USING TECHNOLOGY TO TRAIN TEACHERS

Appropriate Uses of ICT for Teacher Professional Development in Developing Countries

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Appropriate Uses of ICT for Teacher Professional Development in Developing Countries

AN *info*Dev PUBLICATION PREPARED BY

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ICT AND EDUCATION SERIES

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PROJECTS APPEARING IN THIS HANDBOOK

Reference is made to the following projects, with their countries and key technologies appearing in parentheses: Active Learning with Technology (United States, Mexico, Nigeria); Applying Technology to Restructuring Learning (United States, Computers); Basic Education Project (Turkey, Computers); Basic Education Support 2 (Namibia, Computers); Conflict-prevention Project (Rwanda, Computers); Connect-ED Project (Uganda, Computers); DEEP (South Africa, Handheld computers); Discovery Channel Global Education Foundation (Namibia, Video); Discovery Schools Project (Namibia, Video); Educational Inclusion for Disabled Students, Save the Children (Lesotho, Video); EFA Curriculum Project (Uganda, Nicaragua); *Enlaces* (Chile, Computers); *G.S. Soeurs de la assomptión* (Computers, Rwanda); EdTech Leaders Online (United States, Computers); Fundamental Quality and Equity Levels (IRI, Guinea); Initiative for Namibian Educational Technology (Namibia, Computers); Intel Teach to the Future (South Africa, Turkey, Computers); Kids on the Block, SchoolNet (Namibia, Computers); LearnLink (Namibia, Computers); New Schools Program (Egypt, Computers); Mental Arithmetic: The Numbers Family (Honduras, Radio); *Nota 10* (Brazil, Television); *Programa de Informática Educativa* (Costa Rica, Computers); Relief International—Schools Online (Tajikistan, Computers); *Salto para o Futuro* (Brazil, Television); SIEEQ Project (Congo, Video); Uganda VSAT Rural Connectivity Project (Uganda, Computers); Telesecundaria (Mexico, Television); WIDE World (Namibia, Computers); World Links (22 countries, Computers).

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DELPHI PROCESS CONTRIBUTORS

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PREFACE
ICT AND EFA: WHY SHOULD WE CARE?

DANIEL A. WAGNER

As the attention of the international donor community focuses more sharply on the achievement of the Millennium Development Goals, especially those related to Education for All (EFA), the credibility of those involved in the information and communication technology (ICT) community is increasingly treated with suspicion by many educators. This development should not be surprising, given the checkered results of many ICT-related investments in educational reform over the past decade, and the understandable but regrettable tendency to substitute "photo opportunities" for rigorous attention to impact and costs.

The power of ICTs as enablers of change—for good, as well as for bad—is undeniable. However, the use of ICTs in education in many developing countries, especially the "poorest of the poor," is associated with high cost and potential failure. Why should we devote our energies and efforts to investigating such uses?

The answer is simply put: We need to train massive numbers of teachers if EFA goals are to be met. Contrary to the overheated rhetoric and promises of some in the ICT community, ICTs are not *the* answer to problems afflicting the education sector in developing countries … but they can help. Indeed, how can so many teachers be reached *without* the aid of ICT?

When asked about the role of ICTs in the EFA process, the consensus at most development agencies seems to be: there is no role. *We need to build classrooms, build schools*, they say, *and equip them with books and blackboards and latrines* (and many other things). Fair enough, there is no disagreement here. But it is also clear that these steps will not be sufficient.

Back in 1996, UNESCO labeled the situation of teachers around the world a "silent emergency." A decade on, things have not improved much. As efforts to achieve universal completion of six years of high-quality primary education have added tens of millions of new students to the school rolls, efforts to recruit and train new teachers have not kept pace (nor have efforts to upgrade the skills of current teachers who have received inadequate preparation). Few would argue that the student:teacher ratios in excess of 80:1, found in some African countries, are conducive to delivering high-quality education, and indeed, data show that, as school enrolments quickly increase, educational quality appears to be nose-diving in many places.

Countries struggling to meet EFA targets do not need ICTs, of course. They need to better train and support their teachers, move them into the classroom quickly, and support and re-train them regularly to upgrade skills and content mastery. This challenge is compounded by the fact that the greatest needs are often in remote areas far from existing training facilities. It is difficult to see how such challenges can be met without extending the breadth and depth of pre-service and in-service teacher professional development by using ICT.

In the ICT world, current discussions emphasize serving the "next billion" (which will most likely be the emerging middle classes of China, India, Brazil and elsewhere). Given the pressing challenges related to Education for All, the focus on the "next billion" should not obscure the potential utility and relevance of extending ICTs to the "last billion" as well.

Despite current skepticism in donor agencies, policymakers and parents in many developing countries are making increasing demands for the use of ICTs in education. This demand can be harnessed to support

EFA-related teacher training initiatives. It is important that any potential deployment of ICTs be evaluated in terms of meeting specific educational challenges, and not as an end goal in itself. Computers, TV, the Internet and especially older (and currently unfashionable) technologies with proven track records of cost-effective deployment, such as interactive radio, can help to meet the challenges associated with training and supporting the large numbers of teachers necessary required for achieving EFA targets.

SECTION 1
OVERVIEW

Information and Communications Technologies (ICTs) will not make a bad teacher professional development program better. The use of technology can, in fact, make TPD programs worse. When refurbished computers cannot run required software applications, or poor telephone lines don't support Internet connections, teachers and students waste time, grow frustrated, and abandon new practices to return to familiar ones. When an educational television program demonstrates new teaching methods without showing how they can work in one-teacher schools, teachers in those schools watch the program but tune out the message.

That said, ICTs have had tremendous impact on TPD in countries around the world. Successful projects, in combination with decades of education research on student learning, teacher development, and school change, have generated a body of relevant knowledge and best practices. Success can be achieved—but only by untangling the complex set of critical factors, and by leveraging previous successes to minimize risk and strengthen project designs.

This handbook is intended to help decision makers in developing-country governments and donor agencies in their efforts to combine ICT and TPD. To the extent possible in a brief work, the handbook combines a global perspective—including information about best practices and successful projects—with attention to the challenges faced by education policymakers, teachers, and students in Less Developed Countries (LDCs) and countries attempting to meet the goals of Education for All (EFA).

This handbook will help decision makers improve their abilities to:
- Understand the complex relationships between ICT use, professional learning, types of TPD and classroom implementation so as to aid the development of requests for proposals (RFPs)
- Recognize best practices and essential supports in the use of ICTs for TPD in order to evaluate proposals of national, regional, and local scale
- Propose ways of using ICTs to support TPD that can achieve specific objectives in relation to educational improvement
- Identify cost considerations, potential partnerships, evaluation requirements and other factors essential to the planning of effective ICT-enabled TPD
- Communicate effectively with researchers, representatives of NGOs, policymakers, donor-agency personnel, and others about the roles played by TPD and ICT in educational reform

To make effective decisions in regard to TPD, policymakers must be aware of relevant issues; know the characteristics of effective professional development; and understand how ICT can support those characteristics. In LDCs, policymakers must also understand the potential benefits and challenges of ICT-supported TPD in the context of schools that lack adequate classrooms, textbooks, and electricity, and in which teachers face fundamental challenges. When a teacher lacks mastery of the language of instruction, how can ICT help? If a teacher's development of new skills competes with or undermines her role as a mother, or a farmer, how can TPD be effective?

LITERATURE REVIEW, CASE STUDIES AND THE DELPHI PROCESS

The development of this handbook has drawn on several rich sources of information:

The first source of information is an extensive literature review of such topics as TPD and the use of ICT for TPD programs in developing and developed nations, and effective uses of ICT for school improvement. These resources are assembled in the References section of this handbook.

The second source is field-based case-study research specifically focused on the uses of ICT in relation to TPD, conducted in Guinea and Namibia. The focus in Namibia is on comprehensive efforts to integrate computers and the Internet, while the focus in Guinea is on development of educational radio programs for primary students and teachers.

Additional information is based on the authors' own expertise in the areas of international development, education, ICT planning and evaluation, TPD, and curriculum development; and their experience as teachers and trainers using ICT, within such developing country contexts as Uganda, Rwanda, Mexico, Tajikistan, and other countries.

Finally, the handbook draws on the experiences of 26 internationally renowned experts in TPD, ICTs, and development education, who participated in a Delphi process[1] through which they assessed the current state of ICT use in relation to TPD and developed a rough consensus as to future challenges and opportunities. These Delphi participants offered responses to questions, critiqued statements of other Delphi participants, and ranked various predictions regarding program design, implementation, and technologies.

THREE APPROACHES TO ICTS AND TPD

The combination of ICTs and TPD has given rise to a wide range of approaches—from radio programming that "walks" teachers through lessons alongside their students, to the use of computer-aided instruction to improve teachers' math skills, to teachers videotaping each other in action in their classrooms.

The many uses of technology in relation to TPD can be grouped in three categories:
- **A delivery system** providing teachers with information to improve pedagogy and content mastery
- **A focus of study** that develops teachers' abilities to use specific tools, such as computers
- **A catalyst for new forms of teaching and learning**, such as inquiry-based learning, collaborative learning, and other forms of learner-centered pedagogy

This handbook presents information about these approaches with the expectation that decision makers will choose "points of entry" appropriate to the capacities, resources, and weaknesses of their school systems. Concrete examples from LDCs and other developing countries, along with research-derived best practices, are presented with the hope that policymakers will choose goals that ensure that the transformation of learning in the poorest schools will become a source of opportunity for the children in their countries.

HOW TO USE THIS HANDBOOK

Using Technology to Train Teachers is a reference tool and guide for decision makers with *existing* ICT-supported projects in education and for those decision makers who are *planning* new projects.

1 For additional information about the history and characteristics of the Delphi process, refer to *The Delphi Method: Techniques and applications*, edited by Harold Linstone and Murray Turoff (2002, New Jersey Institute of Technology, *http://www.is.njit.edu/pubs/delphibook*), originally published in 1975.

The handbook includes the following sections:

- **Section 1: Overview**
  Goals and objectives of the handbook; overview of sections; key points in the use of ICTs for TPD; schematic of ICT for TPD planning process; best practices in TPD
- **Section 2: ICTs for Teacher Professional Development at a Glance**
  Roles of ICT in TPD and education; strengths, limitations, and cost considerations for key technologies used to support TPD
- **Section 3: Models and Best Practices in Teacher Professional Development**
  Major models of TPD—standardized, site-based, and self-directed
- **Section 4: Technologies for Teacher Professional Development—Computers and the Internet**
  Strengths, limitations, and costs; profiles of successful programs; planning for large-scale implementations
- **Section 5: Technologies for Teacher Professional Development—Radio**
  Strengths, limitations and costs; profiles of successful programs
- **Section 6: Technologies for Teacher Professional Development—Television**
  Strengths, limitations and costs; profiles of projects in Mexico and Brazil
- **Section 7: Technologies for Teacher Professional Development**
  —Video Recording and Playback
  Strengths, limitations and costs of using audio and video recording tools in schools; ideas for implementation
- **Section 8: Online Distance Learning for Teacher Professional Development**
  Strengths, limitations, and costs; online learning vs. face-to-face learning; profiles of successful programs
- **Section 9: Implementing ICT-supported Teacher Professional Development**
  Supporting TPD and ICT use in schools, including teacher scheduling, incentives and school leadership
- **Section 10: Effective Partnerships for ICT-supported Teacher Professional Development**
  Ways in which governmental, civil-society, and private-sector organizations can ensure the success of TPD projects
- **Section 11: Evaluation of ICT-supported Teacher Professional Development**
  Essential terms and concepts in monitoring and evaluation; checklist for evaluation planning
- **Postscript: Making ICT Projects Work**
  Eight guidelines to increase the likelihood of success for all ICT projects in education
- **Glossary**

Readers should adopt different approaches to the information in this handbook based on whether their goals are to improve existing projects or to plan new ones.

To improve existing ICT projects in education:
- Read *Section 3: Models and Best Practices in TPD* to learn how to improve TPD initiatives and how to use TPD to strengthen educational outcomes.
- Refer to the sections addressing tools that are used in your project (radio, television, video, computers and the Internet, online TPD).
- Read *Section 9: Implementing ICT-supported TPD, Section 10: Effective Partnerships for ICT-supported TPD,* and *Section 11: Evaluation of ICT-supported TPD* to identify ways to increase support for your TPD project.

To plan new ICT-supported TPD Projects:
- Review the tables and other information in *Section 2: ICTs for TPD at a Glance* to determine which technologies are likely to offer effective support.
- Read *Section 3: Models and Best Practices in TPD* to determine the TPD methods that are most appropriate for your needs, objectives, and educational context
- Refer to *Section 9: Implementing ICT-supported TPD, Section 10: Effective Partnerships for ICT-supported TPD,* and *Section 11: Evaluation of ICT-supported TPD* at appropriate points in your planning process.

Note that the tables in *Section 2: ICTs for TPD at a Glance* are reproduced at the end of the sections addressing specific technologies. For example, the table on radio in *Section 2* also appears at the send of *Section 5: Technologies for Teacher Professional Development—Radio.*

Section Features

As appropriate, sections include the following aids to reading, planning, and decision-making:
- *Guiding Questions* to be considered throughout your reading.
- *Section Summaries* identifying key points
- *Questions for Further Discussion* that address planning and policy issues raised during profiles of specific projects.
- *Consider Using [Specific Technology] to Support TPD When…*
  Suggested pre-conditions for deployment, including TPD objectives, infrastructure, teachers' capacities, and other criteria.
- *Web Resources* are provided where possible, to help policymakers obtain additional information on the topic discussed

Implementation Briefs

- A set of practical detailed information are presented in a series of *Implementation Briefs* to help practitioners successfully implement ICT-embedded teacher professional development programs

Basic, Intermediate and Advanced Teaching Skills

Throughout this handbook, discussion of appropriate TPD models and supporting technologies distinguishes between teachers with *basic, intermediate,* and *advanced* skills as educators.

