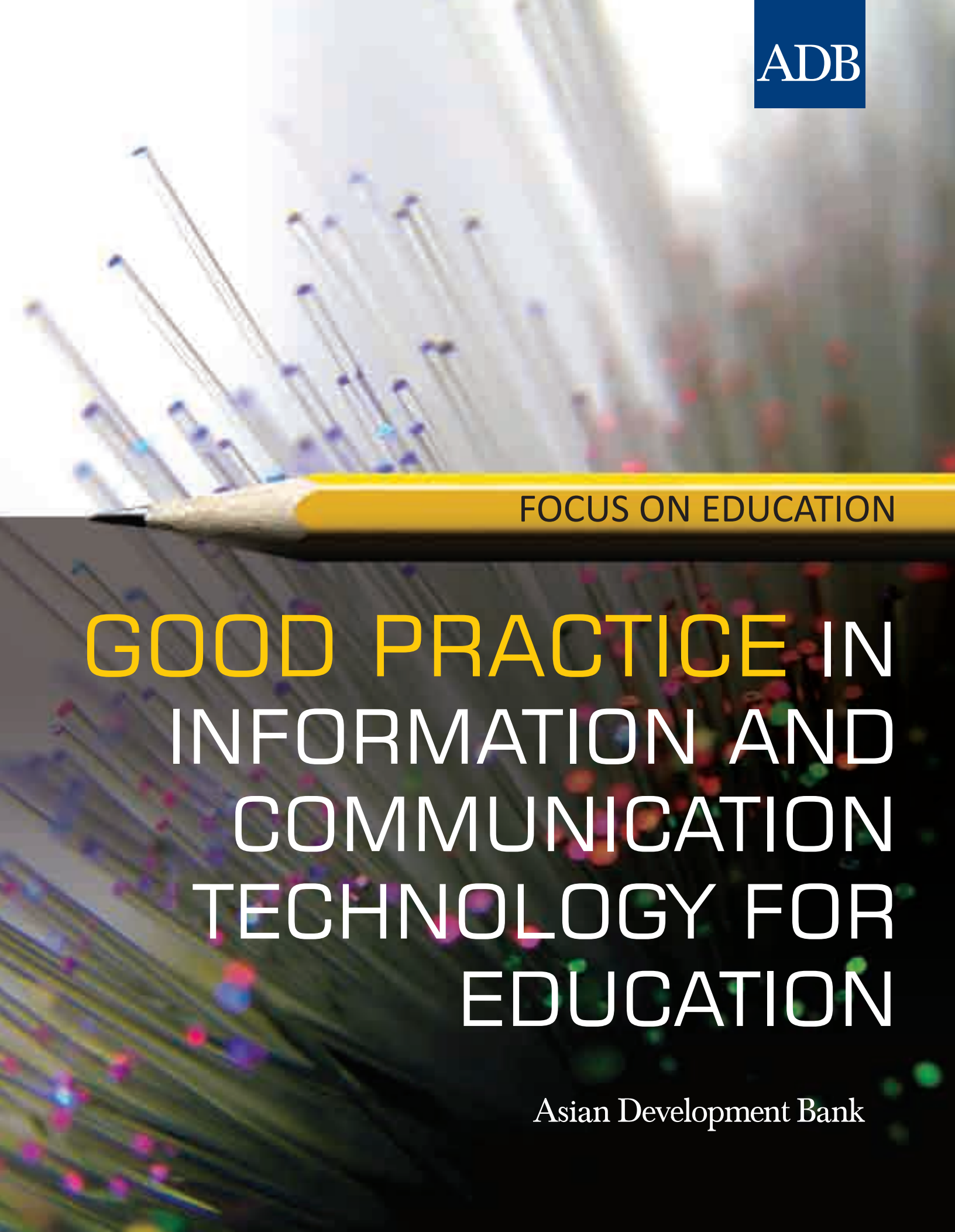
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FOCUS ON EDUCATION
GOOD PRACTICE IN INFORMATION AND COMMUNICATION TECHNOLOGY FOR EDUCATION
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Foreword

Focus on Education

The Asian Development Bank (ADB) has long been providing financing and advisory assistance to its developing member countries (DMCs) for broadening and deepening delivery of education services. Under its new long-term strategic framework, or *Strategy 2020*, ADB reaffirms its commitment to stepping up education sector operations and contributing to further development of human capital and skilled labor force in the DMCs. ADB is keen to ensure the development effectiveness of all its operations and that the assistance provided must be relevant and responsive and must add value.

This series – Focus on Education – surveys important topics including education sector policy, financing, and service delivery; identifies key concerns; and distills practical insights. It is intended for practitioners in the education sector in Asia and the Pacific. It will draw on a wide range of sources, including materials on the experience of ADB's education sector operations, and specific studies conducted by ADB. The series is integral to ADB's efforts to support knowledge sharing and the implementation of *Strategy 2020* in the education sector. We hope that readers will find the series informative in their practice.

Xianbin Yao
Director General
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Preface

The opportunities for education arising from developments in information and communication technology (ICT) are very promising. In recent years, increased computing power, improved wireless and user-friendly technology, and reduced telecommunication costs have contributed to lowering barriers to information access and exchange. The potential for using more innovative, cost-efficient, and user-friendly ICT solutions in education, and for reaching all groups of society—including the poor, those in remote areas, and other disadvantaged groups—has become increasingly feasible in less advanced countries and in more advanced ones.

