to ensure that hardware and software in schools and software used to support schools is interoperable and that data are accessible to authorized stakeholders.

The Schools Interoperability Framework (SIF) is maintained in the United States by the Schools Interoperability Framework Association (SIFA), with membership of over 300 government and private-sector organizations. SIFA has entered into cooperation agreements with Becta in the United Kingdom, European SchoolNet, and education.au (www.educationau.edu.au) in Australia to internationalize development and adoption of SIF.

SIFA
http://www.sifinfo.org

SIFA announcement of cooperation with international organizations
http://www.edustructures.com/com/news/05-03-06.html

Trends in curriculum, teaching, and learning: Primary and secondary school

Accompanying the acceptance of ICT as an educational tool in developing countries, there has been increasing focus on the interactions of ICT and teaching and learning. Although learning to use ICT remains the most prevalent use of ICT in schools, a shift in favor of the use of computers and the Internet to support activities intended to build complex and higher-order skills is taking place. Many factors influence this shift, but these factors may be effectively organized around the linkage of education policy to workforces prepared to contribute to a globalizing world economy. In strategic development plans (e.g., PRSPs) and vision papers (e.g., Rwanda 2020 Vision) efforts to address both globalization and the potential of the knowledge economy in broader society tend to emphasize education as a means to develop communication and higher-order cognitive skills.

Policy facilitation, especially insofar as it draws on experiences in technology-rich education systems, tends to characterize ICT integration and enhanced learning across the curriculum as broadly accepted best practices. However, the concept of "technology integration" as it is reflected in program designs and pedagogical models takes on diverse and in some cases very limited forms in some instances.

Active-learning pedagogies

Whether it takes the form of constructivist pedagogy, project-based or collaborative learning, or competency-based assessment, education systems in many developed and developing countries are attempting to supplement or replace pedagogies based on skills acquisition with active-learning methods. Finland, which now bases its curriculum on PBL, Singapore, and other countries have shifted curricula and classroom practices with overall success. Among developing countries, Costa Rica has been a leader in constructivist education for a decade; larger countries such as India and China have recently undertaken reforms intended to spark development of higher-order cognition and creativity.

These kinds of changes are intertwined with the use of ICT in schools, and have ramifications for

ICT-related curriculum design, teacher education and TPD, student assessment, and other components of the education system. Schools in Singapore have discovered the need to adjust time-tabling, teacher roles, lab and classroom configurations, and other factors influencing the ways that ICT is accessed and used by students in order to approach the kinds of gains in higher-order cognition that are targeted. Among the outcomes of this discovery has been the "teach less, learn more" program (intended to replace approaches that could be labeled "one size fits all.")

National grade-level examinations used for promotion, graduation, and matriculation deflects teachers' classroom practices toward enhancing test results. In response to this situation, school systems in Sweden and other countries that are introducing active-learning pedagogies frequently choose to de-emphasize "high-stakes testing."

The Second Information Technology in Education Study: Module 2 report (SITES M2) documents 174 examples of classroom pedagogical innovation supported by the use of ICT. But SITES M2 also finds that systemic barriers—such as national exams and IT curricula—commonly limit both innovation and the diffusion of innovative practices.

(It bears mentioning that resources, capacities, and challenges shape the possibilities open to each education system, and contribute to determining which initiatives and practices are "best." In countries in which ICT access and use are *not* ubiquitous, for example, barriers to using ICT in schools are higher than in ICT-rich countries, while the economic and social value of basic ICT skills may be greater. In such circumstances, initiatives such as using ICT to deliver new learning resources or to provide introductory computer courses may be practical and defensible first steps.)

SITES M2 Case-study search
http://sitesm2.org/sitesm2_search

Singapore Ministry of Education: EduMall
http://www.moe.gov.sg/edumall/index.htm

Education Commissions of the States
(on trends and research in testing)
http://www.ecs.org

Collaborative online projects

Student-to-student online collaboration has been one of the more common methods of ICT integration by early adopters in schools. Since the first email-based projects launched by iEARN in 1988, students in developed countries have taken advantage of the opportunity to communicate and collaborate with others using email and the Internet. Beginning at least as early as 1996, with the World Links pilot project in Uganda, students in developing countries have been collaborating with other students in both the North and the South.

E-mail collaboration serves as a low-barrier point of entry to the use of ICT to support learning in a range of subjects: E-mail tools are relatively simple to use and require lower bandwidth Internet connections; use of email, as opposed to the Web, minimizes need for teacher guidance and site pre-selection, and maximizes students' time on task; and e-mail-based collaboration complements local small-group collaboration, reducing barriers to active learning.

Collaboration based on use of the Web connects students to knowledge resources. In the case of competitions such as Think.com, teams also collaborate to construct Web sites to frame knowledge that they have gained through research.

European SchoolNet
www.eun.org

iEARN
www.iearn.org

Think.com
www.think.com

World Links
www.world-links.org

School-to-school networking

Within education systems, teachers—and whole schools—adopt technology at differing rates. While decision-makers at the ministry level must work to ensure gains by *all* schools, innovative and early-adopting teachers and schools can draw significant benefits from participation in regional or national collaborative networks.

SchoolNet organizations represent one of the chief mechanisms for school-to-school networking. SchoolNet Uganda, which has over 100 member schools, with more than 80 percent of schools using broadband Internet connections,[15] has worked closely with a Ugandan VSAT service provider to shift billing and pricing in ways that more closely meet the needs and revenue cycles of its member schools. SchoolNet Africa operates a portal-style Africa Education Knowledge Warehouse, with resources for learners, teachers, principals, and policymakers. European SchoolNet includes a large number of member schools, and is currently carrying out the Calibrate project, which is intended to develop a highly searchable open-source environment for sharing learning resources.

European SchoolNet Calibrate project
www.calibrate.eun.org

SchoolNet Africa
www.schoolnetafrica.net

SchoolNet Uganda
www.schoolnetuganda.sc.ug

"Balanced" pedagogies

In the United States and other countries, debate has raged for over a decade among advocates of "back to basics" approaches, such as phonics, and advocates of context-aware approaches such as whole-language, writer's workshop, whole math, or experiential science. That debate is moderating as teachers, followed by education researchers, weigh in on the benefits of combining elements from both pedagogical camps. In reading instruction this approach is framed as "balanced literacy."

Educational software developers, in response, are starting to reflect (at least in their marketing) demand for resources that support teachers' efforts to combine approaches.

Riverdeep
www.riverdeep.net

IntelliTools Balanced Literacy
http://intellitools.com

15 This situation is current as of early 2005. Please refer to *The Uganda rural schools VSAT connectivity project: Lessons in sustainability and educational impact* (Gaible, E. and Nadel, S., in press, Washington, DC: infoDev / World Bank Institute) for detailed information about SchoolNet and private sector involvement in sustainable broadband for rural schools.

Blogs, wikis and podcasts created by teachers and students

A variety of tools that emerged from the Web 2.0 phenomenon have been swiftly adopted by the education community. Web 2.0 refers to a "second-generation" of Internet tools that emphasize user-developed content and social networking. Popular Web 2.0 tools used in schools include blogs, wikis, and podcasts.

Both Apple's iTunes website and Yahoo! list hundreds of podcasts created by students in kindergarten, primary, and secondary schools. Outcomes that have been ascribed to podcasting include improved written and verbal communication skills, improved research skills, and increased motivation.

Blogs (or Web Logs) are websites with content generated by individuals; entries appear in reverse-chronological order and resemble journals in that they reference first-person experience or the thoughts and opinions of the author. Most blogs enable readers to post comments, as well as comments about comments.

Teachers use blogs in ways that support reflection (a critical component of TPD), as well as dialog and feedback with peers. They also may use blogs to publish class Web pages with information about assignments and links to relevant learning resources. With their classes, teachers may also use group blogs, which enable many writers to participate, to stage asynchronous (and writing-based) discussions of classroom topics among students.

Teachers engage students in blogging to promote the development of writing skills and confidence in writing, to enable them to publish the results of Web research and other schoolwork, and to work together on projects via group blogs (and wikis, another form of Web-based collaboration tool).

The application Word Press is among the most popular of blogging tools for educational uses. The open-source Word Press application is downloadable, meaning that school systems can use it to host blogs on their own servers, and free. School systems also use the application Movable Type to support private blogs viewable only by one teacher and one student, or by groups of students.

Downes, Stephen. 2004. **Educational blogging**. EDUCAUSE Review. V39, n5: 14–26. http://www.educause.edu/pub/er/erm04/erm0450.asp?bhcp=1

Word Press
www.wordpress.org

Podcasting in the classroom
Generic lesson plan for student podcasts
http://userwww.sfsu.edu/~nshelley

SupportBlogging!
Wiki promoting understanding of benefits of educational blogging
http://supportblogging.com

Best Wiki 2006 Finalists
The Edublog Awards
Five award-nominated education-focused wikis
http://incsub.org/awards/2006/nominations-for-best-wiki-2006

Probes, digicams and other primary-research tools

Over the past 10 years, educators and education researchers paid increasing attention to the use of electronic probes and other data-collection tools. Probes measure various phenomena—light levels, voltage, temperature, motion, and chemical composition, among others—and enable data to be uploaded to calculators, handheld computers and PDAs, or desktop computers.

Probes support hands-on inquiry-based learning by students in primary and secondary schools, strengthening students' skills at representing scientific phenomena and connecting scientific concepts to real-world events. Because probes have been developed to interface with mobile devices, not only desktop computers, their use may make it possible to integrate forms of ICT into classroom-based learning more affordably.

Challenges, however, to the use of probes in schools include: compatibility issues arising from the proliferation of probe hardware and software products alongside an even greater number of handheld devices; a lack of wireless networking standards for connecting mobile devices; poor linkage between relevant curricula, teacher capacities, and teacher development. (An experimental use of probes in primary schools in Benin, West Africa, found that teacher resistance and lack of education in the use of "innovative technologies" constituted major obstacles.) In all but the most advantaged educational environments, the promise of probes may at this point be outweighed by their attendant challenges. However, the effective use of graphing calculators, which are related tools with relatively low TCO, has been widely established in math and science classrooms and could be effectively emulated.

Smithsonian Institution: Natural Science Resources Center Guide to probeware and computer applications for science and technology concepts for middle school
http://www.nsrconline.org/curriculum_resources/Probeware_Guides.html

The Concord Consortium
Open-source and free probe and other software
http://www.concord.org/resources/browse/172/

Anti-plagiarism tools, services, and activities

At both secondary and tertiary levels, forestalling and detecting plagiarism increasingly occupies teachers' attentions. Search engines that provide students with access to a rich array of knowledge resources also provide the means to plagiarize these works (aided and abetted by cut and paste commands). In many instances, students copy works without knowing proper practices in academic citation, and without fully understanding prohibitions against copying and copyright violation.

Many teacher-resource sites now address plagiarism directly, providing lesson plans for teaching citation practices and copyright, and tools for teachers (and students themselves) to use to detect plagiarized passages. Fee-based services will also check student work.

Plagiarism stoppers: A teacher's guide
Naperville Central High School
http://www.ncusd203.org/central/html/where/plagiarism_stoppers.html

Guidelines for effective Teacher Professional Development

To increase the likelihood of successful TPD when computers are being introduced, the TPD should be:

- **Timely**
  Teachers should learn to use computers at the point in a project when they will have access to them, not before and not after
- **Job-related**
  All TPD, including computer-enabled TPD, should connect to teachers' responsibilities, to their skills and knowledge, or to desired classroom learning outcomes
- **Welcoming**
  Many adults have anxiety about learning, or about computers; initial sessions should aim to build "computer comfort," not high-level skills
- **Hands-on**
  Teachers should be asked to learn by doing, not to learn by listening
- **Technically appropriate**
  Teachers should learn using hardware, systems, and applications that are the same as those they will use in schools
- **Appropriate to the school environment**
  If teachers will be using ten computers with 60 students (or one computer with 60 students), TPD sessions should reflect this reality.

Trends in hardware and configurations

Over the past 10 years—roughly the period in which ICT has been heavily promoted in relation to development—technology innovation has yielded cost and size reductions, increased mobility, increased reliance on server-based access to applications software, and new Internet-based capabilities that range from blogs to VOIP communication to video chat. Specific developments in hardware, networking, and services help schools and school systems address the challenge of student and teacher access to ICT, a basic problem, but one that remains challenging.

Wireless networking

Schools rapidly adopted wireless local networking (using 802.11 protocols). Wireless LANs reduce installation costs—although they may increase support costs—and increase the flexibility of school-based installations. In particular, laptops or workstation computers can be stored in carts and brought into classrooms on a temporary or as-needed basis for use by teachers or students. Carts—or "mobile computer labs"—combine security, mobility, and network hubs.

Internet access in rural, geographically isolated, or under-served areas has also been enhanced by the use of VSAT technology. A single broadband VSAT connection is sufficient to meet the needs of multiple computer labs and classrooms. In areas in which deregulation has led to increased competition among service providers, acquisition and monthly connectivity costs have fallen to levels that make VSAT-based Internet access affordable by schools. In 2003 in Uganda a new entrant in the VSAT market had 44 secondary-school subscribers within its first year of operation.