Teachers with **basic skills** are able to:
- Speak, read, write, and teach with fluency in the national language
- Perform basic arithmetic
- Teach basic language and arithmetic skills using traditional lectures and testing

Teachers with **intermediate skills** have basic skills, and are also able to:
- Understand and teach their subject matter at a basic level in the national language
- Plan their courses to meet national or local standards
- Understand the basics of how children learn
- Adopt teaching methods appropriate to their students' abilities and learning styles

Teachers with **advanced skills** have intermediate skills, and are also able to:
- Teach their subject matter with ease and make relevant connections to other subjects and to daily life
- Develop course outlines, lectures, and instructional materials

- Identify resources to update their knowledge of the subjects they teach
- Build on students' prior knowledge and experience
- Teach students how to analyze and solve problems
- Teach their subject using multiple tools and resources
- Understand and use a variety of instructional strategies, including traditional lectures, project-based learning, inquiry-based learning, and collaborative activities
- Use ongoing assessment to identify and address student weaknesses

TPD program goals must be based in part on teachers' needs and capacities. Choosing models and technologies for TPD must also reflect these conditions. Refer to these guidelines as necessary to categorize the skill levels of specific groups of teachers.

SECTION 2
ICTs FOR TEACHER PROFESSIONAL DEVELOPMENT AT A GLANCE

Tables in this section offer overviews of the education-related characteristics of key technologies used to support TPD. Use the tables to compare tools in relation to program objectives. Refer to Figure 1 below for an overview of a planning process to be used in conjunction with this handbook.

FIGURE 1: PLANNING PROCESS FOR ICT-SUPPORTED TPD COMPUTERS AND THE INTERNET IN TPD AT A GLANCE

Planning

DEVELOPMENT GOALS
National plans for EFA and education, eReadiness, etc.

NEEDS ASSESSMENT
Gaps in # of teachers, teachers' skills, pedagogical methods

PROJECT OBJECTIVES
Classroom Change
Subject mastery, certification, teaching/learning

INFRASTRUCTURE & RESOURCES
Roads | Electrical Power | **Policy Environment**
Legal & regulatory frameworks | **Technology**
Mobile telephone networks
Internet backbone
Telecom & tech markets

AVAILABLE RESOURCES
Human Resources
Teachers
Mentors
Researchers | **Educational Assets**
Schools
Textbooks
Teachers Colleges | **Ed Tech**
Govt. radio station
Computer labs | **Funding**

TECHNOLOGY SOLUTIONS
Radio/Audio | Computers | Television/Video | Internet

COST CALCULATIONS

MONITORING & EVALUATION

Feedback — Adaptation

COMPUTERS AND THE INTERNET IN TPD AT A GLANCE

Roles in TPD & education	Strengths	Limitations	Cost profile	Other considerations
• Provide productivity tools to write reports, make presentations, communicate, design animations, build Web sites, etc. • Provide access to guided TPD resources and collaborative environments, and enable the creation of online communities of practice • Enable acquisition of basic computer skills Internet Computer Driver's License (ICDL), design skills (e.g., Web pages), programming, and hardware maintenance and repair • Provide tools (e.g., spreadsheets, databases) that promote higher-order thinking	• Flexible and powerful—can be used to develop materials, access resources, and communicate • Multiple media and platforms combine text, audio, video, animation, and interactivity • Centralized and decentralized communication supports dissemination of resources and essential feedback from schools • May enable learner-centered and active-learning pedagogies • Enable communication with experts—including TPD mentors, master teachers, and help desks • Improve subject mastery through Computer-Assisted Instruction (CAI), simulations, and other tools • Provide support for collaboration—individuals, pairs, and groups of teachers or students can use computers to collaborate online and face-to-face • Support assessment and recordkeeping—accredited ODL courses, electronic portfolios, etc. • Potential for revision and new versions supports reflection, self-assessment, and other learning-related activities	• Complex tools require both time and TPD to be effective • Hardware, software, and operating-systems are fragile—subject to damage by users, viruses, fluctuating electrical power, etc. • Hardware and software lose value and utility as they age—corporate and institutional users plan on 3 years of service • Highly dependent on infrastructure—electrical, telecommunications, road (for repairs), and human (for maintenance and management) • Without support from leadership and system-wide commitment to new modes of teaching and learning, impact is limited	• Variable production costs—new software tools (e.g., Flash, Director, etc.) drive down production costs of digital content • Variable content-distribution costs are contingent on Internet connectivity and resource format • Significant installation, maintenance, and repair costs • Total Cost of Ownership (TCO) model mandates periodic upgrades	• May contribute to overall e-Readiness • Advances in wireless, VSAT, and other communications tools may increase Internet access • Advances in hardware design may increase ruggedness and decrease power requirements • Mobile devices (handheld computers, phones) have potential to change TPD-focused communications and access to resources • Focus on tools may distract from curriculum-centered learning

RADIO AND THE INTERNET IN TPD AT A GLANCE

Roles in TPD & education	Strengths	Limitations	Cost profile	Other considerations
• Addresses shortages of trained teachers • Basic-skills instruction—math, health, language-of-instruction (English, French, etc.) • Promotes teacher development, primarily via demonstration, guided and hands-on classroom management, and building subject knowledge	• Can lead to improvements in basic skills • Proven curricula in basic math, language arts, health, Early Childhood Care and Development (ECCD) • May be implemented with or without textbooks and other resources • Potential to reach large student populations • Lack of literacy skills not a barrier • Addresses equity and access issues (gender, ethnic, rural) • Can combine hands-on development of teacher skills with student learning • Audio learning may support visualization and concept-building by learners • Enables instructional continuity across grades and subjects • Radio production skills are widespread • Durable, survives extreme environments and long-term use with minimal care • Moderate infrastructure requirements • Low technical-support requirements	• Value of content may degrade over time—long-running programs must evolve with schools and education systems • Broadcast airwaves are subject to political and economic events • Tendency to reinforce rote learning models— interactivity is limited, attention to needs of individual learners is limited • Fixed broadcast schedule • Linear, one-size-fits-all approach • Risk of student and teacher dissatisfaction—including boredom, especially when lessons are broadcast daily • Hardware-replacement programs are necessary: Radios and batteries may be stolen or borrowed	• High to moderate content-development costs • Startup includes cost of radios, cassette players, tapes, batteries, materials development, and training • Per-student recurrent costs of large-scale programs are very low • Funding may combine contributions from ministries of communication, broadcast authorities, private radio networks, parents' groups, and others • Low recurrent cost has not ensured sustainability	• Advance research and formative evaluation are essential for success • Impact is increased by teacher development, printed materials, school site visits and other means • May incorporate songs, use of real-world objectives (e.g., pebbles or beans as math manipulatives), in-class experiments, pair- and group-work and other active-learning elements • Limited quantitative evidence of impact on teacher development • Can be used in combination with other technologies, such as video or "podcasting"—teachers may adopt radio-delivered classroom practices when they see examples on video

TELEVISION IN TPD AT A GLANCE

Roles in TPD & education	Strengths	Limitations	Cost profile	Other considerations
• Addresses shortages of trained teachers • Is a primary means of delivering content and concepts to students across the curriculum • Used in development of teacher skills and knowledge • Provides views of real classroom practices and learning activities • Provides teachers with learning resources that show distant places, graphical representations of concepts, historical events, etc.	• Is both powerful (moving images, audio, etc.) and familiar • Can be used to "bring" viewers to the site of events and phenomena • Helps teachers implement new techniques effectively by observing demonstrations of classroom management and other teaching practices • Has the potential to reach large populations of students and teachers • Addresses equity and access issues—although access requires electrical power • Supports instructional continuity across grades and subjects	• As a visual medium, does not guide teacher through scripted, hands-on classroom activities—unlike radio, television promotes "watch and learn," not "do and learn" • Involves high development costs which may limit testing, review, and revision before programming is launched • Value of content may degrade over time—costs of revisions and new programming are high; visual images "show their age" • Broadcasts are subject to external political and economic disruptions • Television production requires sophisticated skills and facilities • Costs of production and airtime may influence programming to reach audiences outside of schools • Fixed broadcast schedule—can be augmented by taping • Limited by access to electrical power • Hardware costs for reception (television, satellite dish, cabling) and power generation may be too high for poor communities and schools	• High production costs—often US\$1,000 per minute • Commercial broadcast rates are very high • Local installation includes cost of television, satellite dish (in rural locations) • Perstudent recurrent costs of large-scale programs are low—but low recurrent costs have not ensured sustainability • Funding may combine contributions from ministries of communication, broadcast authorities, commercial broadcasters, and others	• Lack of interactivity can be addressed through a range of affordable technologies—fax, email, telephone "call-in" formats • Impact is increased by teacher development, printed materials, school site visits and other means • Limited quantitative evidence of impact on teacher development

VIDEO RECORDING IN TPD AT A GLANCE

Roles in TPD & education

- Demonstrates new modes of teaching and learning through views of real classroom activities (Lesotho video package)
- Video recording of classes shows teachers their own interactions, habits, and progress toward effective teaching

Strengths

- Teachers benefit from seeing other teachers in action
- Teachers benefit from seeing themselves in action
- Video recordings can be used and re-used according to teachers' schedules
- Playback controls (rewind, freeze-frame, etc.) enable close analysis of specific events
- Video production tools can be used locally—in schools, by ministries, etc.
- Broadcast quality video is powerful (moving images, audio, etc.) and familiar
- Effective learning resource for teachers and students—can "bring" viewers to events and phenomena to support concept building, retention, etc.

Limitations

- Value of content may degrade over time—costs of revisions and new programming are high; visual images "show their age"
- Video produced by foreign institutions may be ineffective—teachers may not identify with experiences shown outside recognizable contexts
- Poor roads, lack of rural electrical power and other challenges to distribution in LDCs may reinforce differences in education access

Cost profile

- Variable production costs—professional quality is high cost; local (in-school) production can be low cost
- Initial cost of hardware per school is moderate
- Hardware costs are falling—including digital video cameras, storage media (DVDs, hard drives), and players
- Distribution of video content to schools may entail low or moderate cost
- Potential reuse lowers recurrent costs of large-scale programs
- Professional-quality resources may be available at low cost from universities or foundations

Other considerations

- Advances in digital video may increase the value of video for TPD in LDCs—digital video cameras, portable DVD players
- New, powerful mobile phones can shoot low-resolution video clips
- Compression software (e.g., MPEG4, etc.) makes short videos available via CD-ROM and the Internet
- Easy-to-use editing tools enable moderate-quality video production by ministries, universities, and schools

ONLINE DISTANCE LEARNING IN TPD AT A GLANCE

Roles in TPD & education

- Provides structured and unstructured TPD to teachers
- Provides teachers access to learning resources for use with students
- Peer mentoring and teacher communities support TPD initiatives
- Accredited TPD courses help teachers upgrade qualifications

Strengths

- Anytime, anyplace—wherever connection is available
- Teachers can interact with expert teachers and others
- Written communication (email, discussion) can prompt more reflective and considered participation
- Supports a range of learning styles
- Potential to reach large populations of teachers

Limitations

- Dependent on regular access to computers and the Internet
- Teachers must have computer, language and literacy, and teaching skills to participate effectively
- Many self-paced online courses lack high-quality or interactive content—online materials merely replace print materials
- Internet content may be overwhelming—too much and too many choices
- Online mentoring may be less effective than face-to-face
- Multimedia and interactive course materials require high bandwidth and powerful hardware
- Effect of online TPD on classroom practice is unclear

Cost profile

- Low costs when teachers access free TPD sites and content (e.g., iEARN, CENSE)
- High costs when courses have fees (WIDE World)
- Moderate content development costs (online courses, portals, and communities)
- Moderate operating costs for facilitated courses, portals, and communities

Other considerations

- In some countries, may best be used to build capacity among master teachers, mentors, and teacher-college faculty

SECTION 3
MODELS AND BEST PRACTICES IN TEACHER PROFESSIONAL DEVELOPMENT

GUIDING QUESTIONS

- What are the needs of teachers in our country, and how will teacher professional development (TPD) address these needs?
- Which of the three models of TPD are most appropriate to the needs of our teachers?
- Which models are currently being used in our schools?
- How can ICTs improve and extend current or projected TPD efforts?

SUMMARY

To be effective and successful, teacher professional development must be of high quality and relevant to teachers' needs. No amount of ICT can compensate for TPD that lacks these characteristics.

TPD is the tool by which policymakers convey broad visions, disseminate critical information, and provide guidance to teachers. Effective TPD begins with an understanding of teachers' needs and their work environments—schools and classrooms. TPD then combines a range of techniques to promote learning; provides teachers with the support they need; engages school leadership; and makes use of evaluation to increase its impact. Essential techniques include mentoring, teamwork, observation, reflection and assessment. TPD programs should engage teachers as learners—typically involving the process of "modeling."[2]

When computers are involved, TPD programs must address not only teachers' technical skills, but also their concerns about logistics, about how to use computers with students, and about risks to their status in the classroom. Successful computer-supported or computer-focused TPD provides teachers with hands-on opportunities to build technical skills and work in teams while engaging them in activities that have substantial bearing on their classroom practices or on other aspects of the school workplace.

TPD can be divided into three broad categories:
- **Standardized TPD**
  The most centralized approach, best used to disseminate information and skills among large teacher populations

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2 Modeling is an instructional method in which teachers *experience* the kinds of learning that they are expected to implement in the classroom. Design of TPD might, for example, have teachers working in pairs or teams to help build their understanding of collaborative learning.

- **Site-based TPD**
  Intensive learning by groups of teachers in a school or region, promoting profound and long-term changes in instructional methods
- **Self-directed TPD**
  Independent learning, sometimes initiated at the learner's discretion, using available resources that may include computers and the Internet

Standardized TPD includes the Cascade model, frequently used in TPD programs that involve ICTs. In the Cascade model, one or two "champion" teachers at a school might attend centralized workshops to build computers skills or learn about integrating computers into teaching and learning. When they return to their schools, these champion teachers provide TPD to their colleagues that *also* builds computer use and integration skills.

Different approaches to TPD can complement each other, and can be implemented in a variety of forms, enabling TPD programs to grow to reach large numbers of teachers while supporting teachers in their efforts to improve student learning. *However, site-based TPD, since it addresses locally based needs and reflects local conditions, should be the cornerstone of teacher development across the education system.*

UNDERSTANDING PROFESSIONAL DEVELOPMENT

Teachers need a wide variety of ongoing opportunities to improve their skills. TPD (also known as "in service" or "teacher education") is the instruction provided to teachers to promote their development in a certain area (e.g., technology, reading instruction, subject mastery, etc.). TPD is the tool by which policymakers' visions for change are disseminated and conveyed to teachers. Though the recipient of TPD is the teacher, the ultimate intended beneficiary is the student. *Consequently, professional development is often the most critical component of any ICT project.*

Professional Development vs. Training

Professional development is much more than training, though technology training may be one part of TPD. Professional development—including the ongoing workshops, follow-up, study, reflections, observations and assessment that comprise TPD—accommodates teachers as learners, recognizes the long-term nature of learning, and utilizes methods that are likely to lead teachers to improve their practice as professionals.