ICT for education is an increasingly important area for Asian Development Bank (ADB) assistance in the education sector. At the same time, developments in ICT for education are evolving rapidly. This good practice guide has been prepared to provide an update on that evolution, and to guide ADB's education sector staff in their dialogue with governments and stakeholders of developing member countries, and during project processing.

The guide discusses the rationale for investing in ICT for education, and the issues concerning ICT for education in low- and middle-income countries. Guidance is provided particularly on the following three key levels and their intertwined relationships:

- national ICT policies and their implications for the education sector,
- ICT for education policies and strategies in education sector planning, and
- ICT for education in educational institutions.

The guide draws on ADB's recent regional studies in ICT for education and on the outcome of a major ICT for education international conference organized by ADB, plus other new sources of knowledge and experience. A draft of the guide was improved through peer review among education sector staff. Swetal Sindhvad, consultant, prepared the material for the guide, and Stephen Banta provided editorial inputs. Myla Bonto provided valuable support for the data preparation, and Imelda Marquez provided efficient administrative support.

While the guide has been prepared primarily for the use of education sector staff at ADB, we hope it will be useful also more widely for education ministries, institutions, and other stakeholders of education in our developing member countries.

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Regional and Sustainable Development Department

Abbreviations and Acronyms

ADB	–	Asian Development Bank
DMC	–	developing member country
ICT	–	information and communication technology
M&E	–	monitoring and evaluation
MOE	–	ministry of education
ODL	–	open distance learning
PPP	–	public–private partnership
SWAp	–	sector-wide approach
TCO	–	total cost of ownership
TVET	–	technical and vocational education and training

Introduction

How can a developing nation consider investments in information and communication technology (ICT) for enhancing its formal and nonformal education systems when most of its people still live in absolute poverty? This question is discomforting for everyone concerned with the intersecting issues of ICT and development (ADB 2004). However, these interests are not contradictory, and raising the educational level of the poor is a long-term solution toward alleviating their economic problems. The impact of educational level on economic development is more pronounced with the recent growth of ICT and its increasing importance in social and economic development. This has profound implications for education—both in how ICTs can be used to strengthen education, and how education can be more effective in promoting the growth of ICT in the Asia and Pacific region (ADB 2004, 2008b). However, education systems have changed very little in response. Without improved efficiencies in their education systems, developing nations will not likely be able to provide the additional human capital required to achieve economic self-sufficiency in the context of a highly competitive global economy that is increasingly based on the electronic transfer and manipulation of information (ADB 2004, 2008b).

Why Invest in ICT for Education?

ICT has the potential to "bridge the knowledge gap" in terms of improving quality of education, increasing the quantity of quality educational opportunities, making knowledge building possible through borderless and boundless accessibility to resources and people, and reaching populations in remote areas to satisfy their basic right to education. As various ICTs become increasingly affordable, accessible, and interactive, their role at all levels of education is likely to be all the more significant in making educational outcomes relevant to the labor market, in revolutionizing educational content and delivery, and in fostering "information literacy."

Information literacy is the sustaining force of a knowledge society. Information literacy is recognized as "a basic human right in the digital world" as it empowers individuals "in all walks of life to seek, evaluate, use, and create information effectively to achieve their personal, social, occupational, and educational goals" (UNESCO 2008a). The digital divide is much more than a "technology access" divide; without the skills to use the technologies, an even greater divide emerges—the information literacy divide. This divide is not a "north–south, developed–developing" issue; it applies to all countries and is more a reflection of the extent to which education systems are—or are not—keeping up in the development of knowledge societies (UNESCO 2008a). It is increasingly clear that a principal factor in stimulating economic growth is improvement in cognitive competencies and skills (ADB 2008b).

To date, many initiatives in ICT for education in developing countries have been limited to increasing information access for educational institutions in general and specifically for teacher training, aimed at using ICT-based resources and tools in the classroom. Evidence that the use of ICT leads to higher student achievement or other positive effects is limited to pilots that have yet to be implemented on a larger scale in developing countries. However, ICTs enable access to and use of information that may not be commonly available in certain contexts, thus providing teachers with content they would not have had otherwise to engage their students. In addition, teacher training in ICT for education parallels training in teaching methodology that supports student-centered learning. Hence, investments in ICT for education are likely to lead developing countries toward educational reforms that are necessary for fostering an information-literate citizenry, which is the key to competing in the global economy.

Investments in ICT for education at the basic and secondary levels support information literacy as a foundation for subsequent learning, as well as supporting teacher training in student-centered methodologies that foster critical and analytical thinking during the early years of the education cycle. ICTs have the potential to improve the teaching and learning process by enabling students to access information and engage in interactive learning experiences that would not otherwise be available to them. Such ICT-enhanced classroom experiences have the potential for encouraging student-centered learning, allowing students to be active learners who construct knowledge rather than passively receiving information. As a further pedagogical development, ICT can support evolution from the student-centered approach and the use of interactive technology to team-centered pedagogy and the use of collaborative technology. In this context, the focus is evolving from ensuring appropriate learning styles to ensuring an appropriate learning environment.