> Perry, D. 2003. **Wireless networking in schools: A decision-making guide for school leaders.** British Educational Communications and Technology Agency (BECTA). www.becta.org.uk/page_documents/leas/wire.pdf

Thin-client networking

School and school districts in developed countries, and to a lesser extent in developing countries as well, increasingly choose thin-client solutions to provide ICT access to students and teachers. In a thin-client network, all or almost all software and data resides on a server, from which it is accessed via a network by "thin-client" computers that typically have no hard drive and may run minimal operating systems. Potential advantages of thin-client systems to schools include: lower acquisition costs; lower operating costs due to increased ease of maintenance; and, notably, ubiquitous access by students and teachers to resources, documents in progress, student records and other data—in other words,

"any time, anywhere" there is a computer connected to the network.

In addition, some characteristics of thin-client networks may deliver benefits that are specific, or more pertinent, to schools in infrastructure-poor and economically disadvantaged environments. Without hard drives, client computers typically consume less energy and are more resistant to dust, heat and moisture. In addition, client computers have little value if stolen.

The chief potential disadvantage of a thin-client network lies in the vulnerability of all computers if the server (or server array) malfunctions. Wired Ethernet-based LANs are typically required to enable large volumes of data to move across the network; wireless LANs are insufficient. Rich-media content and applications (e.g., video, audio, multimedia) may not perform well in thin-client network environments, as they can require too much bandwidth.

The Goa Schools Computer Project (GSCP), launched in 2000 in the Indian state of Goa, is among the most well known thin-client-based ICT projects in developing-country schools. The project installed recycled computers in nearly 350 schools; schools receiving four or more computers received these as thin-client networks. Both standalone and networked computers ran GNU/Linux software, which functions reliably in both older PCs and in thin-client configurations, and which generated additional savings in acquisition costs.

The non-profit Ndiyo organization in the United Kingdom is currently developing an ultra-thin-client system specifically for use in developing countries.

Light, D., and Gersick, A. 2003. **A study on the efficacy of a thin client school technology infrastructure**. Center for Children's Technology. http://cct.edc.org/admin/publications/report/ClassLink03_Report.pdf

Ndiyo
http://www.ndiyo.org

One-to-one computing

New developments in affordable, mobile, and laptop hardware have given momentum to one-to-one (or 1:1) computing in developed countries. In the United States, many school districts, and several states—notably Maine and Oregon—have developed programs to enable every student to have full-time access to a laptop computer. Educational researchers from Taiwan, Singapore, the United States, Canada, and elsewhere have formed the Global 1:1 network to investigate the possibilities inherent in the one-to-one model.

These events notwithstanding, one-to-one computing remains the exception in developed-country education systems, not the rule. With the advent of the One Laptop Per Child (OLPC) project, however, several developing countries in Latin America, Africa, and Asia are poised to take steps toward system-wide adoption of 1:1. Within the Caribbean, the national telecommunications provider of Suriname, Telesur, is supporting a 200-laptop pilot initiative using the OLPC-developed laptop.

One of the distinguishing features of 1:1 computing is its focus on the use of technology to facilitate real-time classroom interactions between teachers and students, rather than the asynchronous interactions of virtual communities supported by earlier educational computing projects. Small groups communicating via email, in the 1:1 model, give way to whole-class interactions in which the teacher might use a digital white-board while students use tablet PCs or PDAs to submit questions, answers and comments.

Generally, 1:1 computing is championed as a way of stimulating high interactivity among students and teachers. Of course, continual access to computer technologies also serves as an organic pathway to infusing ICT into learning activities across the curriculum and beyond the boundaries of school.

In the OLPC model, the provision of information appliances configured specifically to stimulate and support knowledge construction will build off children's innate propensity to learn. Although the OLPC laptops will be distributed by governments and supported by schools, children using them will go far beyond the confines of the traditional school-based curriculum.

As stated, a number of education systems in the United States have achieved one-to-one computing via large-scale procurements, leasing programs, and

"scholarships" for disadvantaged children. Some researchers, however, argue that the 1:1 ratio is not advantageous for students, teachers, or schools. Research is now being planned and implemented to analyze this situation; as of yet, however, measurable results remain elusive.

Global 1:1
www.g1:1.org

Edutopia: One-to-one computing
www.edutopia.org/onetoone

One-to-one information resources
http://www.k12one2one.org

Chapter 4

Selected regional ICT initiatives in education

Overview

This section briefly profiles several initiatives that have been launched within the region, or by international organizations with strong ties to the region, in order to increase the effectiveness of ICT in education or to provide new access and capacities.

It is not within the scope of this report to describe or assess larger regional institutions such as UWI or to report on all multi-national initiatives within the region. The objective of this section is instead to draw attention to regional initiatives or organizations that currently support ICT in education effectively, or that in the case of smaller or less mature programs have the potential to provide effective support in the future. This section also identifies initiatives that have had only limited impact but that point to the need for more effective measures.

Initiatives and organizations are presented in sequence based loosely on their launch dates. These include:

- OERU policy initiative
- Caribbean Universities Project for Integrated Distance Education (CUPIDE)
- Caribbean Knowledge and Learning Network (CKLN)
- UWIDEC Blended Learning Project
- Caribbean Association for Distance and Open Learning (CARADOL)
- Virtual University of the Small States of the Commonwealth (VUSSC)

In addition, OERU has expended significant effort on its Education Management Information System (EMIS) initiative. This initiative is discussed in detail in the section, *Regional overview of EMIS,* which also outlines country-specific EMIS efforts.

OERU policy initiative

In 1999, the OERU launched a project to support development of ICT policies in education by OECS member countries. Specific measures included development, review and revision of a *Model ICT policy for the education system* in 2000.

The *Model ICT policy* was complemented by processes of consultation and advisement to several countries supporting review and modification of the model policy and leading to a national policy ready for adoption. The model policy emphasizes issues that include:

- Access
- Learner-centered pedagogies
- TPD
- Lifelong learning
- Information management

The document also specifies technology skills that primary, lower secondary, and upper secondary students will acquire. The model policy also includes 44 statements of actions to be undertaken by the MOE, principals, or other stakeholders.

Countries drawing on the OERU *Model policy* to develop their own ICT policies in education include:

- Anguilla
- British Virgin Islands
- Dominica
- Grenada (in process)
- St. Lucia
- St. Vincent and the Grenadines

These countries, including all four of the Windward Islands, are among the smallest and in several cases poorest in the region. For the most part, their efforts in ICT have been modest, typically emphasizing preparation of secondary students for the CXC ICT

exam. MOE capacity with regard to technology planning, procurement, and implementation is not high overall—despite the presence of capable individuals in these ministries.

For these reasons, OERU support has been exceptionally important. The *Model ICT policy in education* lays the foundation for educational ICT programs that are comprehensive and pedagogically progressive. In most of these instances, however, the impact of policy on practice has yet to be felt substantially.[16]

Recent policy-related events include the March 2007 meeting of Chief Education Officers (CEOs) under the theme, "Educational Policy and Practice in the OECS—Integrating and Sustaining National and Regional Initiatives."

Caribbean Universities Project for Integrated Distance Education (CUPIDE)

The CUPIDE project was launched in 2003 as a partnership among five of the region's universities, with funding through 2006. Its principal objective is to increase access to tertiary education through the development of Distance Education (DE) capacity among these universities. While DE is not unusual in the Caribbean, e-learning penetration is low, with online course offerings tending to originate in universities outside the region. (CUPIDE itself is in fact a mirror site for the Massachusetts Institute of Technology (MIT) Open CourseWare [OCW] project.)

Originally conceived as a capacity-building project within UWIDEC, the project was expanded to include the University of Guyana, the Anton de Kom University of Suriname, the University of Quisqueya, Haiti, and University of Technology (UTech) in Jamaica. Project impact has been limited by disparate capacities among the partnering universities and by the more general difficulties arising from multi-lateral, multi-country collaboration among large institutions. Different levels of technical infrastructure (both nationally and institutionally) and human-resource capacity, in particular, slowed response time and hampered agreement on priorities. These difficulties were compounded by reliance on English as the project's primary language, complicating communication with collaborators in Haiti and Suriname.

Outputs from CUPIDE include:

- Development of the CUPIDE portal (pilot)
- Training on CUPIDE LMS and Web portal
- Four-module pilot course, "Developing an online course using a team approach"
- Mirror-site agreement with MIT OCW
- Formation of CARADOL

Overall, impact has been limited. The CUPIDE portal has been launched as a pilot site, but is has not been populated with course content.

Caribbean Knowledge and Learning Network (CKLN) and E-Link Americas

The CKLN was launched in 2004 by CARICOM with the support of the World Bank, EU, United Nations Development Program (UNDP), UNESCO, ICA, Canadian International Development Agency (CIDA)/ International Development Research Centre (IDRC) and the Organization of American States (OAS). Broadly presented, the CKLN mission is to enhance regional competitiveness by facilitating networking, knowledge sharing, and instruction among Caribbean TLIs. Accomplishing the CKLN mission involves three start-up phases:

- Strengthening the ICT capacity of TLIs
- Establishing a knowledge and learning network
- Building capacity at the regional level

University-level e-learning is to form a key element of the knowledge and learning network. CKLN has conducted one or more workshops on the conversion of course materials for use in Moodle the open-source LMS, a free software e-learning platform.

Other accomplishments to date include the 2005 assessment of infrastructure, ICT competencies, and

16 Although many of the adopted policies have yet to be enacted in schools and school systems, several respondents contacted for this study suggested that the OERU *Model policy* was becoming dated and would benefit from revision to address newer practices and tools.

student administrations systems of nine TLIs involved in a CKLN pilot project, and an overall assessment of the Caribbean labor market.

One element associated with CKLN—an element considered primary by several respondents contacted for this report—was the provision of high-speed, satellite-based Internet connectivity to TLIs through partnership with E-Link Americas. The E-Link Americas project, launched by the Institute for Connectivity in the Americas in 2004, was to provide low-cost, high-speed connectivity throughout Latin America and the Caribbean. Unanticipated project delays, technical challenges, and cost overruns, however, led to decision to close the project in January 2006.

In response to the failure of E-Link Americas, CARICOM has endorsed a CKLN proposal requesting roughly US$10 million for development and implementation of C@ribNET, an advanced high-speed network to connect the region's TLIs.[17]

To date CKLN impact has been limited. The establishment of knowledge and learning networks among researchers, educators, students, and others, however, remains a critical objective within the region, as does implementation of high-speed networking. In May 2006, CKLN was awarded financing of €2 million by the European Union. CKLN will launch a version of the Moodle LMS.

UWIDEC Blended Learning Project

Since 1996, UWIDEC has provided DE to students throughout the Caribbean using a combination of printed instructional resources, face-to-face tutorials, and audio conferencing. UWIDEC is currently transforming a portion of its DE instruction to a "blended learning" approach that combines face-to-face instruction and print-based resources with the use of online learning resources and discussion, synchronous e-tutoring and/or email.

In the original combination of modes, UWIDEC courses rely primarily on printed resources and face-to-face tutorials at its Distance Education Centers and other sites. Three or four audio-conferences per course are used to deliver uniform instructions regarding course administration, exams, and other issues. Tutorials are used to address course content, conduct learning activities, provide feedback, and accomplish other administrative and instructional tasks.

The new, blended-learning structure will continue to rely heavily on printed learning resources, but will use ICT to enhance student access to resources and the possibilities for asynchronous learning. Students will also connect to the UWIDEC LMS, running on the Moodle open-source LMS software, and will receive CD-ROMs with presentations and other course materials. These resources will enable them to participate in online discussions, practice exercises, assessments, and other activities. For the next several years, face-to-face tutorials will remain integral to the instructional design and the assessment process.

For the 2005–2006 academic year, UWIDEC launched a pilot project[18] to develop online courseware for 13 courses originating at its Mona Campus in Barbados. Courses covered introductory sociology, Caribbean civilization, math for social sciences, business and accounting, and education counseling, among other topics. Development of the CD-based content encountered challenges chiefly related to the need for additional staffing with skills in video and online resources.

The change from synchronous, face-to-face tutoring to e-tutoring brought other challenges into focus, including the need to train and maintain a corps of skilled e-tutors, limited student access of materials (whether by choice or as the result of barriers), and limited student interaction online. Additional lessons learned include the need for sustainable, clearly articulated incentives for e-tutors.

Less elaborate higher-education experiments with blended learning have been conducted in the region as well: In Jamaica, in-service teachers are required to achieve the bachelor's degree. To meet the needs of TVET teachers with limited release time and working at a distance from the campus, the UTech used email to reduce these teachers' needs to attend

17 In February 2008, CKLN received an additional $650,000 in funding from IDB to support C@ribNET.
18 Information about the blended-learning pilot project is drawn from Thurab-Nkhosi, D., "The challenges of blended learning at UWIDEC: A case of ICT innovations in the developing country context," (2006) a paper delivered at the Commonwealth of Learning (COL) PCF4 conference in Ocho Rios, Jamaica.

contact-based courses.[19] In Trinidad and Tobago, UWI instructors developed interactive CD-based learning resources to support training in emergency medicine.[20]

Caribbean Association for Distance and Open Learning (CARADOL)

CARADOL was launched by CUPIDE in 2005 to facilitate regional development of open and distance learning (ODL) by enabling networking, communication, capacity building, and partnerships among ODL organizations. CARADOL is open to persons, governmental and non-governmental organizations involved in or interested in DE.