Professional development takes many forms, such as: when teachers plan activities together; when a master teacher observes a young teacher and provides feedback; and when a team of teachers observes a video lesson and reflects on and discusses the lesson. These methods of TPD are all more effective models of teacher learning than simple training.

Making TPD Effective

Effective TPD addresses the core areas of teaching—content, curriculum, assessment and instruction. Regardless of whether ICTs are involved, all TPD projects should:
- **Address teacher and student needs** via approaches that are appropriate for conditions in schools
- **Be long-term, ongoing, sequenced, and cumulative**, providing teachers opportunities to gain new knowledge and skills, reflect on changes in their teaching practice, and increase their abilities over time

- **Focus on student learning outcomes** in ways that enable teachers to use their new knowledge and skills
- **Model learner-centered instruction** so that teachers experience and reflect on the learning activities that they will lead
- **Use formative and summative evaluation** for program improvement

BUILDING TEACHERS' COMPUTER SKILLS

Many computer-supported TPD projects focus on technical concerns, to the exclusion of all others. Underlying these projects is the assumption that learning *how to use* computers equals knowing *how to teach* with computers.

Some degree of technical knowledge is necessary—basic keyboard and mouse skills, familiarity with the operating system and with basic software applications. However, computers are not designed to be used as instructional tools and most teachers need suggestions on how to use them with students. Without those suggestions—and without sensitivity to the array of teachers' concerns—improving teachers' computer skills is not likely to lead to students' use of computers as tools for learning.

Computers raise many concerns among teachers, including:
- *Technical concerns* ("How do I use the computer?")
- *Functional concerns* ("What can computers help me do?")
- *Logistical concerns* ("How can I use so few computers with so many students?")
- *Affective concerns* ("Will these computers replace me as a teacher? Will my students lose respect if they think the computer knows more than me?")
- *Organizational concerns* ("How do I organize my classroom to support the use of computers? How can they be used as part of what I already do in the classroom?")
- *Conceptual concerns* ("How can I learn from and with computers?")
- *Instructional concerns* ("How can computers help my students learn in different ways? How can they support the curriculum? How can they support my teaching? How should I teach using computers?")
- *Evaluation concerns* ("How do I assess student learning in computer-based projects? How does this new way of learning fit with national exams?")

> ## CHARACTERISTICS OF EFFECTIVE TPD
>
> *Any proposal that starts out by "teaching people to use computers" is a dead end. What can it do for me now? How can it reduce my costs for doing things that I do already? How does that free up resources for other activities? How does this technology enable those activities?*
>
> Earl Mardle
> Principal, KeyNet Consultancy
> Sydney, Australia

Successful Approaches to Computers in TPD

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

TPD should also be appropriate to the conditions in teachers' schools. If teachers will be using ten computers with 60 students (or one computer with 60 students), TPD sessions should reflect this reality.

These strategies—far more than technology training in a computer lab—will result in greater teacher use of technology at the school level. Even when they feel minimally proficient with ICTs, teachers will use computers if they feel some degree of comfort and confidence, when they know how computers can improve what they do, and when they have access to functioning equipment and support.

At the point that computers are introduced into schools, head teachers should also receive TPD that builds their confidence and skills. Head teachers should feel comfortable with their understanding of what teachers are being asked to do, how students can use computers to enhance their learning, and how they too can use computers to accomplish meaningful tasks.

Head teachers should also understand that computers are not inherently valuable. Their worth derives from their contribution to the attainment of measurable educational goals..

Learner-centered TPD

Whether it is intended to bring teachers to basic, intermediate or advanced levels of skill—and whether ICTs are used or not—TPD should be *learner-centered*, enabling teachers to experience the types of instruction that they are asked to provide to their students. Activities model instructional approaches that teachers can apply in their own settings, and may range from facilitated discussions to working in small groups to project-based instruction.

Within learner-centered TPD, the voices and actions of teachers themselves, not of the TPD provider, should be the focus, and teachers should engage interactively and collaboratively in activities that reflect their curricula. Like their students, teachers learn by doing—by collaborating with peers, reflecting, planning classroom activities—not by sitting and listening to a facilitator or following along in directed technology instruction.

WHAT IS TECHNOLOGY INTEGRATION?

"Technology integration" refers to the use of computers and the Internet to support teaching and learning across the curriculum. Integrated use of technology may involve students working with computer productivity tools to complete science projects or searching the Internet to find poetry—but it is always tied directly to student mastery of their school subjects.

Properly implemented, technology integration is the best means of building computer skills: Research in South African and Egyptian schools indicates that students learn computer skills better when computers are used to address their own interests rather than in formal skills training.

Technology integration *is not*: A separate subject, a stand-alone project, a focus of study in and of itself.

Example: Students in a Computer Studies course use a word-processing program to create a newsletter. The purpose of the activity is to build skills using the software. Students' use of the computer is separate from their study of school subjects. They are learning about computers.

Technology integration *is*: Using computers on a regular basis, for a purpose connected to math, science, social studies or language arts. Computer use becomes a means of learning, and learning takes place through computer use.

Example: During social studies, a teacher presents students with a task—to research and communicate to the village council five strategies for keeping local water bodies clean. Students use the computer as needed to do research (perhaps with Encarta, a CD-based encyclopedia) and to prepare final reports. They are learning *with* computers.

Learner-centered TPD recognizes and addresses the constraints teachers face in their own schools. If teachers have no access to books, TPD should help them devise strategies to develop learning materials. If teachers have 80 students and one computer, TPD must model—not simply talk about—how teachers integrate technology given such a constraint.

PROFESSIONAL DEVELOPMENT MODELS

The range of models of professional development is far more diverse than standard technology-training workshops. TPD models can be placed in three broad categories, each with its own strengths and weaknesses.

- **Standardized TPD programs**
  Focus on rapid dissemination of specific skills and content, often via a "cascade" or "train-the-trainer" approach
- **School-centered TPD**
  Focus on longer-term change processes, usually via locally facilitated activities that build on-site communities of practice
- **Individual or self-directed TPD**
  Focus on individualized, self-guided TPD with little formal structure or support

All of these TPD models can be used in very low-resource environments. All can be supported by ICT—whether this involves using radio or television to broadcast lessons, providing on-site videotaping of teachers and classrooms, or expanding a local community of practice through e-mail and the Internet.

WHAT ARE CHARACTERISTICS OF GOOD TPD?

Realism. What is taught should be implemented, preferably immediately. Conditions and resources needed for implementation should be achievable, e.g., student literacy, infrastructural support. If technology support (e.g. computers) is expected to lag training, then the program should differentiate pedagogy from technology, message from media, ends from means, so that teachers can start implementing the pedagogy with less sophisticated technology or media.

Dr. Margaret Chia-Watt
Director, Educational Development
Nanyang Polytechnic, Singapore

STANDARDIZED TPD

Standardized TPD typically represents a centralized approach, involving workshops, training sessions, and in many cases the Cascade model of scaled delivery.

Standardized models tend to rely on training-based approaches, in which presenters share skills and knowledge with large groups of educators via face-to-face, broadcast, or online means. Training-based models are frequently employed to develop ICT skills such as those covered by the International Computer Drivers License (ICDL), and sometimes to introduce the integration of computers into the curriculum—as in the Intel Teach to the Future program.

Standardized, training-based approaches should focus on the exploration of an idea and the demonstration and modeling of skills. When employed in accordance with best practices discussed in this handbook, standardized approaches can effectively:

- Expose teachers to new ideas, new ways of doing things, and new colleagues
- Disseminate knowledge and instructional methods to teachers throughout a country or region
- Visibly demonstrate the commitment of a nation or vendor or project to a particular course of action

Often, however, workshops take place at one time and in one location without follow-up, and without helping teachers build the range of skills and capacities needed to use new techniques when they return to their schools. These one-time sessions can certainly help introduce and build awareness about computers, learner-centered instruction, or new curricula. But trainings without support rarely result in effective changes in teaching and learning—or in adoption of computers at the school level.

The Cascade Model

In the Cascade model, one or two teachers from a school receive standardized TPD via a training-based model and return to their schools to replicate the training that they have received—serving as "champion teachers" or a "vanguard team." Cascade approaches are often used to help teachers learn basic computer skills and to integrate computers into teaching and learning.

The World Links program typically relies on a face-to-face Cascade model: Champion teachers participate in professional development. They then return to their schools' computer labs to provide basic computing TPD to their colleagues and serve as coordinators or managers of their schools' computers labs.

Although the scale of Cascade-based TPD is potentially tremendous, weaknesses in the approach may limit its effectiveness. Factors that impede changes in teachers' instructional practices include:
- Workshops that typically focus on helping champion teachers learn new techniques as *users,* without helping them build the skills they need as *professional-development providers*
- Strong challenges for champion teachers due to a lack of both TPD for school leaders, and programs that motivate teachers to participate in TPD

Champion teachers who may lack the leadership, facilitation skills and mastery of the new techniques they need to guide their colleagues effectively—even when time and resources are part of the overall TPD program

Consider Using Standardized TPD When…

The goal is to:
- Disseminate information to the largest number of teachers possible
- Introduce teachers to computers, the Internet, and strategies for using these tools
- Build awareness of best practices
- Expose teachers to new knowledge, skills, strategies and individuals

STANDARDIZED TPD AT A GLANCE

Strengths

- One-to-many format facilitates large-scale project
- Introduces a common knowledge base and skills to many participants
- Broadens teachers' knowledge by providing access to new ideas and strategies
- "Pyramid" training structure facilitates large-scale projects and rapid diffusion across systems
- Can engender new alliances and relationships among participating teachers
- Cost-effective means of distributing discrete sets of knowledge and skills intended to be implemented by all teachers—HIV/AIDS awareness in schools, gender-equity initiatives in classrooms

Limitations

- Excludes site-based issues
- "One size fits all" approach excludes contextual issues that may pose barriers to implementation in schools
- Unless it is a series of workshops over a long period of time, the one-shot approach of workshops does not address the long-term, developmental nature of learning
- Significant diminishment of skills and knowledge in the transfer from champion teacher to colleagues
- Format doesn't provide follow up or support—essential components for success that require additional cost and capacity
- Evaluation and accountability are difficult—classroom-based results only emerge over time, and are outside the workshop structure
- Training facilities may not match school conditions—champion teachers and teachers may not be able to apply TPD

Cost considerations

- Lower unit costs: cost per teacher trained, and cost per hour of training

- Costs include travel-related expenses for trainer and participants
- Cost-effectiveness should be measured in relation to outcomes
- Budgeting should address follow up and support
- Electronic follow up (via the Internet) cannnot work unless all areas of infrastructure are sound

- Allocations must include teacher incentives—especially when champion teachers benefit financially from additional income or per diem reimbursements

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And when conditions are such that:
- ■ Expert knowledge is scarce or concentrated in urban areas
- ■ Additional follow-up can be provided on-site in schools

SITE-BASED TPD

Site-based TPD often takes place in schools, resource centers or teacher training colleges. Teachers work with local ("in house") facilitators or master teachers to engage in more gradual processes of learning, and building mastery of pedagogy, content and technology skills. Site-based TPD often focuses on the specific, situational problems that individual teachers encounter as they try to implement new techniques.

Successful examples of site-based TPD include Guinea's FQEL project, which combines recorded versions of the *Pas à Pas,* or "Step by Step," educational radio broadcasts for teachers with face-to-face local TPD for district inspectors. District inspectors then work with *Pas à Pas* teachers in schools. Namibia's Basic Education Support 2 (BES II) program employs a school cluster-based approach that uses observation, assessment and video examples to help teachers improve instruction and assessment. The Implementation Briefs provide a fuller description of the many types of site-based professional development models, as well as strategies for finding the time to provide site-based TPD.

Site-based TPD models tend to:
- ■ Bring people together to address local issues and needs over a period of time
- ■ Encourage individual initiative and collaborative approaches to problems
- ■ Allow more flexible, sustained and intensive TPD
- ■ Provide ongoing opportunities for professional learning among a single set of teachers

ADDRESSING WOMEN IN TPD

Just as E*ducation for All* mandates educational access for all students, opportunities for TPD should be provided to all teachers, regardless of ethnic group, geographic location or religious affiliation. Because educating girls is critical to a nation's development, and because access to qualified female teachers is critical to girls' development, female teachers should be provided with every opportunity to continue their professional education.

However, site-based approaches are time- and labor-intensive, which also give rise to challenges.

Site-based approaches require locally-based TPD providers skilled in facilitation, instruction, content, curriculum, assessment, and technology. Facilitators also should be adept at helping teachers succeed in low-resource environments. Establishing and maintaining a network of such facilitators to meet the needs of large-scale TPD programs is challenging in any environment. In the teacher-poor education systems of some developing countries, this challenge is magnified.

In addition, because site-based TPD extends over a longer period and takes place in many locations, initiatives in specific regions may be disrupted by civil conflict, disease (HIV/AIDS, cholera, etc), or changes in school leadership.

Despite these challenges, site-based TPD should be part of any country's long-term professional-development planning for educational improvement. Such programs may be expensive while local TPD providers are being developed. However, once site-based programs are in place, new curricula, pedagogies, tools, and administrative practices can be introduced in a cost-effective manner.

Consider Using Site-based TPD When…

- Changing instructional practices is critical
- Plans call for a significant enhancement of teachers' subject knowledge or of classroom teaching and learning
- Objectives include ongoing growth toward overall excellence in teaching and learning
- There is a core group of teachers from each school able to participate in professional development
- Technology—television, radio, the Internet—can be used to supplement professional development
- Facilitators or master teachers can be developed regionally at teacher training colleges or at schools

Site-based methods can augment and provide follow-up for standardized methods. New science units or assessment methods, for example, can be introduced at nationwide workshops to facilitators and teachers. These facilitators will then return to their schools and work onsite with their colleagues to implement the new techniques effectively.