Investments in ICT for education at the higher educational level support the development of a skilled, "ICT-capable" labor force that may attract direct foreign investment, as well as research and development activities and university–private sector links that are important drivers of innovation and growth in advanced economies (ADB 2008b). ICT capability involves technical and cognitive proficiency to access, use, develop, create, and communicate information appropriately, using ICT tools. Along with having the potential to enhance teaching and learning in the classroom, ICTs in higher education have the potential to

- encourage open communication between and among students, faculty, and others that supports active learning and knowledge construction;
- make available information and resources supporting academic research that would not be accessible otherwise; and
- foster development of learning materials, presentations, and lectures in an interactive manner that allows faculty to deliver them to and share them with students directly.

The flexibility and accessibility enabled by ICT have led to the emergence of open distance learning (ODL), wherein the teacher is removed in space and/or time from the student, and most communication is through an electronic medium (e.g., internet, radio, television) (UNESCO 2002). ODL has taken the form of open universities that have adopted a student-centered approach in higher education systems in a number of countries. Open universities have been established to meet the increasing demand for higher and/or tertiary education while providing opportunities to working adults and others who face constraints in accessing such education in its traditional form.

Investments in ICT for education in the area of technical and vocational education and training (TVET) further support the demand for a skilled, "ICT-capable" labor force, which is the hallmark of a country transitioning to a knowledge economy. ODL holds promise for addressing critical problems facing TVET, namely, the lack of qualified instructors, the need to greatly increase the delivery of skills training on a wide scale, and the need to deliver training at much lower unit costs (UNESCO 2003). ODL can be used in TVET to empower disadvantaged populations, such as women and ethnic minorities, and to allow greater participation by working adults who cannot afford to take time off from their jobs and who are interested in improving various aspects of their work and/or their general professional knowledge (UNESCO 2003). Additionally, ICT in TVET has the potential to provide such persons with real-life learning experiences that are applicable to their immediate work situations (e.g., ICT-based simulations that model best practices). In a number of developing member countries (DMCs) of the Asian Development Bank (ADB), TVET students are often from the working class or are minority students having limited access to ICT. The integration of ICT in TVET would provide equality of opportunity for these students (UNESCO 2003).

In alternative settings (e.g., programs for out-of-school youth, adult literacy, students in remote areas), ICTs have the potential to deliver education to those unable to participate in the mainstream education system.

Country Contexts of ICT for Education

Evidence shows that returns to overall investment in education may differ by stage of development of a country. In low-income countries, basic education is the best investment. For middle-income countries, expansion of secondary education yields the highest social returns, while in high-income countries, the returns may be greatest in higher and/or tertiary education (ADB 2008b). However, DMCs need to balance priorities among education's subsectors to meet growing and increasingly complex education and skill requirements as they move up the development ladder (ADB 2008b). For instance, progress in improving enrollments in basic education and the increasingly complex demands of globalization require DMCs to expand basic education to include the secondary level. They also require that DMCs shift attention beyond basic education to TVET and to higher and/or tertiary education. The challenge in

transforming secondary and higher and/or tertiary education is to align them with the demands of a globalized and technology-driven world. Moreover, secondary and higher and/or tertiary education systems need to be more flexible and responsive to both local needs and the global environment of the 21st century (UNESCO 2005, ADB 2008b).

Investment in ICT for education should support this need for balancing priorities among education's subsectors. Plans incorporating ICT for educational improvement must be based on the education development priorities of a country, consequently serving the needs specific to the country context while having the foresight for moving up the next rungs of the development ladder. DMCs that are able to harness the benefits of ICT for improving their education systems as a whole have better chances of improving the quality of their human capital and their use of information.

Country context plays a major role in the way ICT for education takes shape. In the context of low-income countries, the complexities of child labor, low attendance rates, high dropout rates, and low quality resulting in irrelevant primary education may pose constraints to incorporating ICT into the education system. However, such complexities need to be acknowledged as the overall landscape within which ICT is contextualized and operates.

ICT-related solutions that have the potential for transforming the quality and relevance of secondary and tertiary and/or higher education while increasing access face a number of contextual complexities as well. The most pressing issues affecting the improvement and development of education systems in middle-income countries are child labor and gender parity (just as in the context of low-income countries) among marginalized and disadvantaged populations. Despite the progress made in the Asia and Pacific region in increasing primary enrollments, access to primary education remains a major issue for such populations.

Converging and Intersecting Elements of the ICT Ecosystem

Along with contextual complexities specific to the economic situation of a DMC, policy makers and planners should also consider the *ICT ecosystem* existing within the particular DMC. An ICT ecosystem encompasses the policies, strategies, processes, information, technologies, applications, and stakeholders that work together to build a *technology-enabled environment* that supports the existence and growth of a knowledge-based society. A technology-enabled environment is characterized by the existence of a reliable and robust ICT infrastructure and a conducive "info-structure" system that ensures the effective flow of information, making ICT and information accessible and usable within the society (Zainab et al. 2002).

A balanced and sustainable road map toward ICT for education is highly dependent on the elements of a country's ICT ecosystem and the ways in which they converge and intersect. For example, the ICT infrastructure defining a technology-enabled environment determines whether certain ICT resources are feasible to use in the classroom. A plan for using ICT in the classroom can be drawn up and technology can be physically brought in, but if it requires continual electricity and the power source is not available, then the plan is not workable and the technology will collect dust. Similarly, it is no help to teachers if the e-resources they rely on are available on the internet but there is no connectivity in the schools (ADB 2009). Policies, plans, and investments in ICT for education are dependent upon the context within which they emerge.