Although launched by the CUPIDE universities, CARADOL was conceived initially in 1999 at a regional conference in Guyana, "Promotion, Quality, Pragmatism and Partnership in Distance Education Delivery, with additional input during a 2000 "Distance Education in Small States" in Jamaica.[21]

Virtual University of the Small States of the Commonwealth (VUSSC)

Conceived in 2000 by the Commonwealth Education Ministers, VUSSC is a network of organizations collaborating on development of e-learning content in conjunction with the Open Education Resource (OER) initiative of the COL.[22] An international initiative, VUSSC groups participating countries in four regional focal groups. The Caribbean group includes Barbados, Belize, Dominica, Jamaica, St. Kitts and Nevis, St. Vincent and the Grenadines, and Trinidad and Tobago. Both the COL OER initiative and VUSSC are associated with Wikieducator, a wiki-based site hosted by COL and intended to support collaborative authoring of free, open-source educational content.

Content developed for Wikieducator and VUSSC is built using the eXe open-source authoring tool and is designed to run in Moodle, the open-source LMS widely used in Caribbean TLIs, as well as proprietary LMS environments such as WebCT. Curricula focus on topics—tourism, entrepreneurship to date, and life-skills development—that have specific relevance to many SIDS.

VUSSC outcomes to date include:

- Launch of the VUSSC node in Wikieducator (www.wikieducator.org/VUSSC)
- "Boot camps" for courseware developers in Mauritius, Samoa, Singapore, and Trinidad and Tobago
- Development of a VUSSC business plan for 2007–2013

The Mauritius boot camp produced a framework for a certificate-level curriculum in tour guiding.

The March 2007 Singapore workshop was attended by 11 representatives of Caribbean educational organizations out of 26 participants overall. That boot camp produced a nearly complete entrepreneurship course.[23]

VUSSC is conceived as relying on TLIs to provide educational services that include accreditation, admissions, online tutoring and grading, and awarding of certificates, among others. The initiative is intended to build capacity for the development of e-learning resources and to lead to the proliferation of such resources under an open-source model.

At the time of this report, VUSSC has demonstrated potential but has achieved only limited impact—both in terms of trained course developers and completed content. The benefits to TLIs of the development of standards-based open-source e-learning courseware are great. If and when TLIs allocate resources to the development of VUSSC courseware, they may greatly enhance their abilities

19 Johnson, H., " Using blended teaching approaches to upgrade qualifications: The experience of in-service industrial technology/TVET teacher in Jamaica" (2006), a paper delivered at the Commonwealth of Learning PCF4 conference in Ocho Rios, Jamaica.
20 Sammy, I., "A blended approach to emergency medicine training: Developing an integrated curriculum for mature learners" (2006), a paper delivered at the COL PCF4 conference in Ocho Rios, Jamaica.
21 Available information about CARADOL is limited; efforts to contact members of the Steering Committee in the course of this report did not generate replies.
22 Note that VUSSC has never been intended as a true virtual university—its mission as a collaboratory for e-learning content has been consistent since the initiative's founding.
23 http://www.wikieducator.org/VUSSC/Content/Entrepreneurship, last accessed on 7 April, 2007.

to offer e-learning courses that meet the needs of local residents and that contribute to the development of human capacity among SIDS.

Note on potential collaboration among e-learning initiatives

CUPIDE, CARADOL, and CKLN are interconnected, Caribbean-centric initiatives that focus on e-learning to various degrees. VUSSC is an international initiative focused on Commonwealth countries, but which includes strong Caribbean representation. It may be instructive at this point to identify complementarities between these projects, especially in relation to their apparent strengths and limiting factors.

To focus on CUPIDE, the most developed of the purely Caribbean initiatives: both CUPIDE and VUSSC seek to increase capacity for the development of e-learning in the Caribbean. CUPIDE has been limited by the challenges of collaboration; VUSSC is built on a foundation of collaborative (wiki-based, open-source) tools and environments, but lacks adequate financial support to achieve the scale and pace of content development necessary to meet the demand for e-learning courseware targeting Caribbean concerns. There may be barriers to closer collaboration—such as focus among CUPIDE and its partners on degree-based as opposed to certificate-based programs—but there may also be opportunities for effective partnership that deserve exploration.

(Note that all four e-learning-related initiatives support use of the Moodle open-source LMS.)

Chapter 5

Regional and national EMIS initiatives

Summary

EMIS has been the focus of both national and region-wide effort for over 15 years. Results, however, have been limited. Barriers cited by respondents include lack of funds, inadequate connectivity, and teachers' limited access to computers in schools, and limited capacity and experience with EMIS. In addition, without habitual collection, reporting, analysis, and use of education data, EMIS implementation requires significant change-management measures in order to succeed.

Significant regional and national initiatives include:

- EMIS development in Jamaica, 1993–1996
- OERU dissemination of harmonized data-collection instructions, 1990s
- OERU development and dissemination of Excel-based Performance Management Tool (PMT), 2000–2001
- OERU pilot testing of EMIS software in St. Lucia, 1999–2000

The impact of these projects has been incremental, not transformative. In the absence of computer support for information-management, ministries and education systems must fall back on combinations of paper-based reporting, data entry at district or central offices, and eventual, but limited, databasing of information. Such systems are inefficient, generating needlessly repetitive local reporting, and those inefficiencies limit the kinds of information that are aggregated and analyzed.

In 2006 and 2007 at least four countries—Jamaica, Barbados, Antigua and Barbuda, and St. Lucia—conducted EMIS projects. Small-scale pilot tests in Barbados and Antigua used EMIS software newly developed in Barbados. St. Lucia tested EMIS software currently used by over 2,000 schools in Canada. The results of these tests should be used to build relevant and timely knowledge about the comparative advantages and risks of these two vendors.

The collection, management, and use of educational information is, along with development of ICT policy in education, one of the areas in which both region-wide and national efforts have been made in the Caribbean. For the most part, effective EMIS—whether seen as an ICT implementation, as a set of processes to be institutionalized, or as the cornerstone for ongoing organizational improvement—remains elusive. Commonly cited challenges include inadequate network infrastructure, teachers' lack of access to computers, and limited availability of funds for EMIS development. It is probable, however, that in some cases lack of demand for the kinds of analysis enabled by effective EMIS shores up persistent infrastructural and budgetary barriers.

Limited commitment to reporting and analysis, before the introduction of ICT, intensifies the challenges that face EMIS. If data collection and information management have not been valued previously, it is difficult to convince staff to devote new energies to these activities. Well before the introduction of new objectives and tools (whether for data or pedagogy), the school system has evolved a complex cluster of incentives, practices, feedback pathways, and responsibilities that resists change. Attempts to integrate ICT into teaching and learning without changing curricula, student assessment, and teacher evaluation lead nowhere. Similarly, efforts to institute EMIS without supporting data-driven decision-making by teachers, school leadership, education departments and policymakers will be met with, at best, apathy on a system-wide level.

As mentioned elsewhere in this study, there is evidence that Caribbean countries do not take full advantage of funding opportunities provided by

Overview of EMIS in Caribbean SIDS

Country	EMIS history	Current situation	Perceived barriers
Anguilla	Database Management System (DBMS) developed with OERU	■ No activity (no data entered)	■ High cost, lack of available funds
Aruba	No experience	■ No activity	■ High cost, lack of funds ■ Lack of technical capacity
Antigua and Barbuda	Collaboration with OERU led to use of TPM software starting in 2000	■ 2007 pilot test of abusSTAR software in 3 secondary schools	■ Primary schools lack infrastructure; teachers lack capacity
Barbados	EMIS tools in place as part of InterAmerican Development Bank (IDB) reporting requirements	■ Pilot test of abusSTAR EMIS in 7 schools	—
British Virgin Islands	Trial of OERU prototype in 2000 Purchase of SASI (a Pearson Education product) In-service EMIS TPD for all secondary teachers	■ Implementation stalled ■ Plans to implement when barriers are resolved	■ Inadequate network infrastructure ■ Teachers lack routine access to ICT in schools
Cayman Islands	—	—	—
Dominica	EMIS included in draft ICT policy in education	■ No activity	■ High cost, lack of funds ■ Inadequate infrastructure (hardware, network) ■ Lack of technical capacity within MOE
Grenada	No experience	■ No activity	■ Limited technical capacity within MOE
Jamaica	EMIS processes launched in 1993 EMIS development completed in 1996	■ EMIS planning and implementation of in process ■ Funding provided by IDB	—
Montserrat	No experience	■ No activity	■ High cost, lack of funds
St. Lucia	Collaborated with OERU in 1999–2000 to develop regional EMIS	■ Pilot of off-the-shelf EMIS product in 2007	—
Turks and Caicos Islands	EMIS initiative led to purchase of hardware and local development of software Computers and software installed in some schools	■ Implementation stalled due to barriers	■ Inadequate network infrastructure ■ Lack of central database architecture
Trinidad and Tobago	No experience	■ EMIS planning and implementation in process ■ Funding provided by IDB	—

Comparison of current status of EMIS
Source: The Natoma Group

donor and development agencies.[24] Among the reasons cited is the pervasiveness of the view that accessing finance sources involves cumbersome processes. The information generated by EMIS, the analytical practices that drive information collection, and the decision-making that in turn drives analysis all have the potential to lower barriers to financial resources that would otherwise be cumbersome to address.

Although implementation has been limited, the environment for EMIS appears to be growing more favorable. Technical capacity within MOEs in the region is growing. Broadband Internet connectivity for schools is becoming widespread. Teachers increasingly begin service having gained at least basic

24 Greenidge, M. 2006. Caribbean countries failing to take advantage of aid. The Barbados Advocate. 06Sept2006. http://www.barbadosadvocate.com/NewViewNewsleft.cfm?Record=27714 Accessed 8 September 2006. Statements about cumbersome processes and limited Caribbean use of available funding opportunities were made by Dr. Kathleen Gordon, Deputy Director of Information. Technology at CDB. Dr. Gordon also said, "We have to show aid effectiveness; we have to show that what we have provided is effective in reducing poverty within the digital divide. We have to ensure that the funds are applied with those specific objectives and that the objectives are met."

computer skills. Demand—at least in the form of policy statements—for information, analysis, and informed decisions is strong. And, not the least of these considerations, experiences on the part of specific country governments and on that of OERU provide a body of knowledge and lessons learned that has the potential to help countries establish functioning EMIS.

This section briefly reviews several milestones in the history of EMIS effort in the region, summarizes current initiatives, then suggests ways those initiatives can be leveraged for wider benefit.

EMIS milestones in the Caribbean

This section describes three key processes in the development of EMIS practices in the Caribbean: early EMIS efforts in Jamaica, overall policy emphasis on EMIS in the Caribbean, and, addressed in detail, OERU efforts to develop a common EMIS platform and harmonized data models. Although other attempts have been made, and are being made, these three events can be taken as representative of the overall movement to support development of EMIS within the region.

EMIS in Jamaica

In 1993, Jamaica launched one of the first Caribbean EMIS initiatives. Funded by United States Agency for International Development (USAID), the overall goal of the project was to strengthen information-based decision-making through improved access to school census data, system-wide introduction of computer-based recordkeeping, and development of a school-based Geographic Information System (GIS) system linking school data to place. At the time, this initiative represented the leading edge of EMIS development in emerging economies. Despite the completion of EMIS development in 1996, both information access and information utilization in Jamaica remain limited. At a later point the New Horizons Project (NHP) proposed development and implementation of a Jamaica School Administration Software (JSAS) package—to meet local-level information needs that had supposedly been met nationwide by the previous system. Although JSAS was not completed in the 1990s, calls for its development point to the significant limitations in the system developed earlier.

Efforts to establish EMIS in Jamaica continue. As of this writing, JSAS development has recently been completed, and the platform has been adopted by Ministry of Education, Youth and Culture (MOEY). The 2005–2006 national budget anticipated completing the "cascading" of JSAS into schools system-wide; in 2006 plans included the modernization of hardware used by school administration, in large part to support its effort to improve EMIS.

EMIS implementation should not be seen in zero-sum terms: incremental steps along several parallel pathways may constitute practical and significant achievements. These incremental achievements may in turn allow decision-making processes to evolve along with data-management systems, pacing the transformation of the education system from one that practices data-ignorant prediction to one that demands data-driven decisions. Although neither comprehensive nor complete, the effort to attain EMIS in Jamaica stands as a benchmark for other countries in the region.