Many TPD programs cannot be neatly categorized as either standardized or site-based. In the United States, the Applying Technology to Restructuring Learning (ATRL) project of Southwest Educational Development

SITE-BASED TPD AT A GLANCE

Strengths	Limitations	Cost considerations
• More conducive to building a community of practice • Locally based, focused on local needs and builds and cultivates local expertise • Supports sustained TPD efforts that cultivate expertise in schools	• Time intensive • Difficult to provide expertise to low-resource areas, especially those impacted by conflict or that are geographically remote	• On-going training involves recurrent expenditure • Costs include creating training materials, and purchasing audiotapes, cassette players, batteries • Must budget for transportation so facilitators can reach schools

Laboratory combined six annual workshops with monthly, school-based TPD, such as Lesson Study, peer classroom observations, and Open Lessons. This combined approach of standardized workshops and site-based approaches helped teachers create learner-centered, technology-enriched activities.Self-directed TPD

SELF-DIRECTED TPD

In self-directed TPD, teachers are asked to determine their own professional development goals and select activities that will help them attain these goals. Self-directed TPD can involve watching video examples of classrooms, reading books on education or a field of study, keeping journals, performing case studies, taking online courses, or observing classes taught by colleagues. Many teachers already participate in informal, self-directed TPD, by seeking out an experienced colleague for advice, for example, or searching for lesson plans on the Internet.

Self-directed TPD places all responsibility on the teacher and requires little of the school. In many cases, school leadership directs a teacher to develop expertise in a certain area without providing resources or guidance. Teachers may be challenged to make use of the resources that they find on their own: If a lesson plan on plant biology uses Canadian trees as examples, a teacher needs to be able to substitute local trees in ways that support the lesson accurately. If a project description involves "cooperative learning," and bases assessment on interactions within small groups, a teacher without advanced skills may make poor use of the project. Self-directed activities are most effective with teachers who are motivated self-starters, and who have already developed teaching skills and subject mastery.

For these reasons, self-directed TPD does little to promote *basic* or *intermediate* skills, and so is of less benefit to low-skilled teachers. Computers and the Internet can make self-directed TPD more worthwhile, but even with ample access and connectivity, self-directed TPD works best with *advanced* teachers wishing to enhance their knowledge and skills.

While teachers should certainly be encouraged to participate in ongoing, self-motivated learning, self-directed activities should *not* be used as the *primary* means of providing TPD. Instead, they should be used to complement and extend standardized and/or site-based TPD.

Consider Using Self-directed TPD When…

■ There are no other organized professional development options
■ Self-motivated and innovative individual teachers need opportunities for learning that are not otherwise available

- Self-directed activities are part of an overall professional development program that includes standardized or site-based TPD
- Supports, incentives and structures are in place to ensure that self-directed TPD is the most effective way to meet teacher needs

WEB RESOURCES

- *International Society for Technology in Education (ISTE)*
  Educational Technology Standards
  The International Society for Technology in Education (ISTE) has created the most comprehensive set of ICT standards for teachers, students, and administrators. The standards are the product of collaboration of more than 2,000 educators who wrote, tested, and revised learning activities and multidisciplinary units to support classroom teachers preparing students to become technology-capable learners. The hands-on activities focus on subject matter and show how appropriate technology can be employed as part of the learning experience.
  http://www.iste.org (select "NETS" to go the standards section)
- *National Staff Development Council Standards for Professional Development*
  The National Staff Development Council's Standards for Professional Development reflect the most current best practices in professional learning. The standards examine what students are expected to know and be able to do, what teachers must do in order to ensure student success, and the ways in which professional development must meet both goals.
  http://www.nsdc.org
- *South African Curriculum (Wiki Book)*
  This is an example of a Wiki—a Website that allows users to update and edit content collaboratively—that contains South Africa's national curriculum. All information may be accessed for free, commented upon, and modified as necessary.
  http://en.wikibooks.org/wiki/South_African_Curriculum

SECTION 4
TECHNOLOGIES FOR TEACHER PROFESSIONAL DEVELOPMENT— COMPUTERS AND THE INTERNET

GUIDING QUESTIONS

- In what parts of our school systems are teachers ready to develop the intermediate and advanced skills supported by computers and the Internet?
- How will computers and the Internet extend and improve our TPD efforts?
- To take advantage of available capacities and infrastructure, and to meet teachers' needs, should we locate computers for TPD in schools, teacher training colleges, or regional centers?
- What is the outlook for gains in national electrical infrastructure? In technical-support capacity? How do these projections affect planning for the use of computers and the Internet?
- Do other technologies, such as radio, or other models, such as site-based TPD, have greater potential to meet our objectives?

SUMMARY

Computers and the Internet can benefit all parts of the education system, including student learning, teacher development, school leadership, and management. Teachers may gain benefits from using these tools in the areas of content, curriculum, instruction, and assessment. Computers are best used to help teachers build *intermediate* and *advanced* skills.

In teacher training colleges, computers and the Internet can be used to increase teachers' basic skills and subject mastery, to provide access to resources that can later be used in classrooms, and to help teachers build familiarity with specific instructional approaches. However, if teachers will not have access to computers after they are posted to schools, the cost of helping teachers acquire computer skills may outweigh the benefits of computer use during their pre-service education.

In schools, computers and the Internet can serve as flexible resources to support TPD and student learning. Teachers can have just-in-time access to learning resources as they are preparing for lessons; can communicate with mentors and colleagues as part of TPD follow up; and can enroll in distance-based certification

programs. In addition, as students gain computer skills, teachers can integrate the use of computer productivity tools and knowledge resources into their approach to learning in all areas of the curriculum.

Barriers to effectively using computers and the Internet in developing countries include poor infrastructure and limited technical capacity. However, many of these barriers have been successfully overcome through comprehensive project design and good management. Successful projects may minimize risk by growing slowly at first before implementation accelerates.

Several projects, including *Enlaces* in Chile and the Uganda VSAT Rural Connectivity Project, have demonstrated that computers and the Internet can have a positive impact on both teachers' practices and students' learning.

In regional teacher centers, computer support for TPD may offer an effective balance of access and considerations of cost, infrastructure, and technical support. Such centers can be situated in "hub" primary schools, secondary schools, teacher training colleges, or district offices, and can offer teachers opportunities to build skills, find resources, and participate in TPD. However, it is critical that TPD in teacher resource centers remain appropriate to the conditions that confront teachers in their schools.

Capital and recurring costs for nationwide implementation of computers and the Internet are high. For example, total funding for the *Enlaces* project, enabling computer access in over 5,300 schools, was approximately US$160 million over ten years. However, sustainability often poses a greater challenge: monthly connectivity costs for schools in the Uganda VSAT Rural Connectivity project are US$305 per school, with additional costs for computer maintenance, repairs, and replacement.

POTENTIAL USES AND BENEFITS

Computers and the Internet offer a wide range of supports for teaching and learning. Accordingly, this section addresses computers and the Internet in three situations:
- Teacher training colleges
- Schools
- Regional teacher centers

Personal computers are designed to empower users to find or make information resources, and to communicate with anyone else who uses a computer as a communication tool. When properly presented within the context of TPD, these capacities can help teachers address many of the instructional challenges that they face.

If implemented properly, computers and the Internet can:
- Enhance student learning, teacher development, school management, and community development
- Provide access to new learning resources, including content, lesson plans and assessments
- Enable self-directed learning using resources from CDs and the Internet, or via online distance-learning courses
- Offer access to new learning resources, including content, lesson plans and assessments prepared by ministries of education
- Contribute to national e-Readiness

The potential is there. The challenges to realizing this potential in the resource-strapped environments of LDCs are significant, but they are not insurmountable.

THE UGANDA VSAT RURAL CONNECTIVITY PROJECT: PERSEVERANCE PAYS OFF

In January 2002, SchoolNet Uganda and its partners[3] launched the Uganda VSAT Rural Connectivity project, in which 15 rural secondary schools were connected to the Internet by high-speed VSAT[4] terminals. Several of these school-based telecenters were the first Internet "points of presence" in their regions. The pilot project was designed to test the viability and the impact of the satellite-connected VSAT hardware and 15-unit computers labs, augmented by teacher professional development. In Year One of the two-year project, monthly connectivity costs were partially subsidized, but schools paid all other recurrent costs.

At the end of Year One, the U.S.-based VSAT service provider entered bankruptcy and ceased providing satellite service to Africa. After a year spent developing their educational and community-outreach programs, all 15 schools were without Internet connectivity for the first 9 months of 2003. Near the end of this period, an African VSAT company, AFSAT, established operations in Uganda and determined—in part based on the example of the VSAT Project—that schools comprised a credit-worthy market for rural high-speed Internet. AFSAT began offering lower-speed VSAT service at a reduced rate of US$305 per month.

However, AFSAT used a different frequency, requiring VSAT hardware that was entirely different from the hardware already installed in the schools. To keep the project alive, the staff of SchoolNet Uganda re-allocated 75 percent of their salaries for 2004 toward the purchase of AFSAT-ready hardware.

All 15 schools in the VSAT Project were again online and—as a result of lower monthly access fees—were entirely self-sustaining. In addition, these schools were joined by other Ugandan schools, many of which became members of SchoolNet Uganda. As of November 2004, 44 Ugandan schools were operating affordable VSAT Internet connections. SchoolNet Uganda has entered into a close working relationship with the Ministry of Education and Sport, and has received grant funding from several sources to expand its programs.

LESSONS LEARNED

What initial lessons can be learned from the experience of the Uganda VSAT Project? Among them:

- Flexibility and perseverance are critical, as unforeseen challenges will arise.
- Local solutions, when available, are preferable to out-sourcing solutions internationally.
- Decentralized solutions—in this case involving an independent NGO, a private-sector provider, and school administrations with reasonable autonomy—may be most effective during the early phases of ICT adoption.

The change in regulations by the Ministry of Education and Sport (MOES) to allow schools to raise fees at their own discretion was a key factor in the success of the Uganda VSAT project. Decentralization of financial and operational controls of schools is *one* means of facilitating the diffusion of computers in schools. In Uganda, schools have been aggressive and successful in raising funds and securing donations of hardware. As a result, AFSAT and other private-sector vendors of ICT goods and services have begun marketing to schools directly.

This aspect of project evolution is addressed from other perspectives in the *Section 10: Effective Partnerships for ICT-supported Teacher Professional Development.*

COMPUTERS AND THE INTERNET IN TEACHER TRAINING COLLEGES

The design of computer-enabled TPD *must* be appropriate for the school environments in which teachers are working. When computers or the Internet will not be available to teachers in schools, their use for pre-service professional development in teacher training colleges should be shaped by this constraint.

3 Organizations contributing to the Uganda VSAT Rural Connectivity Project included the Ugandan Ministry of Education and Sports, the World Links organization, World Bank Institute, Schools Online, and the Gates Foundation.
4 VSAT (Very Small Aperture Terminal) refers to a satellite ground station that can be used to transmit information and communications.

TPD objectives that can be supported by computers in teacher training colleges include:

- Building teachers' numeracy and literacy skills,including spoken and written language
- Building teachers' more advanced subject mastery, including understanding of key concepts
- Building familiarity with approaches to teaching and learning
- Providing access to information resources and tools that can be used in classrooms

Student teachers can benefit from appropriate online distance learning courses that engage student teachers in understanding specific issues in learning and pedagogy. A student teacher might, for example, complete a course on teaching reading that describes stages in learning to read and that introduces specific activities for each stage. For more information, refer to *Section 8: Online Distance Learning for Teacher Professional Development.*

Connect-ED Uganda: Piloting Computer Use in Teacher Training Colleges
Launched in 2000, the Connectivity for Educator Development (Connect-ED) project in Uganda installed computer labs and Internet connections in eight of Uganda's 39 rural primary teacher training colleges plus Kyambogo University (KyU). Project objectives include providing ICT training to teachers and teacher trainers, and using Internet connectivity and new digital learning resources to enhance the teachers-college curriculum.

In the first phase of the project, tutors and teacher trainers received ICT training in the use of Microsoft Office, use of the Internet for educational research, and development of Web sites for education. Once stationed in primary schools, however, those teachers had little opportunity to use their new skills: As of 2004, less than one percent of Uganda's 13,500 primary schools were connected to the Internet.

Initial experience led to recommendations for a second phase of the project, in which "ICT in colleges should be looked at as a tool for learning but not as a subject."[5] Web- and CD-based resources were developed to support e-learning. These were hosted at KyU and were made accessible to the eight teacher training colleges. Lessons now provide student teachers with access to detailed content across the primary curriculum. Each topic is supported by ideas for classroom activities.

Questions for Further Discussion

Planning for the Connect-ED project should have included consideration of several questions:

- Could a combination of print-based learning resources and the use of more dynamic media (e.g., video, simulations) lead to improved learning outcomes at a reduced cost?
- Could those print resources be made available to all teacher training colleges in Uganda?
- How will computer-lab installations be acquired by the remaining 31 teacher training colleges?
- What is the impact, if any, of unequal access to computers in Ugandan teacher training colleges?

A first step in the design of a project evaluation involves identifying key questions. What questions could be addressed to help assess the impact of Connect-ED? A sample might include:

- How do the online curriculum resources affect learning among student teachers?
- To what degree do student teachers retain subject mastery after one year in the field?
- Do they implement activities in their classrooms that they have encountered online?

By shifting to online distance learning as a means of delivering courses to student teachers, Connect-ED sought to increase the value of its computer installations in the project's Phase II. *If the online courses result in increased subject mastery* among the student teachers, the return on investment in infrastructure and content-development will be positive.

Consider Computers and the Internet in Teacher Training Colleges When…

Minimum capacity and infrastructure requirements can be met, including:
- Stable electricity is supplied to 90 percent of the teacher training colleges targeted
- Local technical support is available
- Ministry or other long-term financial support is available

Appropriate content is available or can be developed, including:
- Interactive multimedia and simulations targeting specific learning outcomes
- Repositories of graphics, texts, audio, and video to support independent research and lesson-plan development
- Interactive online courses

TPD addresses objectives such as:
- Building mastery of key concepts in subject areas (e.g., through the use of interactive simulations)
- Preparing teachers to integrate computers in teaching and learning *in the schools where they are posted*
- Preparing teachers to access Internet content and other learning resources *from their schools*

COMPUTERS AND THE INTERNET IN SCHOOLS

In schools, computers and the Internet can take on entirely new roles in support of TPD, helping teachers refresh or upgrade content skills, develop curriculum and assessment resources, and learn about new approaches to instruction. When computers are connected to the Internet, teachers can share experiences with online mentors or with peers across the country or continent.