In yet another vein, policies and strategies emerging from different sectors or levels of government also determine the effectiveness of ICT in the classroom. For instance, in a number of countries, the national ICT policy is vague, providing a weak framework and little support to sectoral ICT initiatives, and the ICT strategic plan for the education sector is often isolated from national policies and strategies. Therefore, any initiatives to integrate ICT into classrooms to support the teaching–learning process are not likely to generate successful reform, since they are not aligned with strategies of the ministry of education (MOE) and with the vision and mission for ICT presented in the national ICT policy. Likewise, initiatives to widen connectivity to remote areas will flounder if infrastructure development is not accompanied by broader initiatives to foster education, develop locally relevant content, and promote ICT usage (Kanagasingam 2008).

For the purposes of policy formulation and planning for ICT for education, these guides focus on the following elements of the ICT ecosystem:

- the national ICT policy,
- the ICT strategic plan for education as developed by the MOE, and
- incorporation of ICT at the level of the educational institution.

They provide guidance on best practices in developing each element while presenting a framework through which coordinating mechanisms and harmonized strategies might be nurtured. The lack of a comprehensive policy and poor harmonization of initiatives in ICT for education lead to random adoption of different systems and standards, unnecessary duplication of effort, and waste of scarce resources, especially through the loss of potential synergies between and among the elements presented here. These guides will hopefully allow policy makers and planners to recognize and build upon the synergies underlying developments toward ICT for education, and will be useful for ADB education sector staff when engaging in dialogue on these issues in DMCs. The last chapter of the guide provides advice on incorporating these dimensions in education project designs and on implementation.

Working Toward a National ICT Policy

Problems and Issues

ICT is both a sector in its own right and cross-sectoral. The national ICT policy has a key role to play, as it should aim to develop a country's ICT sector while establishing an "ICT-enabled environment" that allows cross-sectoral ICT adoption. An ICT-enabled environment supports the development of ICT and its active use by society. Progress toward developing an ICT-enabled environment includes

- generating demand for ICT across sectors;
- establishing public–private partnerships (PPPs) for advancing ICT development and adoption;
- addressing issues relevant to infrastructure and content; and
- operating a system of regulation, licensing, taxation, and intellectual property rights to address newly found issues related to ICT (ADB 2009).

A national ICT policy should relate to other relevant sectoral policies, whether they are infrastructural (such as telecommunications or e-commerce) or broad and overarching (such as education, tourism, or manufacturing) or integrated between organizations (such as the synergy between ICT and governance) (URT-MCT 2003). The national ICT policy should be the framework that makes it possible for "enabling sectors" (such as ICT and telecommunications) to work together, whereby "enabled sectors" (such as education, health, and agriculture) can become further empowered through the appropriate development and application of ICT (URT-MCT 2003).

The following guides support the development of a national ICT policy that may foster an ICT-enabled environment while supporting ICT adoption by the education sector and providing society with access to ICT.

Guides

1. Focus on stakeholder buy-in by generating society's demand for ICT while addressing commonly held misconceptions about ICT.

Lack of demand for ICT and prevailing misconceptions about ICT are closely related to a lack of awareness and information about the potential of ICT and its use in education. Where governments take an active role in generating

public awareness, such as through marketing and information campaigns and communication of good local practices, stakeholder demand is high. At the same time, knowledge about ICT, which often equates to a limited view of ICT as computer training, is low. Addressing misconceptions is critical, especially because various populations at different socioeconomic levels in developing countries are likely to have varying perceptions of ICT, and therefore different expectations of ICT for education. Misconceptions can lead to disappointment and even cynicism about the benefits ICT can offer for education (ADB 2009).

Stakeholder buy-in may be addressed through national level approaches such as public awareness campaigns that provide information to stakeholders and stress the desired educational objectives, the potential that ICT has to offer for education, and the challenges that may be linked to it. Study tours and field visits at the national, provincial, and district levels can show education administrators from central and field offices how ICT can support education administration and how it can impact classroom teaching and learning.

2. Adopt sector-wide approaches to relate to relevant sectoral policies.

Sector-wide approaches (SWAps) are valuable in linking sectoral plans, policies, and development. SWAps are critical to the development of an ICT-enabled environment, as they aid in connecting sectoral ICT policies and plans (ADB 2009). Such cohesiveness is likely to bring about a holistic integration of ICT throughout society rather than a collection of fragmented initiatives. When properly considered, SWAps can focus funding agencies on assistance and interventions in areas of high strategic importance, as well as coordinate development partners including government, civil society, the private sector, and other aid agencies.

3. Integrate "bottom-up" needs at the classroom level into the national ICT policy.

Clarification of the overall national ICT policy is the first step in creating a national plan that involves all sectors including education. This should take place in parallel with need and demand assessments at the institution level (schools and other educational institutions). Because the ICT in the education sector plan is one part of the overall national ICT plan and strategy, it cannot be developed in isolation (ADB 2009).

4. Establish a public–private partnership program.

If governments have difficulty raising money for large ICT investments from their own resources, then PPPs may be important drivers for ICT development and adoption. Private enterprise can usually move faster than governments to exploit the benefits of new technology, but it is in the interest of both parties to ensure an understanding of mutual responsibilities. PPPs may play a part in developing infrastructure and can be crucial to the development of digital content (ADB 2009).