Policy support for EMIS

Regional support for EMIS has been elaborated at the policy level for at least 10 years, with the 1997 CARICOM meetings serving as an early milestone. The Montego Bay declarations approved by the CARICOM heads of state emphasized education, human development, and preparing Caribbean citizens to take part in the global knowledge economy.[25] These documents included the much-cited description of the "ideal Caribbean person." Among other humanistic statements, the description states that the Caribbean person should be placed "at the centre of the regional development process," with education playing a central, enabling role. Over the course of the next five years, this statement served as a foundation for policy-level support of EMIS.

Prior to the Dakar World Education Forum in 2000, the UNESCO-sponsored Caribbean

25 Documents identifying specific measures emerging from the Montego Bay meetings include *Towards creative and productive citizens for the 21st century* (which included the influential depiction of the "ideal Caribbean person"), *Human resource development and science and technology within the context of the single market and economy,* and *Education and human resource development: Strategies for building a creative and productive workforce.*

Community Secretariat released the *Education For All (EFA) Caribbean Plan of Action 2000–2015*. The plan begins by citing the profile of the ideal Caribbean person, then goes on to set 2002 as the target date for the goal, "To establish Caribbean-wide EMIS networking capacity by initiating CREMIS" (Caribbean Regional Education Management Information System).

Immediately following Dakar, in December 2000, OECS issued its report, *Pillars for Partnership and Progress: The OECS Education Reform Strategy 2010 (PPP).* The PPP also references the Montego Bay description of the ideal Caribbean person as a driving vision. Although it lists a wide range of objectives, the PPP strengthens the link to EMIS by stating that "[u]nderpinning all of these initiatives is the recognition of the unprecedented pace of change particularly over the last ten years and an awareness of the importance of systematic evaluation as a tool of effective implementation."

These policy statements dovetail with OECS support for EMIS that had been gathering momentum throughout the 1990s, and that led to the launch of EMIS pilot testing in St. Lucia. A separate initiative in which OERU developed a policy template to support the drafting of national ICT policies in education also emphasized EMIS.

OERU pilot test of EMIS

Starting in 1999, OERU engaged in activities intended to support region-wide implementation of EMIS. Chief among these activities was the pilot testing of a Commercial Off-the-Shelf (COTS) EMIS system in St. Lucia. The pilot test did not build effective EMIS practices, and did not lead to the intended recommendation of an EMIS product for region-wide adoption. The OERU EMIS pilot test, as described in this section, is best understood as one initiative among a group of measures spanning more than 15 years, all aimed at improving management of education data in the Caribbean.

Throughout the 1990s, OERU supported efforts to improve data collection and management by regional education systems. Funded primarily by Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ), these activities centered on development and distribution of regionally harmonized survey instruments and reporting formats. In the mid-1990s evaluation of these efforts suggested that considerable work remained to be done. (This evaluation in fact formed part of the rationale underlying the pilot test of EMIS by OERU.) However, by 2003, harmonization, data collection, and reporting had progressed sufficiently to enable comparative analysis of transversal indicators in 10 countries in the region and identification of a set of common indicators for the region addressing coverage, completion, and quality of education.[26]

Concomitant with the St. Lucia pilot test of EMIS, OERU developed and disseminated a PMT, essentially a series of data-entry templates and report forms in Microsoft Excel, to facilitate data collection and data-supported decision-making at the school level. At least two schools in seven countries made use of the PMT. This project encountered pre-existing obstacles, including schools' failure in some cases to keep other records adequately paper-based. In addition, although the PMT was much simpler than the GPI Integrated School Management product previously pilot tested in St. Lucia, users in some schools did not have sufficient technical skills to use it. A revision to the PMT was proposed in 2001. In any case, widespread dissemination of the tool did not take place.

(Several schools in Antigua continue to use the original version of the PMT—support for the idea that effective data-collection practices combined with a usable data-management solution may stimulate demand among school leaders for consistent locally generated data-driven decision support.)

The EMIS pilot-test process began in 1999. Software selection was followed by selection of the pilot country, St. Lucia. Installation was completed at the end of 1999, followed by leadership orientation, technical training, and staff training early in 2000. The project suffered delays in relation to the proposed schedule, as well as difficulties that arose from:

- Inadequate connectivity
- Teachers' limited access to computers in schools
- Limited computer skills among teachers
- Poor staff retention of trained teachers

26 Gropello, E. di. 2003. World Bank Working Paper No. 6: Monitoring educational performance in the Caribbean. World Bank.

Aspects of the pilot-test design compounded these systemic problems. Twenty-three schools in St. Lucia participated in the test, roughly 25 percent of the total number of schools. The relatively large scale of the pilot test increased challenges arising due to infrastructure and personnel limitations. And although they were made responsible for data entry, school personnel were given neither release time nor incentives for participation, increasing the impact of barriers such as low skills, limited computer access, and a frustrating network experience.

Most critically, the EMIS software product selected for the field trial was not endorsed for adoption at the end of the project. That product, GPI Integrated School Management software, developed by the *Société GRICS* in Montreal, Canada, has proven to be effective in Canadian schools, notably in Quebec. The tool was selected by OERU in part because of its support for off-network or asynchronous data entry. Localization for use in St. Lucia, however, was not complete and did not yield a product suitable for use by St. Lucian teachers: some display items (e.g., pull-down menus, etc.) were not translated from French to English; the interface was not perceived as easy-to-use; and, user manuals were difficult to understand.

Factors in St. Lucian schools (connectivity, personnel, etc.) intersected with the design of the pilot test and the product selection to stall the OERU EMIS pilot test.

It may, although well after the fact, also be valuable to point out that underlying these problems was the project's approach to procurement. At all stages, the selection process was designed to identify a suitable software *product* rather than a software vendor. Although *Société GRICS* is a well-respected Canadian organization, sales, service and support outside of Canada are not part of its core business: *Société GRICS* is cooperatively owned by the Quebecois school systems that the organization was founded to serve. Although *Société GRICS* does market its services outside of Quebec, its attention is primarily to Francophone markets (per its corporate brochure), and the majority of its sales or adoptions are Quebecois. The staff of roughly 300, while replete with expertise in school-focused technology, is small in relation to the more than 70 products that the organization has developed. Although not definitive by any means, these characteristics suggest that *Société GRICS* was not well suited to meet the opportunity presented by potential region-wide sales and implementation in Caribbean schools.

Regional pilot projects

At present at least four countries in the region have launched or have firm plans to launch EMIS initiatives. Barbados, Antigua, and St. Lucia conducted pilot EMIS projects, which got underway in 2006 and 2007; Jamaica, with its older EMIS in place, has revised its EMIS software and has planned a capital expenditure to enhance school infrastructure.

For many other countries, barriers remain intractable. Beyond the lack of funds, commonly faced barriers include:

- Limited teacher access to computers, in both primary and secondary schools
- Inadequate or unreliable Internet connectivity
- Limited technical capacity within MOE
- Limited experience with EMIS within MOE and among school stakeholders

Respondents from countries with more experience in EMIS implementation also note a significant "cultural" barrier: the absence of demand for accurate, up-to-date and effectively analyzed student information. Although most education systems require schools to record information on paper, the failure of many systems to enter that information in DBMS, to analyze that information, or to share results with school leadership has reinforced poor reporting practices at many levels.

In combination, the three 2007 EMIS pilot projects have the potential to yield results that can be of benefit throughout the region. Each of the three countries conducting tests—Barbados, St. Lucia, and Antigua—has experience with EMIS. The three pilot projects have somewhat different parameters, but share key factors in common. Focused analysis of these projects may yield information that that can be easily built upon by other countries in the region.

Barbados EMIS initiatives: IDB database and abusSTAR EMIS

Because the EduTech 2000 project, Barbados has significant experience with EMIS used to satisfy the

reporting requirements included in project funding agreements. In addition, Barbados has more recently completed a seven-school pilot test of EMIS software developed by a Barbadian company. This solution focuses more tightly on needs of school leadership and the MOE Barbados.

Early in the EduTech 2000 project, IDB contracted development of a project-monitoring database aggregating information from Barbadian schools. As conceived by IDB, the database enables rapid evaluation of progress in relation to project indicators, such as math performance. The database that was developed for EduTech 2000 was among the first to be contracted by IDB as a project component; databases of this type have since become regular components of IDB projects.

During development of the database, MOE Barbados expanded its mission and scope to integrate secondary-school entrance (11-plus) exam results, CXC exam results, and other data streams. The goal is to combine reporting on project indicators with automated data collection and analysis, and querying capacity that is both user-friendly and Web-accessible.

In 2007, the MOE Barbados has also launched an EMIS project using software developed by a Barbadian company specifically to meet both ministry and EduTech requirements. The abusSTAR EMIS has been developed by abusTechnology, Inc., a software development and Web consulting company that currently offers six products serving businesses and schools.

Whereas the IDB database tracks aggregate indicators of student performance, the abusSTAR EMIS targets management and administrative information such as attendance, student biodata, grades, and other categories typical in EMIS; and, the software will enable MOE Barbados to track students from entry into primary school through secondary-school completion.

The 2007 pilot test in Barbados was roughly concurrent with a smaller pilot test of abusSTAR in Antigua and Barbuda.

AbusSTAR is a new entry in the EMIS field: In both countries, teachers and administrators in the secondary schools used the first release of abusSTAR EMIS software.

EduTech program director Mark Ray characterizes the decision to test a locally developed EMIS application: "The thing that made us engage in this pilot is that, once a presentation was made of a demo version of their application, we recognized that although they were a young company they did their research well, specifically focused on the Caribbean context, aligned to the way we referenced things in our schools, the way we carried out assessments in our schools."

Mr. Ray's comment points to the criticality of correlation of the data model and the pre-existing schema used for cataloguing data. However, while design-related factors may align in favor of locally developed solutions such as abusSTAR, considerations of business viability may indicate that more established solutions might be preferable.[27] The Barbados abusSTAR pilot test represents a significant business opportunity for the developer. Delivering strong results in terms of software development, support, and training will be high priorities during the pilot test. Clearly, the potential for product customization, support, and revision based on the needs of the Barbadian MOE offers sharp contrast to the prior OERU EMIS pilot test on St. Lucia. However, the small size of the local vendor also generates business-related risk such as the possibility of business failure or re-direction resulting from sales of other products to a larger corporate or government client. The vendor's limited history and limited experience in EMIS may be attended by a lack of technical or human-resource capacity. Additional risks, then, arise from the immaturity of the abusSTAR product. In this context, the pilot test undertaken by Barbados (and the concurrent pilot test in Antigua) should be looked to for information about the functionality of the abusSTAR system and about the company's ability to support smaller-scale installations. Other considerations, ranging from the company's commitment to refine abusSTAR to the financial viability of a regionally focused Caribbean EMIS enterprise, may emerge over a longer period.

27 Without proper business planning and modeling, small-scale start-up companies run the risk of introducing state-of-the-art or custom tools that target extremely small, price-sensitive markets. In the case of EduTech, the project already experienced these risks in the project's NetSchools initiative. NetSchools relied on a limited-production school-specific laptop computer and infrared network. The company introduced these tools, then shortly changed its business model to emphasize e-learning and Web-based education services. For more information refer to the section, "Project profile: EduTech, Barbados."

Antigua and Barbuda EMIS pilot test: abusSTAR EMIS

In October 2007, Antigua and Barbuda launched a three-school EMIS pilot test using the abusSTAR software. The Board of Education and the Caribbean Development Bank (CDB) jointly funded the project.

In addition to improved recordkeeping, goals for the introduction of EMIS include better use of data in education planning and increased involvement of family members in students' progress through school.

In this instance, as in others, failed prior attempts at EMIS laid the groundwork for improved results. The MOE's past effort to introduce the OERU PMT instruments to schools led to very limited gains in terms of data collection and analysis, but did foster an essential realization about the nature of EMIS. Doristeen Etinoff, Asst. Director of Education, suggests that understanding within the MOE of the support required by school staff is stronger from the experience with PMT: "We learned how hard a task it is to get persons to change their ways of doing things. It's one thing for them to come to training sessions and express their enthusiasm. But when they return to their familiar work environments, with the same stresses and routines…Now we know that we need to stick close to the project and follow up. We need to hold their hands at the school level."

Decision-makers and administrators should review the pilot tests in Antigua and Barbados to build understanding of the costs, benefits, and risks of using a local developer for EMIS tools, and for lessons in providing support for EMIS adoption.

St. Lucia EMIS pilot test: Maplewood Student Administration

Also, in 2007, the MOE of St. Lucia tested the Maplewood Computing, Ltd., EMIS solution. Maplewood, established in 1980, installs and maintains its product in over 2,000 schools in Canada. As with *Société GRICS,* Maplewood primarily serves the Canadian market. Its EMIS product, however, is Anglophone and is compatible with schools' servers. Also in contrast to *Société GRICS*, Maplewood is a privately held company with a product line limited to EMIS and may thus be motivated by the possibility of regional sales to provide service in support of its product.

Pilot test comparison

Comparison of the field tests in St. Lucia with those in Antigua and in Barbados present the opportunity to compare two contrasting EMIS vendors (table below).