Most initiatives placing computers in schools target students. These projects provide an ICT infrastructure that can be used—and ultimately *must* be used—for TPD as well.

Appropriate objectives for the use of computers and the Internet in schools to support TPD include:
- Providing follow-up support for face-to-face professional development
- Supporting the integration of ICT and other areas of the school curriculum

In addition to these objectives, computers and the Internet in schools may *also* support objectives previously identified for teacher training colleges: enhancing basic skills, building subject mastery, and increasing access to information.

Today, more than 2 million primary and secondary students have access to the *Enlaces* network in their schools. Seventy thousand Chilean teachers have been trained—50 percent of all the teachers in the country.

Questions for Further Discussion

Enlaces is among the world's most successful ICT projects in education. In considering the project's overall impact, key questions might include:
- How well does the project serve children in Chile's poorest communities?
- What impact has the project had on the ways that teachers teach and students learn?

Although 90 percent of Chilean students are served by the project, the remaining 10 percent—often in small schools with a single teacher and a multi-grade classroom—are those students who are far from cities, in rural and mountainous areas that do not have electricity or telephone connections. In cities and towns, however, *Enlaces* has been successfully implemented in schools in disadvantaged communities.

ENLACES: CHILE'S NATIONWIDE LEARNING NETWORK

Chile's *Enlaces* program, now based at *Universidad de la Frontera* in the small southern town of Temuco, began in 1990 in 12 schools in Santiago. Network access in schools was provided by very slow dial-up modems that supported email only. The World Wide Web had yet to launch.

Enlaces has a dual focus: to make ICTs an integral part of learning in Chilean schools, and to improve the performance of students and teachers in all areas of the curriculum.

A key element in the program's initial adoption in schools was the development of a customized user-interface, La Plaza, a cartoon representation of a familiar town square that enabled users to launch e-mail applications, explore the network, and access multimedia CDs. Students and teachers could achieve success before they mastered the operating system and file management.

TPD is provided on-site in *Enlaces* schools by a network of over one thousand trainers, coordinated locally and regionally by 35 Chilean universities. At each school, TPD provides 20 teachers with:

- Two-year training covering use of e-mail, the Internet, and educational and office software; creation of teaching materials, and maintenance of hardware and software
- One year of follow-on technical assistance, focusing on incorporating ICT into learning and guiding the school as it develops maintenance and management skills

In addition, teachers attend local "Education Information Technology Encounters" where they exchange experiences and identify best practices.

Impact of Computers in Schools on Teaching and Learning

The educational impact of computers in developing countries has not been extensively studied. A lack of evaluation of, or demonstrable results in pilot phases, combined with the challenges of implementation, create barriers to project extension, replication, and scaling.

Enlaces succeeded in the transition from small-scale pilot to national program in part because its objectives linked directly to proposed goals for educational reform. The project also built a network of partnerships extending from the government, to Chilean universities, to multinational telecommunications and computer companies.

A series of evaluations from 1993 to 1998 showed significant changes in student creativity and reading comprehension, but the project's impact on teachers' behaviors was less clear. *Enlaces* teachers demonstrated improved classroom-management practices, increased comfort with the use of ICTs as educational tools, and increased motivation to participate in TPD. However, changing teachers' approaches to classroom activities and student learning remains a challenge.

Quantitative analysis of the Uganda VSAT Project shows that the project has resulted in measurable changes in teachers' practices and in students' learning. Teachers in schools with computer labs are:
- Four times more likely to assign independent research
- Four times more likely to assign collaborative projects

The combination of factors contributing to these changes includes the computers and the Internet connection, TPD, school leadership, and changes in curriculum and assessment introduced by the Ministry of Education and Sport.

Consider Using Computers and the Internet for TPD in Schools When…

Minimum capacity and infrastructure requirements can be met, including:
- Stable electricity is supplied to 90 percent of the schools targeted

- Local technical support is available
- Ministry or other long-term financial support is available
- Schools are able to raise student fees to cover costs

Curricula have been reformed to emphasize:
- Collaborative work by students in groups
- Independent research and writing
- Use of office productivity software by students to *directly* support learning

TPD addresses objectives such as:
- Preparing teachers to integrate computers in teaching and learning
- Building ICT skills among teachers to support student use of computers
- Establishing online mentoring and TPD follow-up
- Facilitating teacher participation in online communities

COMPUTERS AND THE INTERNET IN REGIONAL TEACHER CENTERS

There are cost-benefit trade-offs to computer-supported TPD in schools and in teacher training colleges:
- Installations *in teacher training colleges* may minimize costs, but may also limit access to pre-service teachers
- Installations *in schools* may provide access to in-service teachers and students, but involve much larger implementations that entail high costs and high levels of infrastructure and technical support

Regional teacher centers of various kinds can serve as cost-effective alternatives to computer labs in teacher training colleges and schools. Computer-supported regional centers can be located in "hub" primary schools, in secondary schools, in teacher training colleges, or in district offices—or in a combination of these facilities. Regional teacher centers can also complement cluster-based methods of TPD, such as lesson study.

The EFA Curriculum Project in Uganda encountered obstacles stemming from inadequate TPD. Teachers were asked to learn via "top-down" instructional methods, both in relation to ICT and in relation to pedagogies. No effort was made to incorporate modeling of desired forms of learning. Though teachers gained skills in using computers, and gained exposure to active-learning pedagogies, they were not adequately prepared to design or build learning resources to enhance instruction.

THE UGANDA EFA CURRICULUM PROJECT: PROVIDING ALTERNATIVE FOR ACCESS

In 2004, three schools involved in the Uganda VSAT Project served as sites for a pilot project in which 27 primary teachers participated in over 70 hours of professional development. TPD led by curriculum-development specialists addressed:

- Using computers and the Internet
- Implementing new teaching and learning techniques
- Developing lesson plans and learning resources

Primary schools were selected on the basis of proximity to VSAT Project schools and as a result of the enthusiasm of head teachers and faculty. In most cases, teachers were able to walk to VSAT Project computer labs in less than 15 minutes. Over the course of the nine-month project, the primary-school teachers averaged five hours of computer-lab use per month—subsidized by vouchers from the project funders.

Participating primary schools received low-cost, battery-powered AlphaSmart keyboards to enable teachers to work without visiting the VSAT labs. AlphaSmarts create documents compatible with Microsoft Word. In addition to using the VSAT Project labs, teachers reported that they were able to successfully and valuably use the AlphaSmarts to develop materials for their lesson plans and student activities.

The principle of computer-supported regional teacher centers, however, remains sound. Resource-center access to ICT for primary teachers is being tested in countries such as Bhutan, Rwanda, Namibia and Nicaragua. Regional teacher centers have the potential to maximize access while minimizing costs, and to help overcome inadequate infrastructure: The 15 VSAT terminals installed in secondary schools for the Uganda VSAT Project, for example, have the potential to provide reliable high-speed internet access to teachers in dozens of nearby primary schools.

Consider Using Computers and the Internet for TPD in Regional Teacher Centers When…

Local capacity and infrastructure present obstacles, including:
- Insufficient/unreliable electrical power in rural areas
- Lack of local technical support

TPD objectives include:
- Providing follow-up, mentoring, or collaboration to support pre-service TPD
- Providing primary teachers with access to knowledge resources and communication tools

COST CONSIDERATIONS

Capital costs for projects involving the use of computers and the Internet are high. During pilot phases, these costs are often borne by donor agencies and other external entities. When the pilot phase is finished, however, both financial and technical sustainability of the computer installations can be problematic for schools.

When projects are brought to scale, much higher capital costs are incurred by country governments and are typically covered by loans or credits. In large-scale projects, capital costs are annualized across three to four years—the typical corporate service life of a desktop computer.

Recurrent costs, including Internet connections, hardware maintenance, and ongoing TPD are often more challenging and may limit project success, growth, and sustainability. Some costs are often passed on to schools, which may require changes in financing rules to meet them.

Cost information is provided for the purposes of illustration only; it should not be used as a basis to predict costs in other contexts.

Overall Costs, Enlaces

Enlaces is funded primarily by the Chilean government, with additional contributions toward recurrent costs by schools and communities, and significant in-kind support from Chilean telecommunications companies.
- Total project funding to reach 5,300 schools is estimated at US$160 million over ten years.
- Lab installations range in cost from US$5,880 in small schools to US$20,932 in large schools.

Recurrent costs (TPD, maintenance, electricity, connectivity, etc.) comprise 40 percent of annual costs. Recurrent costs are higher in larger *Enlaces* schools, because these schools must hire lab coordinators and pay for additional printing, repairs and other operational costs.[6] No information is available on the cost of teacher training.

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6 In 1998, *Enlaces*-related recurrent costs per student (in other words, not including the cost of hardware) were reported between 4 and 8 percent of total average recurrent costs per student.

For information about the expansion of *Enlaces* from 1992 to 2003, refer to *Strategic Planning for Computer Support of TPD,* in this section.

Installation, Operating and TPD Costs, Uganda VSAT Project

Two-year funding for the Uganda VSAT Rural Connectivity project was approximately US$900,000. Per-school installation costs were US$23,480. Internet connectivity and other recurrent costs were typically met by increasing student fees. These increases averaged US$3.95 per term, or 3 percent of total average fees.

Cost of TPD was US$ 15,000 per year (or US$ 1,000 per school) and included salary of one full-time employee plus travel, communications, and other expenses. Roughly 25 percent of teachers received 200 hours of TPD each; cost per teacher trained was approximately US$80 per year.

STRATEGIC PLANNING FOR COMPUTER SUPPORT OF TPD

In developing countries with emerging economies, there have been a handful of centrally driven, large-scale projects providing computers to schools. Some, such as the Basic Education Project in Turkey (Phase I, 1998 – 2001), have focused on providing near-universal access to computer hardware and the Internet as rapidly as possible. In such instances, challenges can arise in several areas relevant to TPD:

■ Lack of locally tested, proven, and replicable models of ICT use in schools
■ Lack of organizational infrastructure to provide TPD

In the Basic Education Project, approximately 8,000 secondary schools received computer labs over the course of two years. Quickly developing capacity to provide computer training on a nationwide scale is well beyond the capacities of most ministries of education.

In most countries, providing training to even one or two school faculty "champion trainers" would require contracting an outside organization. Providing *effective* TPD focused on sound pedagogy, in-depth integration of ICT, and adequate follow-up poses a far greater challenge. Meeting this objective may be beyond the capacities of even the largest private-sector providers, as well as the ministry of education.

In Turkey, the project's limited TPD was supplemented after several years by the Intel Teach to the Future program. Since 2003, the Intel program has provided intensive training to more than 250 Turkish "master teachers"; in a Cascade-model program, these master teachers have provided TPD to more than 25,000 teachers.

Several areas of inquiry may be instructive in relation to large-scale computer implementations:

■ What problems are caused by lag times between lab installation and participation in TPD?
■ How do these problems relate to the service lifecycle of computer hardware, the annualization of capital costs, and plans for sustainability?
■ What lessons can be drawn for program design and scaling?
■ What are the pros and cons of relying on the Intel Foundation to provide all TPD for the project?

Starting Slow: Enlaces

The launch and growth of the Enlaces program in Chile offers an example of successful lab installation and TPD in schools. Nationwide access developed gradually over the course of a decade. The project demonstrated success at both the *pilot* level and in several *mid-level* phases before funding to support participation by all Chilean schools was committed.

Initial implementation involved only five schools. During this pilot phase, both the technical and the pedagogical models were tested and refined. By 1994, 58 schools were included in the project. After refining its models for pedagogy and TPD, *Enlaces* began more rapid expansion in 1996, as shown in Figure 2.

In 2001 *Enlaces* launched a Web-based portal to replace *La Plaza* in most schools. The new *Educar* portal (http://www.educarchile.cl) gives students and teachers access to a wider range of more sophisticated learning resources, and includes separate areas for families, school administrators, and researchers.

The gradual expansion of *Enlaces* enabled the program to develop TPD capacity to keep pace with the addition of schools.

Focus on Primary Schools: Omar Dengo Foundation

Expansion of the nationwide *Programa de Informática Educativa* (PIE) program in Costa Rica also demonstrates a gradual approach and reliance on a proven model. However, with fewer primary schools and fewer barriers of geography or demographics, the growth of the PIE program is relatively constant—arriving at 90 percent coverage through gradual increases in the number of schools served. (The substantial leap in 1998 resulted from expansion to 116 regular primary schools plus the launch of a new program to serve 69 rural one-teacher multigrade schools.)

The program's small scale, relative to the size of the *Enlaces* program, allows specialists at the Omar Dengo Foundation to meet all requirements for TPD.