However, governments cannot simply leave the private sector alone to generate advancements. External support for education sector ICT adoption must be guided by the government to ensure access to all, particularly to disadvantaged, marginalized populations. Funding agencies can play some role in this, as they can work toward reducing risk for private operators who are building infrastructure such as backbone ICT feeds, which may need to be supplied to areas of marginal interest to commercial companies (ADB 2009).

Private enterprise has a large part to play in developing a future pool of technically qualified individuals who will be able to build and sustain the local ICT sector (ADB 2009). Private training courses leading to certification in relevant trades can play a central part in building up a country's ICT professionals.

5. Develop legal and regulatory systems supporting ICT development and usage.

The emergence of a new technology often requires regulation. To allow and encourage ICT to develop, policy makers and planners need to address regulatory issues in radio frequency allocation, e-commerce, online content, voice-over-internet protocol, satellite communications, and intellectual property rights. A recent ADB study highlights the following recommendations (ADB 2009):

- Policy makers should develop a **regulatory framework** that is fairly and transparently enforced so that it attracts investment from the private sector while ensuring opportunities for all citizens to benefit from ICT development. The regulatory framework should create an environment in which new businesses can quickly develop and endure digital security.
- Policy makers should see that **licensing** can be used as a source of revenue, e.g., through leasing of radio frequency bands, as well as a means to regulate content.
- **Tax breaks** can act as an incentive for ICT development, although they must be considered part of a long-term fiscal plan and carefully targeted at specific sections of society. At the same time, electronic goods should be promoted as educational tools.
- **Special technology funds** should also be clearly targeted in terms of their use.
- Concerning **intellectual property rights**, governments should consider the balance between plagiarism and what is acceptable as "open" knowledge. This is particularly tricky for learning materials, and it raises the debate about how flexible regulations can be in permitting teachers to use materials downloaded from the internet in the classroom.

6. Analyze infrastructure and content issues.

Policy makers should analyze the **advantages and disadvantages of proprietary software and of free and open source software** (FOSS). Each offers key benefits that must be assessed when deciding on operating systems. Some key benefits of propriety software include

- a well-controlled development process and managed software updates;
- formalized technical support; and
- a large, managed base of knowledge for applications, technical support, and training.

Key benefits associated with FOSS include

- reduced duplication of effort (due to the pooled efforts of like-minded individuals),
- building upon the work of others,
- better quality control through collaborative problem solving, and
- reduced maintenance costs.

FOSS solutions also have several long-term benefits such as

- sharing of development resources,
- strengthening of indigenous computing skills (and possibly a homegrown computing industry),
- increased likelihood of localization, and
- freedom from being wedded to a single supplier.

A major question in deciding on operating systems is whether proprietary software packages, with their licensing costs, are a better long-term solution than FOSS (ADB 2009).

Localization of content involves creating materials, such as learning materials for students and teachers, that are appropriate to local requirements, as well as the placement of information on the web in local languages. Localization takes into account not just language but also cultural conventions and the requirements of the local population to maximize the ICT experience in education and make it both relevant and useful. Sound localization policies will in turn lead to the development of local software industries that produce applications and content that are useful locally.

Working Toward an ICT Strategic Plan for the Education Sector

Problems and Issues

In a number of countries, the ICT for education plan is isolated from the national ICT policy. ICT for education plans are often disjointed, as they are developed without considering the infrastructure, costing, and development as defined by the national ICT policy (ADB 2009). Just as ICT for education plans must be aligned with national education development objectives and incorporated in the education sector planning process, they should be designed in terms of the parameters defined by the technology-enabled environment made possible by the national ICT policy.

Another setback in the development of an ICT for education plan is that the cost implications (so-called total cost of ownership) are usually not thoroughly worked out; as a result, the MOE simply fails to make sufficient operational budgets available. In most cases, all costs after the initial investment in hardware are either ignored or considered to be school or parental responsibilities (ADB 2009). Related to this setback is the fact that many policy makers and planners do not fully consider identifying funding sources (e.g., government, aid agencies, district education offices, schools, parents) for long-term development and support of ICT for education projects and programs (ADB 2009).

As with all innovative educational changes, plans to introduce ICT for education, specifically in teaching and learning in the classroom, rely heavily on teachers. But, initially, there is often resistance from teachers, especially when they are under the management of school leaders who are not prepared to implement plans for ICT for education at the school level, since they lack knowledge and skills in how ICT may enhance classroom learning, in fostering teacher preparedness for integrating ICT into the classroom, and in overall management of ICT. ICT for education plans need to address how stakeholder buy-in will be established (ADB 2009). In addition, the full participation of teachers and school leaders in adopting new technologies to enhance education requires the MOE to commit to quality teacher education and ongoing professional development of teachers and school leaders (ADB 2009).

Another aspect that must be addressed in ICT for education plans is a program and budget for monitoring and evaluation (M&E). The M&E component is often missing from ICT for education plans or is generally too weak to provide substantive insight (Wagner et al. 2005). The inclusion of a strong M&E component is becoming increasingly important, since many ICT for education

initiatives are based on the misconception that simply putting computers in schools is enough to impact student learning.

The following guides provide ways to develop a comprehensive ICT strategic plan for the education sector while aligning it with the national ICT policy, and incorporating it within the overall strategies and plans of the MOE.

Guides

1. Identify true cost components necessary to support investment in ICT for education, and the true costs of running effective ICT in education systems.