In the absence of an established EMIS solutions provider operating in the Caribbean, these two vendors represent reasonable opportunities for EMIS implementation. Education decision-makers in countries planning for EMIS should seek additional information about the three pilot installations. Benefits of a more formal approach, possibly case-study-based, to comparing these projects should also be undertaken, possibly by OERU.

One respondent framed the importance of regional EMIS implementation and harmonization in the following way:

> In the Caribbean, we do not document well enough. We have information but it's too scattered, so that even when data is there, it's difficult to pull together. And when we are in a position to access aid, the international financing institutions, which reference "Latin America and the Caribbean," do things for Latin America. The Caribbean is an after-thought. I would go to a workshop for Latin America and the Caribbean, and everything would be in Spanish. Project documentation is sent in Spanish. We contribute to our own inability, and Latin America is the majority in terms of sheer numbers. But that's why it's so important for the Caribbean to be unified, to present a unified analysis of what is happening here. So that we are recommendable as a force.

Company	Years in EMIS market	Schools	Nearest office
abusTechnology	1	10 (pilot)	Barbados
Maplewood, Ltd.	27	2,000+	Ontario, Canada

Comparison of EMIS pilot tests
Source: The Natoma Group

Chapter 6

Profiles of selected projects

This section includes brief profiles of four country-based ICT projects in education.

Two of the projects profiled are large-scale efforts to craft comprehensive and long-term solutions to the need to prepare students to work and learn with ICT and the need to enhance thinking, learning, and knowledge across all areas of the curriculum:

- EduTech 2000
  MOE, Barbados
- LMS and NQR integration
  HEART Trust/NTA, Jamaica

EduTech 2000 is profiled in part because the project encountered well-publicized challenges during implementation. Important as well, the design of EduTech 2000 prioritizes the transformation of teaching and learning through curriculum reform, new assessment models, and TPD. These elements are in turn intended to support integration of ICT across the curriculum.

HEART Trust/NTA, among the largest educational organizations in the Caribbean, has successfully installed ICT throughout its network of facilities and programs. At present, HEART Trust/NTA is engaged in the multiyear roll-out of both an LMS and a database of employment-qualifications profiles. Plans are to integrate these two systems to create end-to-end linkages between lifelong learning and employment.

The other two projects profiled are much smaller in scale, but present innovative approaches to problems common to many countries in the Caribbean:

- VOIP network
  Department of Education, US Virgin Islands
- School of Tomorrow
  MOE, Aruba

The US Virgin Islands education system is comprised of two school districts spread over three islands. Enabling teachers to communicate easily with each other—to arrange collaborative projects, for example—is very important. Using a VOIP network to connect all schools reduces both acquisition and operating costs substantially, and provides teachers easy access to voice communications.

Aruba's School of Tomorrow supports field-level experimentation in new pedagogical approaches and the integration of ICT into the curriculum by teachers in two pilot schools. With little funding, the project has nonetheless created several online projects, including a blog-based collaborative project with students from the Netherlands.

Project profile: HEART Trust/National Training Agency, Jamaica

With over 80,000 enrolled students, the Human Employment and Resource Training / National Training Agency (HEART Trust/NTA) is among the largest training and education organizations in the Caribbean. HEART Trust/NTA operates ICT-enabled and ICT-focused programs that are also among the largest and most diverse in the region. The HEART Trust/NTA effort to connect secondary, post-secondary, and tertiary education to workplace competencies and employment is a landmark effort to strengthen the connection between education and economic development.

Education, employment, and economic growth are critically linked in Jamaica and throughout the Caribbean. At present, the Jamaican workforce suffers from low skills and high unemployment despite advances in both primary and secondary education. Primary and lower-secondary school systems have

achieved universal enrolment, however 20 percent of students do not complete higher-secondary school; of those completing, 33 percent do not take CXC or equivalent exams. Moreover, the exam scores of students include over 50 percent failures in math and English. Inadequate student achievement—resulting in high illiteracy and other negative outcomes—generate a Jamaican labor force that lacks academic and work-related qualifications. Lifelong learning and its support by the HEART Trust/NTA are vital to the long-term growth of the Jamaican economy.

Current ICT-related training and initiatives include:

- ICT training for all students at all 27 HEART Trust/NTA institutions
- Vocational Training Development Institute (VTDI) offering tertiary-level and post-graduate programs to develop instructors and educators
- Web-based NQR increasing access to training programs and resources for job seekers and employers—in development
- LMS to support enrolment, student tracking and e-learning—in development

In addition, HEART Trust/NTA maintains a Training Information Management System (TIMS), analogous to an EMIS, that services all HEART Trust/NTA campuses and administrative offices as well as over 25 other organizations involved in TVET in Jamaica.

Since its inception, the HEART Trust/NTA has been supported primarily by a 3 percent employment tax, paid by all Jamaican private-sector employers with revenues above a specified threshold. Firms that provide work-place-based training or employment for HEART students receive relief from a portion of the tax.

ICT training for all students

HEART Trust/NTA offers TVET to school leavers (both secondary-school graduates and non-graduates) in subjects such as automotive maintenance, tourism and hospitality, construction, and early-childhood education. All students in these programs attend courses in basic computer skills.

Several of the 27 HEART Trust/NTA training institutes distributed throughout Jamaica also offer certification in ICT-specific vocational topics: these range from data operations to call-center skills. The HEART Trust/NTA Stony Hill campus, in addition, includes a Cisco Regional Training Academy with seven labs and capacity for 500 students. Ten other training institutes house or are connected to local Cisco academies.

Vocational Training Development Institute

VTDI provides training to prospective TVET trainers and educators at its campus in Kingston, which features six computer labs supporting instruction in basic computer skills, networking, programming, graphic design, Web development, and instructional technology.

VTDI offers a four-year B.Ed. degree in TVET, in collaboration with the University of Technology, intended to prepare secondary-school graduates 25 years old and above to become TVET instructors. VTDI offers B.Ed. specializations that include: computing with accounting, electrical technology, and office systems and technology. All other B.Ed. curricula, such as clothing design and family studies, begin with one-semester IT courses.

Non-ICT TVET certifications programs address entrepreneurship, building and drafting, and entertainment management. Again, all student trainers are introduced to ICT. VTDI offers the following technology-focused certificates and diplomas for job-seekers and for TVET teachers and trainers:

- Instructional Technology Certificate
  Education-related ICT skills for TVET instructors
  (three semesters, part-time)
- ICT Instructor diploma
  Advanced ICT training (e.g., Java, Visual Basic) for TVET instructors
  (two years, part-time)
- Education and Training diploma—ICT specialization
  (18 months, part-time)
- ICT Technologist diploma
  Advanced ICT training for others
  (two years, full-time)

VTDI also serves as a local Cisco Certified Networking Academy.

National Qualifications Register (NQR) and Learning Management System (LMS)

The NQR is the Web-based component supporting the transformation of HEART Trust/NTA assessment and accreditation processes. This transformation has the potential to solidify the relationship between education, training, and employment in Jamaica, and to radically strengthen lifelong learning. The NQR is scheduled for completion in 2008.

As the basis of this change, students are to be assessed against a "unit-competency standard": As a competency is mastered, as demonstrated by assessment, a student is certified in that specific competency. Over time, students accumulate groups of competencies relevant to specified skill sets and work roles, which are then recognized as National Qualifications.

Students' accumulated competencies will be logged throughout their "careers" as lifelong learners. The system will also maintain and provide access to industry standards, and will support accreditation of training providers across Jamaica.

The NQR and unit-competency assessment will establish a "vertical" linkage between student achievement in secondary, post-secondary and tertiary learning, by making students' TVET qualifications available to prospective employers. This linkage will strengthen the connection between education in Jamaica—and TVET in particular—with industry needs, and will build demand for training and certification services.

Also scheduled for completion in 2008, the Web-enabled LMS is intended to provide e-learning access to students at all HEART Trust/NTA training institutes and to DE students, including students at other TVET institutions. Outcomes of LMS implementation will include an overall standardization of TVET, resulting in higher-quality instruction and better-prepared graduates.

By integrating the LMS and NQR, HEART Trust/NTA will establish a comprehensive solution for Jamaican TVET increasing learners' access to standardized curricula, certifying competencies as they are mastered, and facilitating employment processes.

Training Information Management System

The current TIMS provides HEART Trust/NTA training institutes and management with complete student tracking, including entrance testing, institution placement, attendance, and student performance. The HEART Trust/NTA TIMS also provides information relevant to exit tests, certification, job placement, and student post-training outcomes in terms of employment. Exemplifying data-driven decision-making, HEART Trust/NTA uses TIMS data to evaluate the effectiveness and efficiency of its TVET instruction.

The current TIMS system is not Web-enabled, meaning that learners and prospective employers do not have access to its records. As part of the development and integration of the NQR and LMS, HEART Trust/NTA will make TIMS data available on the Internet. This means that job seekers will be able to search employee profiles posted by employers and respond with applications.

Project profile: VOIP Telephone Network, US Virgin Islands

The US Virgin Islands has implemented a VOIP-based telephone network among 30 percent of public schools to support teacher-to-teacher and teacher-to-parent communication. This solution is yielding results in terms of reduced costs, increased flexibility, and more effective interaction among teachers, students, and families.

Selection of VOIP telephony

The US Virgin Islands covers two school districts and three islands—St. John, St. Thomas, and St. Croix. Both districts include schools in urban communities and rural communities, with the separation of schools and districts presenting obstacles to communication, coordination, and collaboration.

As is the case in many school districts in the United States and in other countries, teachers' access to school-supported telephones is limited. Older school infrastructure, including lack of installed telephone lines, and the high price of traditional Private

Branch Exchange (PBX) telephone hardware make the cost of retrofitting schools to provide teachers access to voice telephony prohibitive. In addition, establishment of 800-number call-in lines—used by schools for a "homework hotline"—would entail charges for all incoming calls.

Lower acquisition, installation, and operating costs

In comparison, VOIP telephony can be built on top of the US Virgin Islands Department of Education's (VIDE's) existing ICT installation, which includes broadband Internet connectivity to all schools. Several schools, in addition, have at least one computer per classroom for use by teachers and students, typically connected by wireless to the school LAN. Cost of VOIP hardware, then, is dramatically lower than a traditional PBX network, and is both much simpler and less expensive to install.

VOIP telephony also reduced maintenance requirements while giving administrators the ability to add extensions and features, and configure systems. As with all ICT systems used in primary and secondary schools, the telephone system is maintained and serviced by the VIDE Office of Instructional Technology E-rate Telecommunications grant from the Universal Service Administration Company (USAC), the administrative organization for the US Universal Service Fund.[28] The simplicity of running voice telephone through schools' LANs and broadband connections is as critical as the system's lower cost.

Impact on teaching and learning

Cost-effective audio communication benefits students, families, and teachers by providing support for:

- The Homework Hotline, enabling families to encourage and engage in students' education
- Teacher-to-teacher coordination of Video teleconference (VTC) and of student collaborative projects
- On-demand technical support for teachers encountering problems using or integrating technology into teaching and learning

The Homework Hotline is a significant initiative of the VIDE. Its success depends on teachers having easy access to telephones in order to update information, check messages, and respond to requests. VOIP telephony is a critical component in the Homework Hotline system.

In the words of Clinton Stapleton, Director of the Office of Instructional Technology, "Collaboration strengthens higher-level thinking, the phones allow teachers to manage collaboration. Ordinarily, they are isolated in their classrooms and schools, in terms of what happens in the real world. Using the VOIP system, teachers can connect their classes with other teachers and students across the water, just through their four-digit extensions."

Project profile: School of Tomorrow, Aruba

Although funded at a low level, the School of Tomorrow in Aruba is among the most successful and innovative ICT programs in education in the Caribbean. Students routinely use word processing, spreadsheet, presentation, and other software in the course of their curricula. In special projects, such as a World Cup blogging project with students from the Netherlands, School of Tomorrow students scan, draw, write, upload, and share comments and ideas with others.

The School of Tomorrow was founded by Ilonka N. Sjak-Shie in 2004 at the IPA. At the outset, ICT capacity, both within IPA and in Aruban schools overall was low. The School of Tomorrow comprises a model ICT classroom at IPA, plus two pilot schools with roughly 15 computers per school. These facilities—established with a UNESCO grant of only US$25,000—enable School of Tomorrow to offer pre-service and in-service teachers the opportunity to explore a technology-rich classroom.

In the pilot schools, students have access to 15 Internet-connected computers (both desktop and laptop), one digital video camcorder, one scanner, three digital cameras, 15 headphones, 15 webcams, and a color printer.

Ms. Sjak-Shie mentors the most active of the pilot schools, Colegio Cristo Rey, which has adopted

28 The Universal Service Fund is supported by contributions from telecommunications companies in the U.S., and is intended to support low-cost access for rural communicates and disadvantaged individuals (www.usac.org).

active learning pedagogies in combination with ICT across its curriculum. The students in the school have been involved in the development of three pilot "learning environments."

The most developed of these environments is "2006 World Cup." The project was supported by additional funding from the Aruban telecommunications company *Servicio di Telecomunicacion di Aruba* (SETAR) and the Dutch NGO KANS. KANS specifically funds collaborative projects among schools in the Netherlands and its territories and former territories.