FIGURE 3: GROWTH IN NUMBER OF SCHOOLS PARTICIPATING IN THE PIE PROJECT
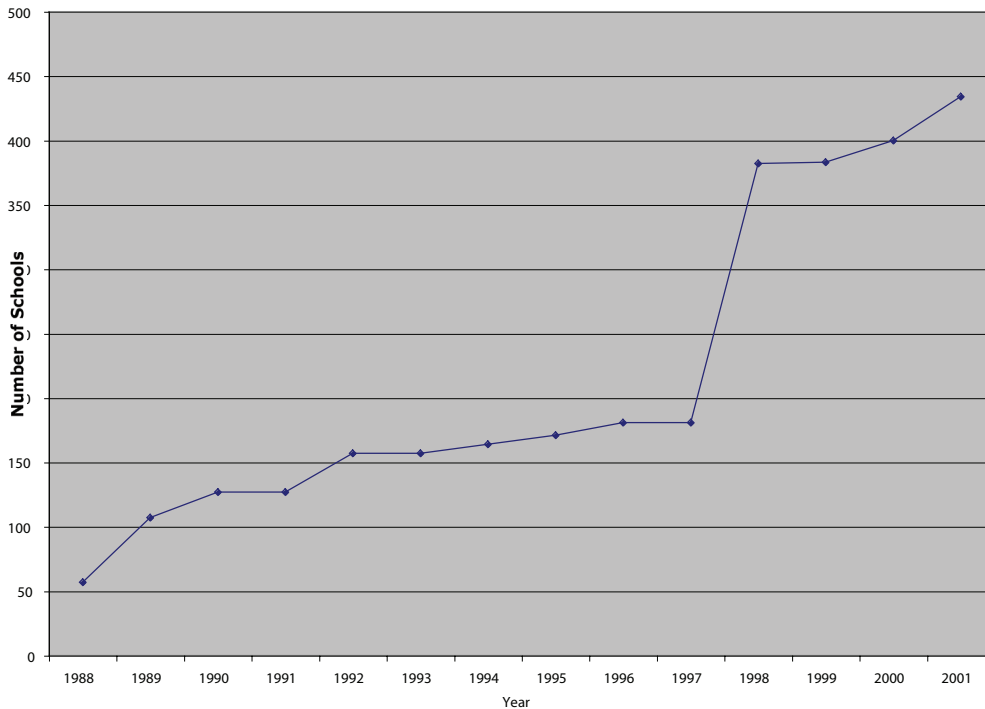
The PIE program focuses on "continuous" TPD through three complementary modes:

■ Yearly TPD sessions for all teachers
■ Mentoring and self-assessment
■ Bi-annual national conferences

Pedagogy focuses on project-based learning: Student "researchers" at different schools and in different grades work together in teams to create reports, databases, charts, spreadsheets, concept maps, and other "artifacts" generated by the research process.

Question for Further Discussion

Both *Enlaces* and the PIE program are noteworthy—and rare—examples of successful nationwide projects in educational computing. Both projects began with significant efforts in primary schools.
■ What advantages do educational-computing projects in primary schools have over projects in secondary schools? What disadvantages?
■ What ramifications do primary-school computer projects have for TPD? How might those ramifications be addressed?
■ What skills and knowledge should be addressed by TPD to enable teachers to implement project-based learning effectively?

COMPUTERS AND THE INTERNET IN TPD AT A GLANCE

Roles in TPD & education

- Provide productivity tools to write reports, make presentations, communicate, design animations, build Web sites, etc.
- Provide access to guided TPD resources and collaborative environments, and enable the creation of online communities of practice
- Enable acquisition of basic computer skills (ICDL), design skills (e.g., Web pages), programming, and hardware maintenance and repair
- Provide tools (e.g., spreadsheets, databases) that promote higher-order thinking

Strengths

- Flexible and powerful—can be used to develop materials, access resources, and communicate
- Multiple media and platforms combine text, audio, video, animation, and interactivity
- Centralized and decentralized communication supports dissemination of resources and essential feedback from schools
- May enable learner-centered and active-learning pedagogies
- Enable communication with experts—including TPD mentors, master teachers, and help desks
- Improve subject mastery through Computer-Assisted Instruction (CAI), simulations, and other tools
- Provide support for collaboration—individuals, pairs, and groups of teachers or students can use computers to collaborate online and face-to-face
- Support assessment and recordkeeping—accredited ODL courses, electronic portfolios, etc.
- Potential for revision and new versions supports reflection, self-assessment, and other learning-related activities

Limitations

- Complex tools require both time and TPD to be effective
- Hardware, software, and operating-systems are fragile—subject to damage by users, viruses, fluctuating electrical power, etc.
- Hardware and software lose value and utility as they age—corporate and institutional users plan on 3 years of service
- Highly dependent on infrastructure—electrical, telecommunications, road (for repairs), and human (for maintenance and management)
- Without support from leadership and system-wide commitment to new modes of teaching and learning, impact is limited

Cost profile

- Variable production costs—new software tools (e.g., Flash, Director, etc.) drive down production costs of digital content
- Variable content-distribution costs are contingent on Internet connectivity and resource format
- Significant installation, maintenance, and repair costs
- Total Cost of Ownership (TCO) model mandates periodic upgrades
- May contribute to overall e-Readiness

Other considerations

- Advances in wireless, VSAT, and other communications tools may increase Internet access
- Advances in hardware design may increase ruggedness and decrease power requirements
- Mobile devices (handheld computers, phones) have potential to change TPD-focused communications and access to resources
- Focus on tools may distract from curriculum-centered learning

WEB RESOURCES

■ *Connecting Student Learning and Technology*
Computers are not inherently instructional tools, and most teachers need suggestions for using them. This guide provides such suggestions. It is not a nuts-and-bolts manual, but a discussion about using technology in environments that support learning, offering suggestions for using computers as instructional tools in environments that support learner-centered approaches. Educational computing use is examined by application (word processing, spreadsheets, etc.).
http://www.sedl.org/pubs/tec26/flash.html

■ *Technologies for Education: Potentials, Parameters and Prospects*
A joint effort of UNESCO and the Academy for Education Development (AED), this document provides a comprehensive and informative compendium of information on the range of issues associated with computers in education—from policy, to hardware and software provision, content and teacher training.
http://www.aed.org/ToolsandPublications/upload/TechEdBook.pdf

SECTION 5
TECHNOLOGIES
FOR TEACHER PROFESSIONAL
DEVELOPMENT—RADIO

GUIDING QUESTIONS

- Which of our TPD needs or goals can be met through the use of radio broadcasts?
- To what extent does our country have access to the skills and facilities needed to produce programming in these media? How extensive and reliable is the relevant infrastructure?
- How are these technologies currently used in our schools and communities? How could these programs be improved or complemented by additional programs in TPD?
- What methods and what content are appropriate to meet our TPD objectives?

IN THIS SECTION

- Interactive Radio Instruction
- Sous le Fromager: Dual-audience Direct Instruction
- Educational impact of IRI
- Cost Considerations
- Pas à Pas: Top-down Radio-based TPD
- Strategic Considerations
- New Radio and Audio Tools
- Web Resources

SUMMARY

Radio is the most widely used communications technology in many of the poorest countries of the world. The cost of a radio receiver is low enough to be afforded by most communities and many individual families. Battery-operated and hand-cranked radios can operate without grid-based electrical power, and in school systems where skilled teachers are in short supply, radio can improve student learning while helping teachers gain skills and confidence. Radio is best used as a tool to guide whole-class participation and to provide teachers with hands-on experience in specific pedagogies.

Over the past three decades, education systems and donor agencies have advanced radio-based instruction beyond simple rote learning. Interactive Radio Instruction (IRI) comprises a body of techniques and content that has been shaped by research and by education policy to support active engagement of students and teachers. IRI has demonstrated positive impact on many EFA-related indicators, such as promotion, attendance, and dropout rates, and has been used to improve the quality of education for large numbers of students in the absence of qualified teachers. IRI has led to improved post-test performance by students and increased motivation on the part of teachers.

With high start-up costs and moderate recurring costs, radio projects are good candidates for donor support. But radio-based education can be disrupted by outside political and economic forces—such as re-allocation of specific radio frequencies—and by the need to fund broadcasts, replace radios and batteries in schools, and develop new course materials to avoid dissatisfaction on the part of teachers and students. In addition, radio tends to reinforce rote learning and linear, one-size-fits-all approaches.

INTERACTIVE RADIO INSTRUCTION

Since the mid-1970s, radio has helped teach basic skills to millions of students in developing countries. Typically, radio is deployed to improve the quality of education for large numbers of students when a school system faces a shortage of skilled teachers.

In some instances, such as the *Pas à Pas* series in Guinea, radio programming is developed specifically for teachers. In other instances, IRI programs—including the Guinean program *Sous le Fromager*—focus on student learning but also give teachers hands-on practice.

Radio for TPD is best used to enhance teachers' *basic* skills.

Interactive Radio Instruction (IRI) is a set of pedagogical practices that has been developed through over 30 years of fieldwork and research. IRI has evolved to include—at its best—group and pair work by students, guided inquiry, play-based learning, and other activities. Regular IRI broadcasts offer curriculum developers the opportunity to scaffold instruction across a series of episodes and to model activities—such as short experiments using locally available materials—that can be completed by teachers and students between broadcasts.

Some IRI programs, such as the Guinean program *Sous le Fromager,* help students learn while also giving teachers direct instruction on how to teach. This approach, focusing on the needs of both students and teachers, is known as "dual audience direct instruction."

Educational Impact of IRI

IRI impact on student learning has been extensively evaluated. Programs in many countries have demonstrated improved post-test performance by students receiving radio instruction compared to control groups of students.[7] Studies have also shown that IRI can have positive effects on Universal Primary Completion indicators such as promotion, attendance, dropout and grade-repetition rates.

As noted, IRI programs often target teacher development in conjunction with student learning—either formally or as an indirect objective. Anecdotal evidence of impact is strong, with teachers in many programs stating that IRI has increased their motivation, enabled them to overcome embarrassment at their lack of subject mastery, and changed their approaches to teaching and learning. However, quantitative evidence of change in teacher practice as a result of IRI has not been generated.

Cost for initial development of IRI programming is often high. Production costs may be augmented by costs for supporting printed materials, TPD, ongoing program management, and evaluation. Effective IRI also requires a commitment to advanced research and formative evaluation to ensure that programs are engaging and that they lead to enhanced learning.

Recurrent costs typically include airtime, batteries, radios or cassette players, and tapes for schools. Other common recurrent costs include print production, print distribution, and teacher development. (Some programs publish IRI classroom materials in newspapers to reduce printing costs.)

The financial appeal of the IRI model is based on dramatic reductions in the cost per student as programs increase their geographic coverage and as they are re-broadcast:

7 As an example of the gains reported, students receiving *English in Action* instruction through South Africa's Open Learning Systems Education Trust (OLSET) showed improvements in post-test scores that increased based on the number of lessons students had received: students receiving fewer than 33 lessons averaged 6.7 percent gains; students receiving between 34 and 66 lessons averaged 13 percent gains, and; students receiving more than 66 lessons averaged 24 percent gains. However, it is critical to note that basing overall educational strategies on the results of closed post-tests may not factor in bias in testing.

SOUS LE FROMAGER: DUAL-AUDIENCE DIRECT INSTRUCTION

The Guinean project *Sous le Fromager*—funded by USAID and administered by Education Development Center (EDC) and the *Institut National de Recherche et Action Pédagogique* (INRAP)—was a cornerstone in the Fundamental Quality in Education Level (FQEL) project (1998-2005). *Sous le Fromager* directs teachers to lead the class through specific actions that require students to respond verbally or physically.

The program, broadcast over the course of 122 weeks, reached 25,000 classrooms—60 to 70 percent of the total primary school audience in Guinea. In addition to actual programming, teachers receive instructional materials and detailed teacher guides to assist them in preparing for and carrying out activities. Teacher guides used text and drawings to help teachers know what to do before, during and after a radio broadcast.

Sous le Fromager was originally created as a tool to improve student learning in French, math, and science. However, the popular radio program evolved into an effective tool for TPD. The project has reported that teachers increased their use of active-learning instructional methods and improved their subject knowledge. Engaging teachers as "co-learners" alongside students, and at the same time influencing teachers' classroom practices, *Sous le Fromager* is an excellent example of dual-audience direct-instruction TPD.

- *Mental Arithmetic: The Numbers Family,* a program launched in Honduras in 1986, reported Year One costs per student of US$2.94, based on 200,000 students and the inclusion of production costs and materials-development costs.
- Costs per student for *Mental Arithmetic* fell sharply in subsequent years to US$1.01.

Recurrent costs per student tend to remain stable over the life of an IRI program.

For IRI projects with TPD as their primary focus, however, reductions in per-unit costs will be more limited, based on smaller target populations. For TPD and other small-audience projects, developers should consider reusing or adapting proven TPD-focused IRI materials from other countries if they are available, to avoid materials development costs.

PAS À PAS: TOP-DOWN RADIO-BASED TPD

Pas à Pas is a weekly radio broadcast designed to help primary teachers increase their *knowledge of good instruction and assessment*. Unlike *Sous le Fromager*, which is entertaining, multimodal, and an example of IRI, the *Pas à Pas* program is more didactic and less interactive. *Pas à Pas* is not an example of IRI.

The 30-minute program offers a simulated teaching episode after which the "teacher" is interviewed about his/her use of instructional strategies, formative assessment, etc. Compared to *Sous le Fromager, Pas à Pas* listenership is low—30 percent—in part because it is broadcast on Thursday afternoons, when teachers are out of school for professional development activities, but which, in many Guinean communities, is market time.

Questions for Further Discussion

The Guinean program *Sous le Fromager* achieves impact among teachers as well as students, even though it was primarily designed to improve the quality of student learning. The Guinean TPD program, *Pas à Pas,* focuses on teachers exclusively, and is much less successful.

- *Sous le Fromager* unintentionally resulted in improved practices among teachers. In designing a complementary TPD program to consolidate the teachers' gains from *Sous le Fromager,* what would be the program objectives?
- In the case of TPD radio programming such as *Pas à Pas*, in which teachers are addressed directly, how could it be structured differently to make it more effective?

Strategic Considerations

Among the factors to be considered in relation to IRI are three that affect sustainability:
- **Recurrent costs**
  Broad estimates by World Bank researchers have determined that recurrent costs of small-scale IRI

programs average 17 percent of total per-student spending in countries such as Ethiopia, Chad, Mali, and Lesotho.[8] Total per-student spending may include teacher salaries, facilities maintenance, textbooks, and other items included in school operating costs. Seventeen percent of total per-student expenditures, then, may represent all funds available for educational improvement.

- **Limited listening time**
  The use of IRI is generally limited to brief periods during the school day (or outside the school day for teachers). Teachers and school-based resources—whether local materials, textbooks, library books, or computers and CDs—may remain the primary means of student learning throughout the school day.
- **Challenges to large-scale projects**
  With high production costs and relatively low recurrent costs, IRI lends itself to donor funding. But often IRI production is completed through a university or NGO, or under international contract. Ministry personnel may not build capacity to produce IRI, and may have little motivation to allocate funds necessary to continue broadcasting. For these reasons, IRI is often piloted successfully but not taken to scale.

To achieve IRI programming which is successful, sustainable, and taken to scale, development and implementation of IRI planning should be coordinated with other critical components of educational improvement, including teacher development and curriculum change.