Policy makers and planners must calculate the **total cost of ownership** (TCO) of the vision for ICT for education. The TCO includes

- **investment costs** (e.g., hardware, classroom refurbishment, rewiring, furniture provision);
- **replacement costs** (e.g., replacing hardware);
- **recurrent costs** (e.g., consumables, power, internet connection, maintenance, servicing); and
- **associated costs** (e.g., teacher training, possible additional human resources, software development and provision) (ADB 2009).

After the components of the TCO are known, policy makers and planners can consider alternative costing profiles and their implications for teaching and learning policies and for mid- to long-term sustainability and affordability.

TCO is only part of the picture when planning ICT integration. Critical to the discussion are considerations of cost efficiency. This requires schools and education systems to clearly understand their educational goals and how investments in technology can contribute to their achievement. The value of an investment in technology is determined by understanding anticipated benefits versus the cost of implementation and ownership (ADB 2009).

2. Consider public–private partnerships for covering associated costs while providing expertise.

Governments are generally responsible for the associated costs of ICT provision strategies such as curriculum reform, assessment reform, preservice or in-service teacher training, and e-materials development, but PPPs can cover some of the costs of teacher training and in some instances can provide the expertise necessary for designing the content of training courses and even conducting the training (ADB 2009, Kader 2008).

3. The teacher education curriculum should be relevant in terms of country context and should be designed for improving productivity, preparing teaching materials, and integrating technology into teaching.

The teacher education curriculum must strike a balance between methods and content. In terms of methods, the curriculum should cover the integration of technology into teaching, preparation of teaching resources using technology, and teaching methodology for computer studies. In designing the curriculum, it is necessary to consider the resources available in the local colleges and schools so that teacher education is in accordance with existing resources (Wong 2008).

The teacher education curriculum should include training in hardware maintenance, instruction in basic networking, and training in setting up simple networks. Teachers should have some working knowledge regarding maintenance, since technology maintenance is usually an issue in sustaining ICT integration in learning environments, and trained staff to ensure maintenance are often lacking in schools (Wong 2008).

Technology should be mainstreamed into the entire teacher education curriculum and introduced in context to develop preservice teachers' ICT capability. The many uses of technology should be integrated throughout coursework and field experiences. Restricting technology experiences to a single course or to a single area of teacher education, such as methods courses, will not prepare trainees to be technology-using teachers. Preservice teachers should see their professors and mentors model innovative uses of technology; they should use ICT in their own learning; and they should explore creative uses of technology in their teaching (Wong 2008).

4. ICT teacher training should be hands-on.

Trainees should develop teaching materials employing the technologies that they will be using in their classrooms, design assignments and exercises, and participate in discussions about the sequencing of content. Trainees should also be guided to work in teams (Kader 2008).

5. Professional development for school leaders should include skills development to take on technology leadership tasks in the school, pedagogical transformation, as well as the development of a school ICT culture. In essence, they should be trained to become school technology leaders.

In supporting school leaders to become school technology leaders, it is important that they understand that to establish a vision for a school they

must establish an ICT culture within the school. Professional development for school technology leaders must include

- general knowledge about hardware capabilities and how software applications can be applied to instruction,
- opportunities to learn how to operate technology and to use it whenever possible for carrying out their own duties (especially when communicating with others), and
- the basics of planning for ICT in the school (Brockmeier et al. 2005; ADB 2008a).

6. A pro-equity approach should be employed in conducting M&E activities while concentrating on measures of student and teacher learning.

Evaluators should engage in data collection with transparency as to who comprise the population target, and where this population fits into the national fabric and policy of poverty reduction. It is important to draw from M&E activities any conclusions about both policy formation and project implementation that can address pro-equity issues (Wagner et al. 2005).

The learning measures that are likely to be most sensitive to ICT-supported programs are those that are custom-designed for the program, such as performance assessments. A major critique of performance assessments is that they are too narrowly focused on learning goals that are specific to a program and thus may be biased in favor of ICT-supported learning (Wagner et al. 2005). Rather than testing memorized factual knowledge, performance assessments should be designed to measure students' understanding of important concepts, principles, and problem-solving skills in a manner that is similar to situations in which students might apply their knowledge in the real world outside the classroom.

Incorporating ICT at the Educational Institution Level

Problems and Issues

At the level of the educational institution, the concept of ICT for education is defined by the learning objectives associated with it. ICT for education is often associated with achieving technology literacy rather than information literacy. Informatics, or computer education, is usually the focus in defining ICT for education, which makes one think of ICT in education as a curricular subject rather than an approach to enhanced educational processes. The difference between "ICT, the subject" and "ICT in subjects" is not clearly delineated (Kader 2008). Moreover, the two concepts are seldom connected.

Parallel to this issue is the fact that ICT for education is often narrowly associated with merely using computers and the internet in the classroom. ICTs range from low to high technologies that have the potential for enhancing educational processes in different ways, and therefore educational initiatives do not necessarily need to rely on the use of computers and the internet to develop improved teaching and learning practices. Innovative (and not necessarily sophisticated) ICT for education solutions, which are contextualized and adequately optimized to suit local circumstances, can often add more value to educational quality and access (ADB 2008a, 2008b).

Upon integration of technology into the learning environment at any level of education, the role of the teacher is often questioned. For instance, teachers commonly mistake courseware or educational software as a replacement for pedagogy. A common misconception among teachers is that using the courseware or educational software simply means assigning a topic for students to learn or search (Kader 2008). Those teachers do not see that they have an active role as a guide for their students as they engage in using the courseware or educational software.