In the project's three phases, students were asked to:

- Develop personal blogs using text and images
- Visit and add comments and other content to other students' blogs
- Contribute news and opinions to blogs over the course of the World Cup competition

In addition, students developed travel budgets, itineraries, and other items while planning for simulated trips to Germany to view the competition, and participated in a simulated FIFA youth conference. Student and teacher curriculum guides developed by School of Tomorrow and IPA supported all activities.

Other School of Tomorrow projects include collaborative development of a Web site enabling foreigners to develop their understanding of Aruba and its culture, and a site presenting information about Aruban ecology.

At IPA, School of Tomorrow has also been instrumental in supporting integration of ICT across the curriculum in all Aruban schools. Ms. Sjak-Shie and her colleagues coach in-service and pre-service teachers in active-learning pedagogies (e.g., project-based learning, constructivist approaches, etc.) supported by ICT. Teachers are encouraged to design projects and test them with their students, integrating ICT into those projects at their own discretion.

"Younger teachers with computer experience may come in to schools and flip open their laptops to start teaching," says Ms. Sjak-Shie, "but that doesn't make them better teachers. I believe that there's danger in introducing technology into a traditional system as though the technology itself is an innovation."

"We have to call them ICT projects," she adds, "but it's not about the ICT. We are here to change your educational model."

Project profile: EduTech 2000, Barbados

Overview

The Education Sector Enhancement Program, generally referred to as EduTech or EduTech 2000, involves the comprehensive reform of primary and secondary education in Barbados. ICT is intended to catalyze or support the transformation of teaching and learning, enabling students to become better prepared for participation in a globalizing economy and culture. The EduTech project is notable within the scope of this study because it is a large-scale program that pointedly frames the introduction and adoption of ICT as a means of change, not as an end.

Conceived in 1997 and launched in 2000, EduTech includes four program components:

- **Civil works**
  Rehabilitation of 73 out of 105 school facilities, including but not limited to preparation of computer facilities, with a projected rate of approximately 20 schools per year
- **Technological infrastructure**
  Procurement and installation of hardware, software, and networks for all schools and for MOE Barbados
- **Human resource development**
  TPD for all in-service teachers to enable faculty and staff to use ICT effectively to support learning in all curriculum areas and to build technology-leadership capacity in schools; institutional strengthening to support project management, monitoring and evaluation, and teachers' access to electronic content
- **Curriculum development**
  Revision of primary and secondary curricula, with the participation of teachers, to facilitate active-learning pedagogies and the integrated use of ICT

The four components outline a framework that entails the transformation of many if not all core activities of the educational system, ranging from information management to teacher education to assessment.

The substantial delays that EduTech has encountered have arisen from challenges inherent in a project of such scope and complexity, especially in light of institutional and private sector capacity. Lack of capacity in planning, procurement and management may have limited the ability of MOE Barbados to adapt to and meet some challenges, such as those arising from its pilot 1:1 computing initiative.

Background

Barbados is among the larger of the Caribbean SIDS, with a relatively strong economy. Almost 40 years ago, Barbados achieved universal access to primary and secondary education, objectives that remain unmet in some of the region's countries. By the mid-1990s, however, it had become apparent that the quality of education, as reflected in exam scores and other indicators, was not high enough and enable graduates to enter the workforce with skills in demand in the globalizing economy.

Policy and planning

Starting as early as 1995, Barbadian education administrators undertook processes of analysis, vision building, and planning intended to address inadequacies in the quality of teaching and learning. These processes led to drafting of the document, *White paper on education reform* (1995), which in turn laid the philosophical, pedagogical, and organizational foundation for key planning documents:

- EduTech Master plan (1997)
- Curriculum Reform 2000 (2000)

Mark Ray, Program Director for the Education Sector Enhancement Program within the MOE Barbados, describes the importance of these documents:

"The Master Plan looked at the thinking behind the integration of technology, the purpose for which it would be used, and the structures to support it in terms of human resources and technological resources. It identified the need for schools to develop operational plans that outline how they see the technology being used. That document shaped the path that we're going on. When there were challenges we were able to look at where we wanted to be."

From its conception, EduTech was framed as a long-term, multi-component project. Given the substantial obstacles that the project encountered, the guidance framed in these planning documents has proven critically important. Evaluation of project results is similarly challenging, and is yet incomplete.

Funding

EduTech is financed through a combination of loans and government funding:

IDB loan	US$85,000,000
CDB loan	31,500,000
Govt. of Barbados	96,607,000
Total	*US$213,107,000*

With a projected cost of US$213 million, EduTech at its inception was the largest ICT-supported education project by Caribbean SIDS. Direct costs of ICT installation comprise roughly 42 percent of the overall project budget:

Civil works	US$39,000,000
Technology infrastructure	88,900,000
Human resource development	4,900,000
Curriculum development	1,500,000
Institutional strengthening	5,400,000
Total	*US$139,700,000*

(Additional funds are allocated to administration, operating costs, contingency, and financing, bringing the total project budget to US$213 million.)

In an ICT project of this complexity, with all four components linked tightly to technology integration, it is likely that direct costs of all components are significantly related to ICT.

Areas of risk identified in early IDB loan documents[29] specifically include the likelihood of MOE Barbados deviation from project timelines, specifically delay in the contracting and execution of

29 Much of the donor-related information in this profile is drawn from two documents: *Programa de mejoamiento del sector de la education*, (BA-0009, undated), and *Country program evaluation: Barbados 1989–2004* (Office of Evaluation and Oversight, IDB, March 2006). Note that the overall level of financial assistance given by IDB to Barbados is low, averaging 0.6 percent of GDP per year. However, IDB financing for EduTech constitutes the largest of IDB loans approved to Barbados between 1992 and 2002.

construction, with concomitant delays in installation of ICT and the need to repeat training of teachers. In the event, this description was proven prescient.

Other areas of identified risk included the general uncertainty surrounding the complex project design, the demonstrated risks of large-scale ICT projects, and institutional capacity on the part of the Government of Barbados and MOE. To address some of these risks, the project design identified the need for flexibility and for a "test and fix" approach.

Project design

The EduTech project plan called for facility rehabilitation and installation of ICT in 15 demonstration schools, allowing field-testing of ICT and of other inputs and activities (e.g., TPD, drafting of school technology plans, etc.). Facility rehabilitation and ICT installation then proceeded at a pace of roughly 20 schools per year, with the overall project timeline spanning seven years.

The ICT plan for all schools included:

- Teacher multimedia centers in all classrooms
- PCs and laptops in staff rooms

Primary schools would in addition receive:

- 1–3 computers in each classroom
- 1 computer lab per school with less than 500 students; 2 labs per school with more than 500 students

Secondary schools would in addition receive:

- Computers in each classroom
- Subject-specific ICT facilities
- One 30-computer lab

Additional hardware and peripherals would include digital cameras, scanners, science probes, electronic whiteboards, and other items. Software would include both productivity applications (Microsoft Office) and educational software.

Early stages in EduTech implementation also called for completion of the reform of primary and secondary curricula, a process begun in 1996 (shortly after the 1995 White Paper) and conceived as the bedrock of the transformative process. Reforms focus on introduction of learner-centered techniques, including Constructivist pedagogies, collaborative and project-based learning, and other methods. Among the most far-reaching initiatives included in EduTech is the reform of assessment practices, emphasizing continuous-assessment alternatives to test-based assessment. These alternatives include peer- and self-assessment, exhibitions, portfolio assessment, and other methods intended to increase the linkage between learning and assessment and to emphasize the development of competencies rather than performance on exams.

Curriculum reform also emphasized use of "indigenous," or Barbadian materials as learning resources, with the further objective of enabling teachers to develop ICT-based learning resources as the project progressed. Development of the revised curricula involved strong participation by teachers throughout, which (anecdotally) has increased teachers' acceptance of the reforms.

The institution-strengthening component—in addition to supporting training at all levels in MOE Barbados, including school faculty—included establishment of an Education Evaluation Center (EEC) at the Cave Hill Campus of UWI in Barbados. In response to donor concerns about the need for close project monitoring —as a way of informing means to inform adaptive responses to complex and unplanned events, the EEC would focus its evaluation efforts on impacts rather than implementation metrics. Impacts to be measured would encompass effects on students, teachers, and families, notably the results of learner-centered pedagogies and the use of ICT.

Project implementation: Civil works and ICT

From its earliest implementation efforts, EduTech encountered unanticipated problems centering on the civil-works component and leading to substantial delays. Many Barbadian school buildings are very old. During the project-planning phase, buildings were assessed in relation to facilities upgrades, but invasive assessment techniques (involving opening walls, foundations, ceilings, etc.) were not used. When facilities upgrades began, the conditions encountered showed that initial cost and time estimates were overly optimistic. More extensive construction required temporary school closures and the transfer of students, and increased the complexity of an already-complex project. The

civil-works component was scheduled for completion in the 2007–2008 academic year.

Delays in the civil-works component resulted in the concomitant delay of the project's technological-infrastructure component. At the time of the project's 2005 re-structuring, civil-works rehabilitation had been completed for 32 schools. Also at that time, 15 of the Phase 1 demonstration schools had received their full ICT installations, with an additional seven Phase 2 primary schools also receiving ICT installations.

The 2006 country program evaluation by IDB cites a June 2005 PPMR stating that the completion rate for civil works was 30 percent, with completion of the ICT component at 25 percent.

In 2005, MOE and the Government of Barbados re-structured EduTech to de-link civil works from ICT installation and use. Emphasis also shifted from providing complete ICT installations on a school-by-school basis to achieving partial installations in all schools, thus providing teachers and students with at least minimal access to computers and the Internet. Accelerating the deployment of partial installations also gives teachers the opportunity to explore capacities built during TPD before the impact of their training dissipates.

Available information on current EduTech ICT installations is as follows:

- All primary schools have computers that students can access
- All primary schools have Internet access
- 24 of 71 EduTech primary schools have received complete ICT installations
  (labs of 12–30 computers, computers in classrooms, peripherals)
- All secondary schools have received at least 30 computers from the EduTech program
- All secondary schools have Internet access, but not all computers are connected
- All secondary schools have core sets of educational software
  (math, science, health and family, language arts, critical thinking)
- 11 of 29 secondary schools have received complete ICT installations
  (30-computer labs, computers in classrooms, peripherals

With the revised implementation scheme, the EduTech program has attempted to accelerate ICT installation. The 2006 IDB program review finds that of the US$85 million loan total, 31 percent or US$28.2 million had been disbursed. At the end of the initial seven-year loan period, 23.6 percent of the planned technology had been installed. Final disbursements from IDB and CDB have been extended for three years.

Also in 2005, the Government of Barbados and IDB agreed to cancel US$24 million in funding for EduTech. This step was taken in response to two primary factors: the MOE determined that a portion of civil works would not be completed within the project timeframe, in part due to competition for contractors resulting from increased construction activity in Barbados; and advances in wireless networking and mobile technologies (laptops on carts) could enable more effective use of ICT at lower cost. Civil works will continue beyond the end of the project funding cycle, and all schools with receive at least basic technology packages.

Project implementation: Curriculum and TPD

The revised curriculum, development of which started in 1996, was completed in 2002. Curriculum reforms were fully implemented in schools as of July 2005. The extent to which teachers have adopted active-learning and other pedagogies that are emphasized in the revised curricula is not known.

Over 1,100 primary and secondary teachers completed the EduTech technology-mastery training at Erdiston Teachers College, while more than 700 teachers participated in teaching-methodology training focused on integration of ICT into the curriculum. Additional TPD was provided for principals, coaches, and IT coordinators. A number of issues arose in relation to timing and coordination of TPD. Specifically, technology-focused TPD was not coordinated with access to ICT in teachers' schools.

Project evaluation

Since the launch of EduTech, there have been several efforts to evaluate the impact of the project overall and of specific components. These include:

- EEC case studies of best practices (2003)
- EEC evaluation of the NetSchools (laptop) project, of values education in primary and secondary schools, and of the use of ICT by school administration (2003–2005)
- IDB external mid-term project evaluation by Ontario Institute for Studies in Education (OISE, 2005)
- IDB evaluation of educational impact by Professor Maureen Pirog and Sharon Kioko, Indiana University (2006)
- MOE Barbados survey of teacher use of technologies (2006)

EduTech impact as captured by these efforts is at best mixed. The EEC report on best practices also identified challenges facing the implementation process, and suggested that significant problems remained in terms of hardware maintenance and networking, teachers' approaches to the use of computers for learning, hardware configurations in schools and other factors. This study also found that participation in EduTech has led to increased learner-centered instruction, improved planning for ICT integration, increased interaction between teachers and students, and greater student interest and motivation.