New Radio and Audio Tools

To ensure that IRI reaches students in geographically remote areas, lessons can be recorded on cassette tape and provided to schools. Recorded lessons also give schools and teachers the ability to schedule and replay lessons conveniently.

Many other technologies are emerging with the potential to increase the impact of IRI. These include:

- **Hand-cranked radios**
  Radios with hand-cranked generators and rechargeable batteries extend the reach of radio broadcasting to areas without electrical power. The Freeplay Foundation has developed the Lifeline Radio, combining both solar and wind-up power generation; thousands have been distributed throughout Africa as a result of private and foundation contributions.
- **Digital audio**
  The ability to record in digital files enables sounds to be recorded on many different devices, and to be easily stored, edited, and distributed. Digital audio files can be downloaded via the Internet (through podcasts) or shared via email.
- **Audio compression (MP3, etc.)**
  Audio compression technologies strip inaudible frequencies out of digital audio files to create files of much smaller size. Compression renders audio files more suitable for delivery over the Internet—via audio streaming—or, via Multimedia Message Service (MMS), to mobile telephones.
- **Digital radio**
  Digital radio, or Digital Audio Broadcasting (DAB), has the potential to increase access to radio signals, lower airtime costs, and expand the services that radio provides. Digital radio signals may carry any binary-encoded data, which means that digital radios can transmit multimedia information via download to computers.

Consider Using Radio to Support TPD When…

Minimum capacity and infrastructure requirements for other technologies cannot be met.

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8 The lower-income countries with IRI programs had a mean per-capita GNP of US$390 in 1993. The calculation of 17 percent of total per-student spending is based on small-scale IRI programs of less than 100,000 students per year. Average recurrent costs were estimated to be 6 percent of total per-student spending.

Problems to be addressed include:

■ Lack of qualified teachers means that classes are conducted by para-teachers, volunteers or others
■ Teachers lack basic skills in the language of instruction, math, or other subjects
■ Teachers lack knowledge of instructional practices
■ Students are failing to gain basic skills

TPD objectives include:

■ Developing teachers' (and students') basic skills and knowledge of core subjects
■ Improving teachers' abilities to manage whole-class instruction
■ Increasing teachers' use of simple interactive pedagogies such as questioning strategies
■ Increasing teachers' motivation, confidence, and/or enthusiasm for teaching

WEB RESOURCES

■ *Interactive Radio Instruction: Impact, Sustainability, and Future Directions*
Edited by Alan Dock and John Helwig, this 1999 publication, part of the World Bank's Education and Technology series, contains seven reports, including detailed analysis of costs of IRI programs and case studies from six countries in Africa.
http://www-wds.worldbank.org
(use Advanced Search by author "Dock")

■ *Interactive Radio Instruction: Twenty-three Years of Improving Educational Quality*
A 1997 analysis by Andrea Bosch of Education Development Center, this study outlines the strengths of IRI in relation to the challenges of infrastructure and educational quality that confront developing countries, with information about South Africa's OLSET project.
http://www-wds.worldbank.org
(use Advanced Search by author "Bosch")

RADIO IN TPD AT A GLANCE

Roles in TPD & education	Strengths	Limitations	Cost profile	Other considerations
• Addresses shortages of trained teachers • Provides instruction to hard-to-reach, displaced, or home-bound populations • Provides basic-skills instruction—math, health, language-of-instruction (English, French, etc.) • Promotes teacher development primarily via demonstration, guided and hands-on classroom management, and building subject knowledge • Can lead to improvements in basic skills	• Proven curricula in basic math, language arts, health, Early Childhood Care and Development (ECCD) • May be implemented with or without textbooks and other resources • Potential to reach large student populations • Lack of literacy skills not a barrier • Addresses equity and access issues (gender, ethnic, rural) • Can combine hands-on development of teacher skills with student learning • Audio learning may support visualization and concept-building by learners • Enables instructional continuity across grades and subjects • Durable, survives extreme environments and long-term use with minimal care • Moderate infrastructure requirements • Low technical-support requirements	• Value of content may degrade over time—long-running programs must evolve with schools and education systems • Broadcast airwaves are subject to political and economic events • Tendency to reinforce rote learning models— interactivity and attention to needs of individual learners are limited • Fixed broadcast schedule • Linear, one-size-fits-all approach • Risk of student and teacher dissatisfaction—including boredom, especially when lessons are broadcast daily • Hardware-replacement programs are necessary: Radios and batteries may be borrowed indefinitely or stolen	• High to moderate content-development costs • Startup includes cost of radios, cassette players, tapes, batteries, as well as development of materials • Per-student recurrent costs of large-scale programs are very low • Funding may combine contributions from ministries of communication, broadcast authorities, private radio networks, parents' groups, and others • Low recurrent cost has not ensured sustainability • Advance research and	• formative evaluation are essential for success • Impact is increased by teacher development, printed materials, school site visits and other means • May incorporate songs, use of real-world objectives (e.g., pebbles or beans as math manipulatives), in-class experiments, pair and group work and other active learning elements • Limited quantitative evidence of impact on teacher development • Can be used in combination with other technologies, such as video or "pod-casting"—teachers may adopt radio-delivered classroom practices when they see examples on video

SECTION 6
TECHNOLOGIES
FOR TEACHER PROFESSIONAL
DEVELOPMENT—TELEVISION

GUIDING QUESTIONS

- Which of our TPD needs or goals can be met through the use of television broadcasts?
- To what extent does our country have access to the skills and facilities needed to produce programming in this medium? How extensive and reliable is the relevant infrastructure?
- How are these technologies currently used in our schools and communities? How could these programs be improved or complemented by additional programs in TPD?
- What methods and what content are appropriate to meet our TPD objectives?

IN THIS SECTION

- Television for TPD
- Mexico's *Telesecundaria* Junior-secondary Curriculum
- Brazil's Television for TPD
- Educational Impact
- Cost Considerations

SUMMARY

Television has been employed successfully in several of the largest developing countries, including Mexico, Brazil, and China. Television's strengths include the power to engage viewers, to present conceptual information visually, and to show real people and environments from throughout the world. Television can support TPD by giving teachers opportunities to observe other teachers as they implement new instructional practices. By enabling teachers to anticipate what will happen, television reduces the risk inherent in experimentation.

Mexico's *Telesecundaria* program is designed specifically to provide year-round curricula to rural junior-secondary schools, enabling college graduates with no training as teachers to guide students toward successful completion by supplementing educational programming with in-class discussion, lessons, and assessments.

With high production costs *and* high recurrent costs for broadcast airtime, television is most cost-effective when it is used to support large-scale projects. *Telesecundaria* reaches 1.2 million students each year, and over the course of its 30-year history has achieved respectable results: completion rates by *Telesecundaria* students are similar to those of students in regular schools; students' performance on exams is slightly lower than that of students' in regular schools.

In Brazil, both private- and public-sector channels carry educational programming that addresses vocational training, social issues such as HIV/AIDS prevention, and ways to improve classroom instruction. *Salto para o futuro,* broadcast by the government to address TPD, is watched by roughly 200,000 Brazilian primary and secondary teachers. The program's goal is to guide teachers in instructional change, but results are mixed.

Without close connection to the concerns of teachers and support at the school level, TPD-focused television is more appropriate as a means to improve existing teaching and learning rather than a means to effect substantial change.

TELEVISION FOR TPD

Mexico, Brazil, and China have been among the leaders in the use of broadcast television for instruction in developing countries. Of these, programs in Mexico and Brazil are profiled.

Three main factors define the strengths and limitations of educational television:
- Powerful combinations of images and information
- High production and recurrent costs
- Highly skilled personnel

As a tool for TPD, television is often used to show teachers real teacher-student interactions in the classroom, enabling them to observe the management of learning activities. In this area, the uses of television and radio for TPD can be contrasted: whereas television *shows* teachers images of teachers and students in action, radio often is used to *guide* teachers through scripted activities.

Mexico's Telesecundaria Junior-secondary Curriculum

Started in 1968 to address the shortage of teachers in rural schools, *Telesecundaria* today reaches over 1.2 million students in 16,500 schools serving grades 7 through 9—over 15 percent of total enrolment in junior secondary school.

Teacher shortages hit secondary schools especially hard, because secondary teachers are required to master advanced knowledge of one subject—typically language arts, science, math, or social studies. Addressing this challenge by broadcasting educational programming throughout the school day, *Telesecundaria* enables a single teacher to teach all subjects effectively.

Every day in *Telesecundaria* classrooms, students:
- Watch 15-minute lessons on television, then
- Take part in 35-minute follow-up activities guided by their teachers
- Complete assessments of their learning

The curriculum is focused on community-based concerns such as pollution, water issues or hygiene. Class size in Telescecundaria classrooms averages 22 students while that of regular junior-secondary schools is 35 students.

Teachers also participate in one-week pre-service trainings and in ongoing in-service workshops that build mastery of the curriculum and lead to improved teaching practice. The *Telesecundaria* broadcasts provide critical support for students and teachers in small rural schools.

Brazil's Television for TPD

Both private-sector and public-sector channels offer educational programming in Brazil. The best-known channel, *Canal futura,* is funded by a consortium of Brazilian and multi-national corporations and operated by *Globo,* the world's fourth-largest television broadcasting company. *Canal Futura* offers over 20 educational programs. One of *Canal Futura's* first education programs, *A-Plus,* was intended for teachers.

The success of *Canal futura's* education programming is based on scale. *A-Plus* was originally intended for teachers, but over time it expanded its programming to reach 13 million viewers; the Brazilian education system employs only two million teachers.

In 1996, the national Ministry of Education launched its own channel, *TV Escola* ("School TV"), broadcasting programs via satellite on TPD and student learning. The *TV Escola* program *Salto para o futuro* marked its 10th anniversary of daily broadcasting in 2005. The hour-long program presents a debate among three experts in education focused on issues in education theory and practice. Debates—a very low-cost format—are supplemented by short video clips that show practices and learning activities in action in real classrooms.

Teachers often view *Salto para o futuro* in groups at their school. The program is interactive: During the broadcast, teachers send questions, ideas, and opinions to the panel via fax, email, and telephone.

Educational Impact

The *Telesecundaria* and *TV Escola* channels are both operated by their national governments independently of commercial broadcasting. For this reason, programming can address audiences of students or teachers that are much too small for commercial broadcasters: *Telesecundaria* reaches 16,500 schools, 50,000 teachers, and 1.2 million students, and *Salto para o futuro* reaches roughly 200,000, or 10 percent, of Brazil's primary and secondary teachers per year. *Telesecundaria* has reported the following results:

- **Completion rates equal to students in regular schools**
  73 percent of students enrolling in grade 7 at a *Telesecundaria* complete grade 9, a completion rate that is 5 percent lower than students in regular secondary schools. This difference is not statistically significant.
- **Student achievement lower than that of students in regular schools**
  62 percent of *Telesecundaria* students pass grade 9 reading exams, while 40 percent pass grade 9 math. Pass rates for students in regular schools are 76 percent and 50 percent.

Telesecundarias serve rural areas, populated by poor families in which youth often work. In this context, *Telesecundaria's* completion rate is impressive. To properly assess the *Telesecundaria* test scores, results would require adjustment for socio-economic status and other factors.

TV Escola: Salto para o futuro tries to use TPD-focused programming to influence teachers' classroom practices. Independent evaluation suggests that even though it incorporates interaction via fax, phone, and email, the program may not be connected closely to teachers' day-to-day concerns to be effective. Researchers suggest that for *Salto para o futuro* to be effective, "it must advance beyond making requests or suggestions to in-service teachers, to become linked to the educational life of the school, rather than to proposals imposed by the central office."[9]

Cost Considerations

Television production costs are high, and airtime is expensive. In 1998, production of a 15-minute *Telesecundaria* module cost between US$30,000 and US$50,000 and required about 20 days to complete. *Telesecundaria* re-uses its instructional programs, but still reports high recurrent costs:

- Recurrent costs, over half of which are teacher salaries, are three times greater than the annualized investment in video production.
- Costs per student, at more than US$500 per year, are 15 percent higher than in regular schools.
- Initial investment in program production (US$594 million) has been followed by recurring costs of US$425 million per year.

9 See Castro, A. M. (2002). Descentralização e Autonomia: Limites e Possibilidades de um Programa de Formação de Professores. Educação Online. Available: http://www.educacaoonline.pro.br/art_descentralizacao_e_autonomia.asp

Questions for Further Discussion

Supported by long-term commitment and resources, *Telesecundaria* has achieved substantial impact in educational access and improvement. However, questions can be raised about opportunity costs and program flexibility:

■ Over the course of the *Telesecundaria's* 30-year history, what other long-term capacity-building and educational-improvement measures might have been by-passed as a result of the financial and organizational commitment to television?

■ How can *Telesecundaria* take advantage of new developments in Internet access, video production and delivery, cut costing techniques and improvements in learning outcomes?

■ With a substantial investment in *Telesecundaria,* how might Mexico's secondary school program adapt as the country begins to emphasize computers and the Internet in schools?

Consider Using Television to Support TPD When…

Minimum capacity and infrastructure requirements can be met, including:

■ Stable electricity is supplied to 90 percent of the area targeted
■ Design, production, and other technical skills are available
■ Committed long-term funding is *at least* equal to initial start-up and production costs
■ Government or commercial broadcasting networks are available, with satellite broadcasting available if rural areas are involved

Problems to be addressed include:
■ A scarcity of qualified teachers, especially in rural areas
■ A large number of students who are are unschooled or receive inadequate teaching

Program objectives include:
■ Changing teaching and learning throughout the entire system
■ Increasing teachers' and students' access to rich educational content

WEB RESOURCE

■ *Providing Teacher Training through Educational Television: The China Experience*
Yidan Wang provides an overview of the context, history, and impact of China's use of in-service educational television to address the country's high numbers of unaccredited and under-skilled teachers.
http://pdf.dec.org/pdf_docs/PNACH453.pdf

TELEVISION IN TPD AT A GLANCE

Roles in TPD & education

- Addresses shortages of trained teachers
- Primary means of delivering content and concepts to students across the curriculum
- Development of teacher skills and knowledge
- Provides views of real classroom practices and learning activities
- Provides teachers with learning resources that show distant places, graphical representations of concepts, historical events, etc.