Part and parcel of the issue regarding the teacher's role in an ICT-enhanced learning environment is the lack of initiative by school leaders in fostering an ICT culture within the school. Along with being able to support teachers to integrate ICT into the teaching-learning process, school leaders need to ensure that teachers have the opportunity to explore the purposes and functions of various ICTs and that ICT integration supports a number of functions of the school outside of the classroom. Such opportunities will enable teachers and other school staff to become regular users of ICT.

The impact of ICT on the teaching–learning process and student achievement is a question that is foremost in the minds of policy makers, planners, and stakeholders. This question is particularly pressing when considering future ICT investments and in scaling up initiatives in ICT for education. The knowledge emerging from M&E of classroom ICT-enhanced learning provides insights that may inform decision making at the level of the educational institution as well as at the level of the MOE and higher. School leaders at the level of the educational institution should therefore plan and budget for M&E programs.

The following guides provide strategies for developing a school environment supportive of sustainable ICT integration.

Guides

1. Instead of defining ICT for education in terms of technology literacy or information literacy, the concept of "ICT capability" should be understood and considered as a definition of ICT for education.

ICT capability involves technical and cognitive proficiency to access, use, develop, create, and communicate information appropriately using ICT tools. Learners demonstrate this capability by applying technology purposefully to solve problems, analyze and exchange information, develop ideas, create models, and control devices. They are discriminating in their use of information and ICT tools, and systematic in reviewing and evaluating the contribution that ICT can make to their work as it progresses. ICT capability is much broader than acquiring a set of technical competencies in software applications. ICT capability involves the appropriate selection, use, and evaluation of ICTs. In essence, learners need to know *what* ICTs are available, *when* to use them, and *why* they are appropriate for given tasks (DES-GOVUK 2004).

2. Along with establishing informatics or computer education as a curricular subject, the overall school curriculum should be assessed to identify ways in which ICT may enhance learning in both core subject areas and electives.

The following are prescribed actions for assessing ICT across the curriculum (DES-GOVUK 2004):

- Raise awareness of how ICT capability can be applied and developed in specific subject areas.
- Analyze opportunities that exist in specific subject areas for developing and applying students' ICT capability.
- Consider how ICT can add value to the teaching and learning of specific subject areas.

3. ICT for education encompasses low and high technologies.

"Low technologies" or "traditional technologies" usually demand a low budget for integration and implementation into the classroom. Teacher training for incorporating traditional technologies in the classroom may simply involve imparting knowledge about where in the curriculum they should be integrated and when to schedule their use in the class period.

Technologies that fall in the "in-between" category are those to which more than a few schools may have access for using in the classroom. Such technologies work in the same way as traditional technologies. For both, the teacher's role is important in helping students make connections between what they know and what they learn from the media.

"High technologies" are those that enable students to become active participants in their own learning process. Such technologies are called "interactive technologies." Teachers need to provide students with access to such technologies and guidance in using them in a way that will enhance their learning.

4. In an ICT-supported learning environment, teachers need to act as a guide to facilitate student-centered learning.

The emergence of the knowledge society leads to the notion that teachers cannot stand complacent as the "sage on the stage." The following are key roles for the teacher as a guide (Lim et al. 2005):

- Provide learners with the guidance necessary for thinking critically and analytically about the information they receive through print or electronic media.
- Provide learners with the opportunity to experience knowledge construction.
- Provide learners with a forum to question information and exchange ideas.

5. School leaders must communicate a vision for ICT in the school and foster an ICT culture that allows all school staff to be regular users of ICT.

School leaders should consider developing ICT policies and strategies through a participatory approach between school management and teachers (or even students) that would

- outline a joint vision for ICT to support school development,
- structure access to the ICT equipment,

- clarify mutual expectations concerning the purpose and frequency of ICT use,
- specify available support, and
- clarify possible incentives available for teachers who actively seek professional development and improvement of their teaching practice with ICT.

School leaders should continuously assess the role and usage of ICT throughout school operations. Such an assessment would enable growth of an ICT culture. The following are recommended assessments (Wagner et al. 2005):

- Measure staff competencies in using and integrating ICT.
- Assess modalities of ICT integration.
- Assess ICT for student-centered learning.
- Assess ICT in terms of the teacher's role in the teaching–learning process.

Additionally, the ICT culture of a school can encourage teachers to continuously explore ICT for enhancing student learning. For instance, school leaders can organize "open door" sessions wherein teachers can showcase their teaching methods that integrate ICT and offer workshops for their peers. School leaders can also promote communities of practice among teachers in which they may share ideas and resources for incorporating ICT into the teaching–learning process.

6. M&E activities should measure the impact of ICT on the overall learning environment.

M&E at the school level should include an assessment of how teachers are using ICT to increase the depth of student understanding and learning engagement, and how students are impacted by ICT integration. Part of this assessment should be an inquiry into how teachers are using ICT in ways that measure up to both school goals for ICT use and the potential that exists for ICT as an instructional aid, as well as an examination of how the school has allocated resources so that students and teachers can realize the resources' potential. M&E should also measure how effective their professional development or training has been in helping teachers attain ICT capabilities, as well as the effectiveness of teachers' and school leaders' ICT capabilities to do things that they could not have done otherwise (MO-DOESE 2006).