The MOE Barbados survey documents relatively low levels of technology use in relation to the levels of access in Phase 1 and Phase 2 schools. The survey was distributed to 189 secondary teachers and 225 primary teachers, with 45 percent of teachers surveyed returning responses. Teachers reported moderate to low participation in TPD: 65 percent of primary teachers and 76 percent of secondary teachers reported completing basic training in IT skills; 31 percent of primary teachers and 50 percent of secondary teachers reported completing training in teaching methodologies. Use of technologies for learning is roughly proportional to these levels of training: 26.1 percent of teacher report using computers at least once daily; 37.5 percent report using computers once per week; teachers predominately use Microsoft Word, with use of the Internet lagging these numbers. Student access to technology is much lower: only 23.5 percent of teachers' reports conducting activities in which students use technology once per week or more. Given the substantial investment made in EduTech, these results, if accurate, are disappointing.

The evaluation by Pirog and Kioko is focused on impact on learning and features a strong experimental design—especially in light of variations in implementation across the intervention group and the lack of baseline data. That study derives baseline values from students' scores on the Barbados Secondary School Entrance Exams (BSSEE) from 1990 to 2005, enabling comparison of students' performance prior to EduTech and following EduTech interventions of varying periods and scope. The BSSEE is an exit examination taken by all Barbadian students upon completion of their final year of primary school. At the time of this evaluation, no school had received complete inputs for all four EduTech components, and the period and scope of intervention for all schools (Phases 1–4) was jumbled.

However, Pirog and Kioko are able to control for an extremely large number of confounding variables arising from differential EduTech intervention. To summarize results of their evaluation: overall impact (as reflected in BSSEE scores) is large and negative for math in the first two years of EduTech intervention, while these effects decline in magnitude over time. Impact in English studies is positive, with the magnitudes of these impacts also declining over time. In a number of comparisons, student performance post-EduTech is noticeably lower.

Efforts by Pirog and Kioko to assess the impact of separate components are challenged by the complex interrelationships of these components. Their findings are that:

- TPD within EduTech has negative effects on math and English scores, effects which decline over time in math but that are sustained in English
- Civil works has uniformly positive impacts, which also decline over time
- ICT impacts do not achieve significance

Because implementation of the EduTech curriculum lagged for students in their final year of primary school, assessment of the impact of the revised curriculum was not possible.

Per Pirog and Kioko, one explanation for the negative impacts is that the significant disruption caused by a combination of new factors—including ICT, new pedagogies and new assessment practices,

as well as changes caused by facilities rehabilitation—outweighs near-term positive impacts of EduTech inputs. A second explanation, which does not exclude the first explanation as a factor, is that EduTech outcomes are not effectively measured by the BSSEE.

Evaluations by the EEC focus on attitudes, perceptions, and practices for the most part. Although the organization received IDB support for formative monitoring and evaluation—part of the test-and-fix model—the IDB Barbados program report cites the mid-term evaluation by the Ontario Institute for Studies in Education (OISE) in saying that the EEC "…is gathering useful data on the implementation of the ESEP (Education Sector Enhancement Program – EduTech), but this information does not inform the GOB (Government of Barbados) nor the IDB or CDB."

NetSchools pilot project

The EduTech project design called for a pilot 1:1 computing initiative to be launched in four primary and two secondary schools. This initiative would provide every student with a laptop computer for use on the school LAN and outside the school premises. In a country with a relatively strong economy but unequal distribution of wealth and income, school-sponsored 1:1 computing was seen as a way of ensuring equitable access to ICT for disadvantaged students.

The project adopted the hardware and networking solution provided by NetSchools, a US-based start-up company focused on the education market. The NetSchools solution consisted of:

- Ruggedized laptop computers
  The NetSchools proprietary StudyPro laptops featured magnesium cases and flash memory running Windows 95[30]
- Infra-red school LAN
  The infrared network featured a ceiling-mount installation in classroom
- Web-delivered learning resources
  NetSchools provided both their own customized curriculum resources and links to many other resources

At roughly the same time, the NetSchools solution was adopted by a small but not insignificant number of United States school districts in states that included South Carolina and West Virginia. Total cost of a NetSchools package was roughly US$2,000–$2,200 per student in schools in the United States.

Project impact was limited by significant problems with the laptop and networking hardware. Computers were limited by inadequate memory and storage, suffered frequent failures with repairs requiring long delays (while the importance of "uptime" is magnified in 1:1 computing environments), and the infrared network connections in classrooms frequently failed. In addition, students were frequently unsuccessful in their attempts to access the Internet or the school network from home.

While hardware problems essentially short-circuited the NetSchools project in the short term, the company's inadequate business model and planning, combined with the unproven nature of its hardware and its business model, rendered adaptation and follow-on inputs impossible. Early in the project, the NetSchools founder died and the company's new leadership shifted its business model to emphasize NetSchools' proprietary educational software.

In 2002 NetSchools Corporation was acquired by PLATO Learning, Inc., which ended NetSchools' hardware business to consolidate its focus on content, services, and e-learning. Shortly after the NetSchools acquisition, 802.11 wireless networking began to be widely available and to radically reduce funding and technical capacity required introducing school-wide LANs.

In addition, the NetSchools reliance on proprietary development entailed high risk, with that risk passed on to customers, such as the Barbados MOE, which had made substantial investments in the NetSchools hardware solution.

Concluding view

Assessment of the EduTech project is complicated not only by the project's structural complexity but by the inherent complexity and difficulty of educational transformation. From this perspective, delays in civil works and ICT installation introduce

30 Although technical specifications and descriptions of the NetSchools configuration are limited, it bears noting that running Windows 95 on a completely solid-state computer (no hard drive) with then-current microprocessors would present significant technical and product-support challenges.

the prospect of essential concentrated focus on the curriculum and TPD interventions for profound change. And yet, even given this unanticipated segmentation of the project's components, impact as measured by Pirog and Kioko is negligible.

What are we to make of this?

EduTech goals set substantial achievement benchmarks for Barbadian school leadership, teachers, and students—especially in light of the prescriptive character of post-colonial school systems. Inputs in terms of TPD have thus far been minimal, and indeed the project budget includes funding for ICT over 20 times greater than expenditures on teacher development. Regardless of the delays incurred by technology installation, teachers' importance to the re-making of teaching and learning vastly outweighs the potential impact of computers, software, and the Internet. It is not unlikely that had both the civil-works and ICT components proceeded as planned, measurable outcomes of EduTech would be little changed.

And yet, MOE Barbados and the teachers and students in Barbados retain the touchstone framework of the 1995 White Paper; they are gaining relatively robust technologies in schools: they have access to a curriculum that is entirely focused on supporting active learning. The project, speaking realistically, has just begun.

Recommendations

It is not within the scope of this study to offer specific recommendations with regard to individual projects. Nevertheless, the situation with regard to EduTech warrants several broad suggestions, inasmuch as implementation will soon be completed and impact evaluations will no doubt yield results unchanged from those found by of Pirog and Kioko.

From a great distance, then, the following choices seem obvious:

- **Greatly increase funding for TPD**
  The budget allocation as originally conceived was substantially lower than that recommended for ICT projects in general, let alone projects entailing simultaneous curriculum revisions.
- **Adopt a new TPD design**
  Pull-out in-service programs for teachers combined with increased capacitation of IT coordinators cannot achieve wholesale change in classroom activities. Models involving processes such as on-site mentoring by circuit mentors, teacher self-assessment, communities of practice, and technology "hub" schools that offer in-class practica are more likely to support desired outcomes.

  In addition, the TPD curriculum appears to present technology training in "stovepipe subjects" such as basic technology, use of digital cameras, use of projectors, and use of the Internet that are separate from the teaching methodologies course. If technology integration is a desired outcome, more integrated TPD geared curricula should be used.
- **Re-focus project evaluation to test appropriate outcomes**
  Although the scope and methodology of the evaluation by Pirog and Kioko appears to be of the highest quality, the central indicator, performance on the BSSEE, is likely not adequate to measure the learning outcomes emphasized by EduTech. Development of students' abilities to frame problems, communicate, collaborate, and think creatively may yet be beyond the reach of Barbadian schools. But these outcomes are more pointedly and clearly outside the parameters of the BSSEE. They are, however, the outcomes that EduTech is designed to achieve. In light of the significant challenges that the project has faced, plus the overall difficulty attending its goals, a reasonable step would be to establish new, measurable indicators of learning outcomes and collect data from current students that will serve as a future baseline.

Chapter 7

Conclusion

Computers and the Internet have had limited impact in Caribbean primary and secondary education beyond serving as a base supporting student achievement on the practical portions of the CXC IT exams. Major barriers to effective education, such as teacher capacity, the relevance of the curriculum, information management, and graduates' competencies have not been affected by the past decade's investments in ICT. The region's universities and, in some cases, colleges have built technical capacity and the capacity to support the development of technology-related skills. The use of technology to overcome geographic barriers and the lack of access to tertiary education, however, is only beginning.

Over the same period, however, the economic and cultural challenges posed by globalization have intensified. To an extent, these factors are forcing the hands of education systems worldwide. The demands placed on these systems are less for ICT-literate secondary graduates than for "creative problem solvers" (see Reich, 2004) or, less ambitiously, for graduates who are information literate, can communicate, and have good teamwork skills.

The base of ICT infrastructure in schools has the potential to contribute to education systems' more effective response to policy goals and to internal and external forces affecting the Caribbean today. Most secondary schools and some primary schools provide access to computer and, where the telecommunications system permits, to the Internet. Several countries—Jamaica, Trinidad and Tobago, Barbados and others—have major technology implementations in process or nearing completion.

At the primary and secondary levels, the full potential of technology will only be unlocked by effective approaches to other essential, systemic challenges to Caribbean education. Changes to national curricula and regional assessment to increase the relevance and effectiveness of student learning will present opportunities to link computer use to real-world productivity skills, dynamic sources of information on the World Wide Web, and to collaboration tools. Increasing professionalism among teachers, especially in relation to active-learning pedagogies, will distribute computer use among a wider segment of Caribbean faculty. Given approaches such as these, the impact of ICT on student motivation, demonstrated within the region (see Pirog and Kioko, 2006) and internationally (see Kozma, 2003; Gaible and Nadel, in press), might contribute to student completion rates. In a real sense, increasing the relevance and effectiveness of Caribbean education will increase the relevance of ICT use in Caribbean schools.

Key observations

The intent of this Survey of ICT in Education in the Caribbean is to capture "snapshots" of the use of computers and the Internet in the region's education systems, and from these to develop understanding of current status, successes, barriers and trends. In addition to the region-wide focus on technical training, as mentioned, the following points are important:

- **Successful establishment of school-level ICT "infrastructure"**
  Technology infrastructure in terms of hardware and connectivity has been established at the secondary level in most countries. The main challenge directly related to school computer installations is maintenance—many computers are old, out of repair, and unable to support current operating systems, applications and Web applications. While region-wide focus on IT skills has driven roll-out of infrastructure, elements of this system such as IT teachers, curricula, and exams block change.

- **Lack of capacity for large-scale ICT projects** The largest-scale initiatives within the region, such as Job Skills Education Program (JSEP) in Jamaica and EduTech in Barbados, expose the need for additional capacity at the ministry level. Functions ranging from procurement to maintenance to information management must be addressed in planning and then managed effectively. Although many Caribbean countries do not require projects on the scale of EduTech and JSEP, improved strategic and implementation planning will lead to more integrated initiatives that delivery higher value.
- **Lack of impact from regional initiatives** Despite sharing many aspects in common, education systems in the Caribbean have not benefited greatly from regional cooperation or regional initiatives. Initiatives targeting policy and information management have addressed, appropriately, challenging tasks. However the impact of those activities has been limited. In the case of OERU support for ICT policy in education, lack of linkage between policy and planning or practice has contributed to the blunting of these efforts. Less challenging activities, such as support for school-to-school tele-collaboration or Web-based contest, might have greater influence on teaching and learning. At the tertiary level, regional initiatives related to ICT have yet to bear fruit, however the CKLN continues to pursue enhanced connectivity for TLIs as a foundation for further regional collaboration.

An additional, overarching consideration is that Caribbean governments and ministries of education have benefitted little, if at all, from international experiences and lessons learned in small- and large-scale technology implementations in schools. The United States (in the 1980s), Turkey (in the 1990s), and many other countries have introduced ICT into schools as a way of building technical skills, and have subsequently pivoted to shift resources toward the use of technology to improve teaching and learning across the curriculum. Other countries—notably Costa Rica, Chile and Jordan—have focused large-scale projects on substantial reform of curricula and practice. These and other extensively documented projects do not appear to have influenced the Caribbean region's course in relation to ICT in education systems.

Re-assessing the potential of curriculum integration

The introduction to this volume of the *Survey* posed three questions regarding the value of ICT integration and its alternatives. These can summarized as follows: What leverage does integration of computers and the Internet into the curriculum offer on the problems confronting Caribbean education systems?

The most frequently proposed alternative to focus on technical skills, integration would if properly implemented require that Caribbean countries address several critical issues. These include:

- Problems related to technology installations, including maintenance, aging hardware, heterogeneous software, and *some* problems related to financial and information management
- Mechanisms and programs for teacher professional development addressing both technology skills and pedagogical methods
- Curriculum and assessment in relation to classroom practice and desired student learning activities and outcomes

Without measures to address these components of national education systems, integration process—such as those described in OERU-based policies—would be doomed less to failure than to never getting started in any meaningful way.