Incorporating ICT for Education in Project Design and Implementation

Problems and Issues

Support for ICT for education can be provided through a specific stand-alone project or through a component in a larger education project or program. Such specific projects or components may focus on one of the key levels discussed earlier in this review, or on their combination (i.e., having a multilevel focus):

- Concentration on ICT policy and strategy development in the sector can be more appropriate, particularly as part of a broader education sector project, a sector development program, or a sector-wide approach (SWAp) having a comprehensive education sector planning and capacity development focus with links to the national ICT policy and strategy frameworks.
- ICT for education development at the institution or school level can be pursued through a component in the above broader project design or may require a specific stand-alone project intervention. Both components of a larger project/program and specific stand-alone projects can focus on development of ICT for teacher education (teacher development focus) or development of ICT for improving education in schools in certain subsectors or subject areas (pupil/classroom/school level focus).

In the light of increasing evidence, ICT for education development assistance at the institution or school level will likely have a limited impact unless the ICT policies and strategies in the sector have been developed to facilitate and support efficient use of ICT for education at these levels. In the absence of such comprehensive sector-level policies and strategies for ICT for education, it is justifiable to design a stand-alone ICT for education project as a pilot with the specific aim to use the pilot experience to inform and help the planning of policy and strategy for the sector.

Decisions on ICT investments in the education sector in developing member countries (DMCs) are too often driven by hardware procurement and infrastructure issues only. Project designs based on such a narrow approach are pursuing an "ICT in education" perspective instead of an "ICT for education" perspective. The "ICT in education" perspective does not provide

an adequate framework for assessing to what degree the ICT solutions and arrangements pursued will actually improve educational quality and delivery (the "ICT for education" perspective) in the context of an individual DMC. While procurement of ICT equipment can be important, it should not be the main objective of ICT activities in the sector. Evidence (ADB 2007) strongly suggests that larger scale procurement of ICT hardware and development of ICT infrastructure for the education sector should be undertaken in a DMC only after sector plans adequately address

- ICT policy and strategy options in the sector and their synergies with the national ICT vision and regulations;
- contextualizing and optimizing ICT for education solutions in the sector to suit the local circumstances;
- Total cost of ownership (TCO) and cost efficiency of ICT investments in the sector, including appropriate use of high and low technologies, and feasible cost-sharing options through public–private partnerships (PPPs) to achieve and maintain developmental and financial sustainability of ICT for education in the sector; and
- capacity development and resource needs in the sector to effectively implement and monitor the preceding three points.

Guides

In addition to the issues indicated above, the following issues should be reflected in project design, initially at the project concept stage, and more comprehensively in the final project design.

1. Devise a clear rationale for investment in ICT for education.

Knowledge economy rationale. In the broader development perspective, it should be emphasized that, to be able to compete in the global economy, DMCs need to make their way toward transitioning to knowledge economies. A key aspect of a knowledge economy is an information-literate and ICT-capable labor force. Investments in ICT for education foster information literacy and ICT capability at all levels of education. Education systems need to respond to the demands of the global economy.

Pedagogical rationale. ICT for education fosters student-centered learning, which supports greater critical and analytical thinking skills. In this context, ICT for education enables the teacher's role to evolve from that of a traditional frontal teacher to that of a facilitator and guide for students, which is important to help the students develop skills for creating and sharing knowledge for their learning. Appropriate ICT for education provides access to information that would not be available otherwise, and expands learning experiences in the classroom setting.

While student-centered pedagogy remains important, ICT for education also enables further pedagogical development. ICT for education is increasingly evolving from interactive technology and learning to collaborative technology and learning, and thus at the classroom level from student-centered pedagogy to collaborative and team-centered pedagogy. In this context, focus is evolving from appropriate learning styles to an appropriate learning environment. This evolution may be more feasible in the circumstances of middle-income countries.

Equitable access rationale. Recent developments in technology provide increasingly effective ways to reach out to populations in remote areas and to other disadvantaged groups that do not have access to quality educational opportunities, thus providing them with a link to global professional networks and the global economy.

2. Encourage cost sharing and partnerships.

In recent years, telecommunications costs and costs of ICT as technology solutions have decreased greatly overall, and at the same time the technological capacity and user-friendliness of these solutions have much improved. These factors together have contributed to improved cost efficiency of ICT for education.

However, in spite of these positive developments in technology and cost, DMC governments alone will not be able to afford to finance ICT for education on a sustainable basis. In low-income countries, up to 95% of the recurrent cost of the education sector is spent on salaries, and 5% or less is available for educational materials and technology. In many DMCs, the 5% translates to a mere $20 per student per year (ADB 2009). In these circumstances, the financial feasibility of e.g., the $100 laptop initiatives, which are pursuing a vision of one laptop computer per student, is clearly questionable.

ADB, as a development bank, is increasingly expected to provide advice and capacity development for implementation of cost sharing and PPPs in the education sector. ICT for education provides a context in which the interests of all parties in such partnerships can more easily meet. Cost sharing and PPPs are necessary and should be strongly encouraged and supported through ADB assistance.

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Good Practice in Information and Communication Technology for Education

ICT for education is a rapidly evolving and high-priority development area. This guide stresses the importance of a holistic good practice framework in which ICT for education issues are pursued through three interrelated perspectives: (i) national perspective, (ii) education sector perspective, and (iii) education institution and school perspective. The guide draws on a range of sources, including the findings of ADB's studies on ICT for education and the experience ADB has gained with stakeholders and partners in providing project assistance for ICT for education in its developing member countries.

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