Ironically, it is also likely that despite a decade of delivery of the IT curriculum in schools, students' limited technology skills would create an obstacle—in combination with teachers' own emerging skills— which constitute an obstacle to effective approaches to technology integration.

Possible outcomes of curriculum integration

Given current progress toward meeting the minimal requirements for such approaches, what are likely outcomes of efforts to integrate technology into other areas of the curriculum?

An effective shift of teaching and learning from test-focused activities to active-learning pedagogies will, in the mid-term (perhaps three to seven years), likely result in regular but not transformative

teaching and learning practices by teachers and students. Some classes, but not all, will most likely practice simple uses of computers and the Internet to support a reformed—but not transformed—curriculum. These practices could include Internet-based searches for information, comparing conflicting resources, organizing information, developing slide presentations or Web pages, and presenting findings to classmates. Less frequently, students might participate in longer-term and more elaborate projects, collaborating with students in other schools in the Caribbean and outside the region, and some teachers would use technology to demonstrate challenging concepts. In some schools, innovative teachers might design and help construct "one-off" experiments that push local boundaries of PBL, either engaging students in real-world community blogging to effect a reduction on greenhouse emissions or developing and writing materials for distribution outside of school to increase awareness of HIV/AIDS. That said, it is expected that education in the Caribbean will continue to be marked by persistent tension between traditional modes of teaching—useful for dispatching curriculum units—and more innovative, in-depth explorations of various curricular goals. Both modes might be supported by ICT. (Students would, as secondary effects of these activities, increase their real-world technical and workplace skills.)

These outcomes of efforts to integrate ICT in other areas of the curriculum, while positive in relation to current practice, are subject to many factors that might increase or decrease levels of participation. In addition to the "pre-requisite" influences such as loosening of the curriculum and mechanisms for TPD, factors positively influencing participation could include:

- Regional or national development of digital learning resources
- Support for local, cluster-based communities of practice among teachers
- Online support for inter-school collaboration, such as forums, list serves, group blogs, and contests
- Re-organization of the IT curriculum to increase emphasis on practice, reduce emphasis on theory, and to support students' approaches to other subjects
- Introduction of alternative assessment methods that support students' participation in collaborative projects, contests, and other non-standardized learning activities

These and other influencing factors can be organized according to their scope—local (or distributive), national, and regional. In many instances, regional activities have the potential to bypass national education frameworks (e.g., curricula, assessments, TPD structures) to enable distributive adoption of active-learning pedagogies at the local level and by individual teachers. This cataloguing of influences characterizes all efforts to increase the effectiveness of technology in the service of teaching and learning: The future of ICT in education in the Caribbean will be determined by the interplay of policy, implementation at the levels of both regional organizations and national education systems, and practice in schools by teachers and students.

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Glossary

Active learning: A broad term for classroom or online processes, such as collaborative learning or project-based learning, in which students are engaged in guided activities that promote learning; related to "learning by doing," among other concepts.

Activity: A process or set of actions performed by teachers and students, as in "a classroom activity."

ADSL (Asymmetric Digital Subscriber Line): A form of broadband connectivity provided by telecommunications companies using existing telephone lines, providing relatively fast transfer of information via the Internet.

Assessment: The act of measuring knowledge, skills and performance, usually in the service of learning.

Bandwidth: The amount and rate of transmission capability of an electronic device. Typically measured in bits per second for *digital* devices (like computers) and in cycles per second for *analog* devices (such as radio). It is the range of frequencies that can be transmitted by phone line, fibre-optic cable, wireless or T-1 line.

Blog (or Web Log): A publicly accessible journal available on the World Wide Web, often allowing visitors to the blog to comment on entries; group blogs may feature the blogs of several, hundreds, or thousands of individuals.

Broadband: A telecommunications signalling method with a wide range of frequencies, enabling faster transmission of data; often fibre-optic cable or ADSL.

Chat (or Instant Messaging): An informal online way of directly connecting people who are online at the same time. AOL Instant Messenger (AIM), ICQ, or iChat client software can be downloaded free.

CAI (Computer Assisted Instruction): A means of delivering educational content and related problem sets in which the learner's performance is assessed automatically and frequently, with assessment resulting in delivery of new content to address deficiencies.

Collaborative learning: Education that relies on any of several frameworks for activities in which students work together to solve problems, find and structure information, or create reports, playscripts, or other materials; often used interchangeably with "cooperative learning," although cooperative learning may be used to refer more specifically to pedagogical techniques involving structured assignments and assessment protocols.

Connectivity: The ability to access an electronic network to send and receive information between locations or devices; connectivity is typically provided using telephone lines, wireless signals, satellite communications, and other, similar means.

Cooperative learning: See "Collaborative learning."

Courseware: Educational software, typically enabling learning of a specific curriculum.

Curriculum: A fixed course of study in a particular subject area at a certain developmental point (e.g., age or grade), in which students address specific, related topics and skills and are assessed on those topics and skills.

Database Management System (DBMS): Software that supports development and use of an electronic database.

Distance Education (DE): Courses typically at the college-level (but also including agricultural extension and other non-formal forms of learning) in which students do not visit a school campus for every class; in developing countries, often relying on

printed materials and the postal service, but increasingly making use of computers, the Internet, mobile telephony and other means.

E-learning: A style of learning in which students interact with digitally delivered content, services and support, often including a distant teacher; although most widely applied to Web-based learning, "e-learning" is also used to refer to learning via satellite TV, DVD, and/or CD-ROM, and is in many instances a sub-set of DE (see "Distance Education").

EMIS (Education Management Information System): A technological system for collecting, storing, retrieving, and analyzing information about an education system to support planning and administration; EMIS typically involves teachers and schools uploading data to a central system; information may include anything from student attendance and grades to the size and condition of school facilities.

Geographic Information System (GIS): Hardware and software used to store, retrieve, map and analyze geographic data, usually oriented in relation to Earth coordinates.

Gross Enrolment Ratio (GER): Information indicating the levels of education attained by members of a specific population.

Information and Communications Technology (ICT): Any technology (mainly digital but also analog) that allows users to create, store, display information in all its forms (text, images, video, audio) or communicate with others over a distance, such as computers, television, handheld computers, radio, audiocassettes, DVD and CD players, cell phones, networks, and the convergence of any of these technologies.

Inquiry-based learning: A form of learning activity in which students observe and question phenomena; pose explanations of what they see; devise and conduct tests to support or contradict their theories; analyze data; draw conclusions from experimental data; design and build models; or any combination of these.

Interactivity: The level of influence that the learner has over educational activities and events; typically used to refer to the design of learning activities and especially educational software and the use of ICT; a highly interactive classroom activity might ask students to set objectives, and determine the activities that will accomplish those objectives as well as the means of assessment; a highly interactive software application might ask students to make choices as to how a problem will be solved.

Internet: A network of networks with worldwide scale, in which millions of computers are interconnected through standardized protocols (TCP/IP).

ISP (Internet Service Provider): An entity that provides individuals and organizations access to the Internet.

LAN (Local Area Network): A network connecting computers that are in the same physical location, such as a school or classroom.

Learner-centered/Student-centered: Instruction based on the belief that students are natural learners, who are more motivated to learn when given the freedom and autonomy to solve authentic problems, work on real-world projects or employ real-world tools, collaborate with peers, and are given greater responsibility and voice in how their work will be assessed.

Learning Management System (LMS): Software that either manages or enables educators to manage students' learning activities, typically by offering Web-based course enrolment functions, delivery of appropriate learning resources and assessments, and course completion notification, as well as many other functions; also known as a Learning Content Management System.

Lesson plan: A teacher-developed and teacher-written study plan that guides instruction; may contain an outline of the important points of a lesson arranged in sequential order, including the activities of the student and instructor, the specific learning objectives for that lesson, the resources and materials to be used, and how and when to use them.

One-to-one computing (or 1:1): Classroom-, school-, district- or system-wide provision of computers, typically laptops, to students; laptops and other mobile devices enable students to use computers in all classes and at home.

Open Source: Open source refers to any program whose source code is made freely available for use and modification as users or other developers see fit; also sometimes referred to as "Free and Open Source Software" (FOSS) and "Free/Libre and Open Source Software").

Outcome: The effect of program or project activities on the beliefs, behaviors, skills, knowledge, attitudes or affect of the targeted population. Outcomes can also be non-personal: access to resources, changes in policies, improvements in environmental conditions, etc.

Pedagogy: The science of teaching and the methods used to teach.

Podcasting: A method of publishing audio broadcasts via the Internet, allowing users to subscribe to a feed of new MP3 files that can be downloaded to portable music players or to computers; podcasting uses a syndication model—such as RSS—to deliver an enclosed file automatically. Podcasting enables independent producers to create self-published, syndicated "radio shows," and gives broadcast radio programs a new distribution method.

Project-based Learning (PBL): An instructional strategy that provides meaningful, active and productive contexts for learning, and that allows students to access and manage the information they gather; distinct from "Problem-based Learning" (also referred to as "PBL"), a teaching technique that emerged from medical schools and that emphasizes assigning student groups diagnostic or other problems to be solved independently.

School leaver: Any student who stops attending school, whether by dropping out or by graduating.

SIDS (Small Island Developing States): Island countries, typically remote, with small populations, limited resources, whose vulnerability to natural disasters and external economic shocks pose challenges to their sustainable development.

Simulation software: Computer code that represents processes, activities, or an environment, enabling learners to interactively experience the effects of changes in specific variables; examples include a simulation in which learners adjust the length of the pendulum to see how length affects periodicity, and more complex off-the-shelf games such as SimCity Societies (simcitysocieties.ea.com).

SMS (Short Message Service): A service that allows short text messages to be sent between mobile phones.

Sustainability: The capacity of a program, project or other intervention to continue its activities over time.

Teacher Professional Development (TPD): The provision of learning opportunities to teachers intended to enable them to advance their knowledge of their subject areas, their teaching practices or other components of their careers in education; typically indicates learning opportunities that are both more broad and more focused on pedagogy than those provided in "training"; often qualified as "pre-service" and "in-service."

Technical/Vocational Education and Training (TVET): Programs that enable learning of work-related skills, knowledge, and behaviors.

Technology integration: The use of technology by teachers and students as a tool to support learning objectives, enhance instruction, and improve student learning in any subject in the school curriculum (exclusive of IT courses); technology integration may be designed to build students technology skills, but only in the course of improving their mastery of curriculum content.

Tertiary Level Institution (TLI): Universities, colleges, polytechnic institutes, and other organizations that provide education to graduates of secondary school.

Thin-client network: A LAN that links computer terminals ("thin clients" or "dumb terminals") to a server that provides them with software applications and information-processing services; the server may also be used to store users' data.

Total Cost of Ownership (TCO): A method of developing financial estimates of the cost of purchasing, maintaining and disposing of computer hardware, software and systems; TCO estimates may include installation, training, electricity or other costs associated with purchase and use.

VSAT (Very Small Aperture Transmission): A small, earth-based transceiver that transmits digitally to satellites at high speeds.

WAN (Wide Area Network): A network connecting computers or other devices that are spread out across several locations; a WAN might connect all the schools in a district.

Web 2.0: Any of a loose group of technologies, such as blogs and social-networking sites, that promotes the use of creativity, collaboration, and sharing to achieve results that are desired in common.

Wiki: Software that allows users to created, edit, and link Web pages, often in collaboration with other users.

Wireless: The ability of one ICT device (computer, cell phone) to communicate with another without cables or wires.

World Wide Web: An information-representation method that operates via the Internet to enable users to access resources that may contain text, images and sounds, and that display in a standard fashion on many computers and software applications.

SURVEY OF ICT AND EDUCATION IN THE CARIBBEAN

A Summary Report, Based on 16 Country Surveys

This project seeks to gather together in a single resource the most relevant and useful information on ICT in education activities in the Caribbean.

The study addresses the following general topics:

- The state of policy and planning
- Current usage of ICT in the primary, secondary and tertiary education systems
- Pre-service and in-service teacher professional development (TPD)
- Critical challenges

Contents:

- Regional trends in ICT in Caribbean education
- Global trends in ICT and education, and their relevance to the Caribbean context
- Selected regional ICT initiatives in education
- Regional and national EMIS initiatives

This Summary Report is complemented by 16 separate Country Reports addressing policy and planning; ICT in primary and secondary schools; TPD; tertiary education; non-formal learning and TVET; education management information systems (EMIS) and Ministry of Education (MOE) capacity; barriers and challenges.

Please note that Cuba, the Dominican Republic, Haiti, and the U.S. Commonwealth Territory of Puerto Rico are not included in this survey.

About *info*Dev

*info*Dev is a partnership of international development agencies, coordinated and served by an expert Secretariat housed in the Global ICT Department (GICT) of the World Bank, one of its key donors and founders. It acts as a neutral convener of dialogue, and as a coordinator of joint action among bilateral and multilateral donors—supporting global sharing of information on ICT for development (ICT4D), and helping to reduce duplication of efforts and investments. To this end, *info*Dev sponsors cutting-edge research and analysis to help identify global best practice in the use of ICT4D.

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