Strengths

- The medium is both powerful (moving images, audio, etc.) and familiar
- Can be used to "bring" viewers to the site of events and phenomena
- Observing demonstrations of classroom management and other teaching practices helps teachers implement new techniques effectively
- Potential to reach large populations of students and teachers
- Addresses equity and access issues—although access requires electrical power
- Supports instructional continuity across grades and subjects

Limitations

- Visual medium does not guide teacher through scripted, hands-on classroom activities—unlike radio, television promotes "watch and learn," not "do and learn"
- High development costs may limit testing, review, and revision before programming is launched
- Value of content may degrade over time—costs of revisions and new programming are high; visual images "show their age"
- Broadcast airwaves are subject to political and economic events
- Television production requires sophisticated skills and facilities
- Costs of production and airtime may influence programming to reach audiences outside of schools

Cost profile

- Fixed broadcast schedule—can be augmented by taping
- Limited by access to electrical power
- Hardware costs for reception (television, satellite dish, cabling) and power generation may be too high for poor communities and schools   High production costs—often US$ 1,000 per minute
- Commercial broadcast rates are very high
- Local installation includes cost of television, satellite dish (in rural locations)

Other considerations

- Per-student recurrent costs of large-scale programs are low—but low recurrent costs have not ensured sustainability
- Funding may combine contributions from ministries of communication, broadcast authorities, commercial broadcasters, and others   Lack of interactivity can be addressed through a range of affordable technologies—fax, email, telephone "call-in" formats—and by incorporating wait time, discussion questions, and facilitator directions into programming
- Impact is increased by teacher development, printed materials, school site visits and other means
- Limited quantitative evidence of impact on teacher development

SECTION 7
TECHNOLOGIES FOR TEACHER PROFESSIONAL DEVELOPMENT—VIDEO RECORDING AND PLAYBACK

GUIDING QUESTIONS

- What professional-development goals will video help us address?
- What existing or planned programs for education improvement could benefit from video-supported TPD?
- What organizational structures, such as school clusters or district offices, can assist with sharing and use of video equipment?
- To what extent does limited infrastructure, especially electrical power, pose a challenge? How might this challenge be overcome?
- If real gains in terms of teaching can be achieved through the introduction of video, what is the estimated addition to the cost per teacher trained?

IN THIS SECTION

- Video Recording and Playback for TPD
- Video for Observation and Self-Assessment
- Video Support for Teacher Change in Congo
- New Video Tools
- Strategic Considerations
- Web Resource

SUMMARY

This section addresses the use of video recording and playback tools to support TPD, specifically in helping teachers improve their instructional techniques. Video tools have been used effectively in many schools to support *on-site* TPD efforts and follow-up to *standardized* TPD.

Teachers who are asked to try new instructional techniques benefit when they see other teachers using those same techniques. They also benefit from opportunities to review and assess their own classroom practices. Video recording and playback tools enable both of these activities. For these reasons, video recording and playback offer powerful support for on-site TPD methods.

The cost of digital video tools has fallen dramatically and continues to fall, while their robustness and versatility has increased, making them suitable for use in low-infrastructure environments. Video tools can be shared among classrooms or schools. Ministries and schools can create their own libraries of best-practice classroom videos for circulation and sharing.

Key considerations for success in the deployment of video tools for recording and playback center on integrating their use into existing programs of site-based TPD or follow up, and in identifying new opportunities to support teaching and learning to increase the value and cost-effectiveness of these tools.

Video recording and playback tools are best used to improve teachers' *intermediate* or *advanced* skills.

VIDEO RECORDING AND PLAYBACK FOR TPD[10]

Teachers benefit when they see other teachers work in new ways. When they see a teacher helping six or seven small groups of students, or using questions that prompt intense reflection and statements of opinion rather than half-hearted right answers, they understand such practices better. The risk in experimenting—the risk of the unknown—is reduced.

Whether it is used to support students or teachers, recorded video offers advantages that include reuse and schools' control of the schedule. In addition, teachers (or students) can control the rate of presentation (freeze-frame, play, rewind, etc.), enabling viewing to be interspersed with discussion or specific sequences to be repeated.

Video for Observation and Self Assessment

Video segments of classroom activities are commonly used to enable teachers to watch expert teachers and also observe their own experiments with new instructional methods.

Video of classroom practices can be acquired from many universities and private-sector companies, often via Internet download. Such videos are designed to achieve specific objectives in specific contexts, however, and may not be appropriate for use in developing-country school systems.

Giving teachers the opportunity to assess their own classroom practices is another effective use of video. The Basic Education Support 2 program in Namibia tasked circuit inspectors with videotaping teachers' classrooms to enable observation, assessment, and sharing of case studies.

In sub-Saharan Africa and other regions, video has been used effectively to aid teachers grappling with new teaching modes. In 1996, schools in Lesotho demonstrated techniques for including disabled students in regular classes in a video series produced by Save the Children. The series of 13 tapes, each

SHARING CLASSROOM PRACTICE

Two-way radio, video, and other communication technologies can bring isolated teachers into conversations with a larger community, which can be important if there is a strong guiding structure that ensures that discussion is productive and focused.... And there are lots of ways that visual and text-based technologies can help capture and disseminate complex-but-concrete images of teacher practice or student learning processes, which can then become the basis of discussion and analysis.... But the technology does not do much to ensure that trainers with real expertise are leading the resulting discussions.

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STRATÉGIES INTÉGRÉES POUR UNE EDUCATION EQUITABLE ET DE QUALITÉ: VIDEO SUPPORT FOR TEACHER CHANGE IN CONGO

The *Stratégies Intégrées pour une Education Equitable et de Qualité*[11] (SIEEQ) project in the Democratic Republic of Congo uses video to support teacher development in workshops and to provide follow-up support for teachers once they have returned to their schools.

Video is the lynchpin technology for improving teachers' classroom practices. Initial work with Congolese teachers in their own classrooms is videotaped and edited by project personnel to create a DVD for use in professional development workshops. The 720 teachers targeted by the project observe specific pedagogies by their peers and colleagues, and compare those pedagogical techniques with their own practices.

SIEEQ also uses video as part of a program of intensive follow-up support for teachers. When an SIEEQ team travels to a project school, they bring a digital video camcorder and a laptop—often charging the batteries using a car-based inverter. They film teachers working with students, upload the video to the laptop, and share the video with the teachers, using it as a basis for encouragement and constructive suggestions.

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10 Audio recording and playback tools can also be used effectively in the classroom. Primary uses include playback of IRI lessons, whether these are recorded by ministries of education to provide access to schools outside of radio broadcast "footprints" or by schools themselves to enable re-use. In addition, educational organizations, such as the National Education Computing Conference (NECC), make available for purchase audio recordings of sessions from their conferences.
11 The SIEEQ project has the following implementing partners: Education Development Center (EDC); The Academy for Educational Development (AED); Intercultural Center for Research in Education; International Foundation for Education and Self-Help; The Mitchell Group. Information about the project was provided via telephone interview, August 15, 2005, with Stephanie Foerster, Communications Manager, International Education Systems Division and Kanjit Hailu, Program Assistant, of the International Education Systems Division at EDC.

about 15 minutes long, guides teachers through identifying physical and cognitive disabilities, helping children overcome them, and ensuring that the classroom remains a safe, equitable, and welcoming environment.

New Video Tools

Consumer-level video playback and recording hardware, as well as video camcorders, have been available for several decades. Cost considerations, as a result, vary widely according to project requirements and local availability.

Innovation in the arena of digital video may significantly increase the usefulness of video for professional development in developing countries. Digital recordings of video can be compressed, transmitted over the Internet, via digital radio, or via telephone, and can be edited in computer workstations.

- **Digital video**
  The ability to record video in digital files enables recording, editing, and storage on computers and other devices, as well as transmission via the Internet and other networks.
- **Video compression (MPEG 4, etc.)**
  Video compression reduces the amount of data required to render images and motion, facilitating storage on DVDs or hard drives and transmission via the Internet.
- **DVD**
  DVD technologies enable several hours of video to be stored in a durable medium that can be played on computers with DVD drives or on standalone DVD players. Some computers also "burn" or write DVDs.
- **Portable media devices**
  Powered by rechargeable batteries, portable DVD players (including those found on laptop computers) and others types of portable media devices (including video iPods) can provide video to schools with limited or no electrical power.
- **Digital video camcorders, digital camers, webcams and mobile phone cameras**
  Digital camcorders (below US$500 at present) enable video to be uploaded to computers for editing or transmission via the Internet. (Lower-priced 'webcams' produce video of lower quality.) Many still-photo digital cameras and some mobile phones now also shoot video—although quality is inferior.
- **Multimedia Messaging System (MMS)**
  Evolved from SMS (or Short Messaging System), MMS enables mobile telephone users to share audio, video, and photos.

Strategic Considerations

Video recording and playback tools have not been used extensively to support TPD in developing countries. However, as a tool to strengthen site-based TPD, video has the potential to be effective. Strategic considerations revolve around several factors:

- **Support for site-based TPD**
  Video recording and playback tools are best seen as complements to site-based TPD or as follow-up to standardized TPD. Site-based TPD can provide the structured opportunities that teachers need in order to benefit from observing master teachers or their own efforts.
- **Managing access**
  Schools can share video production and playback tools. Such sharing can reinforce peer support and collaboration. Management and accountability mechanisms must be developed to minimize theft, misuse, and breakage.
- **Leveraging assets**
  DVD players can be used to show educational programming to students and can also be used for TPD. Video camcorders ear-marked for TPD can be loaned out to special student projects, such as creating video records of community elders.

In all of the above considerations, the key is to identify the *existing programs* that can benefit from video support, as well as other *near-term opportunities* for the use of these tools, and to then determine how use of these tools can be allocated and managed most effectively.

Consider Using Video Recording and Playback to Support TPD When…

Minimum capacity and infrastructure requirements can be met, including:
- Stable electricity is supplied to 70 percent of the schools targeted
- All hardware can be serviced within the country

Existing TPD efforts include:
- Site-based programs such as Mentoring, Lesson Study, or Open Lessons
- Standardized programs that include, or will include, site-based follow up

Dissemination and delivery, if planned, can include:
- Delivery of video cassettes or DVDs by postal or other means
- Network access to digital video via the Internet, digital radio, or MMS

Appropriate content is available, such as:
- Locally produced video
- Foreign-produced video that shows teachers and classroom environments with which your teachers can identify

Professional development addresses objectives such as:
- Enhancing or changing the ways teachers manage classroom activities, such as small group work or whole-class discussion
- Providing teachers and students with powerful visual resources for learning

WEB RESOURCE

- *Active Learning with Technology Video Series*
  Developed by Southwest Educational Development Laboratory, this series of ten videos provides examples of effective uses of technology in classroom instruction. The first two episodes in this series provide an overview of the role of technology in supporting student-centered learning. The other eight classroom episodes depict students and educators engaged with technology as part of innovative project-based activities. The technologies and instructional strategies employed are highly adaptable to other content areas and grades.
  http://www.sedl.org/pubs/catalog/items/tec50.html

VIDEO RECORDING IN TPD AT A GLANCE

Roles in TPD & education

- Demonstrates new modes of teaching and learning through views of real classroom activities (Lesotho video package)
- Video recording of classes shows teachers their own interactions, habits, and progress toward effective teaching

  Teachers benefit from seeing other teachers in action

Strengths

- Teachers benefit from seeing themselves in action
- Video recordings can be used and re-used according to teachers' schedules
- Playback controls (rewind, freeze-frame, etc.) enable close analysis of specific events
- Video production tools can be used locally—in schools, by ministries, etc.
- Broadcast quality video is powerful (moving images, audio, etc.) and familiar
- Effective learning resource for teachers and students—can "bring" viewers to events and phenomena to support concept building, retention, etc

Limitations

- Value of content may degrade over time—costs of revisions and new programming are high; visual images "show their age"
- Video produced by foreign institutions may be ineffective—teachers may not identify with experiences shown outside recognizable contexts
- Poor roads, lack of rural electrical power and other challenges to distribution in LDCs may reinforce differences in education access

Cost profile

- Variable production costs—professional quality is high; cost of local (in-school) production can be low
- Initial cost of hardware per school is moderate
- Hardware costs are falling—including for digital video cameras, storage media (DVDs, hard drives), and players
- Distribution of video content to schools may entail low or moderate cost
- Potential reuse lowers recurrent costs of largescale programs
- Low-cost, professional-quality resources may be available from universities or foundations

Other considerations

- Advances in digital video may increase the value of video for TPD in LDCs—digital video cameras, portable DVD players
- New, powerful mobile phones can shoot low-resolution video clips
- Compression software (e.g., MPEG4, etc.) makes short videos available via CD-ROM and the Internet
- Easy-to-use editing tools enable moderate-quality video production by ministries, universities, and schools

SECTION 8
ONLINE DISTANCE LEARNING FOR TEACHER PROFESSIONAL DEVELOPMENT

GUIDING QUESTIONS

- How can the country's educational system best take advantage of the many international resources in online TPD?
- Are there educators in the country who are using computers and have the skills to benefit from online TPD courses?
- Which model—self-directed, online TPD courses, or online TPD communities—is most appropriate for the local situation?

SUMMARY

Online distance learning for TPD can be described by three models: self-directed online TPD, online courses for TPD, and online communities for TPD. Many web sites combine resources for self-directed learning with courses, and with discussions or other community functions.

All forms of online TPD require access to computers and an Internet connection, as well as the skills to use these. In addition, online TPD requires strong literacy and language skills. In general, online TPD may be most appropriate for *advanced* teachers or as a means of providing crucial follow-up support for face-to-face TPD.

MODES OF ONLINE TPD

The potential of online TPD lies in part with its ability to make multi-channel instruction—based on content and on interaction with peers and mentors—available to large numbers of students while enabling participants to remain employed. In addition, online TPD provides teachers, school leaders, and educational specialists access to TPD resources from top-tier institutions such as Harvard University.

Online-learning approaches to TPD using these tools can be grouped into three modes:
- Self-directed
- Online courses
- Online communities

These three categories are parallel to the three TPD models addressed in *Section 3: Models and Best Practices in Teacher Professional Development.*

However, boundaries between categories of online TPD are more fluid: A teacher may discover a course while at a teacher resource center (self-directed TPD), complete the online TPD course in six sessions, and after that sign up for the course's list-server discussion of classroom-management techniques.

Face-to-face vs. Online TPD

Face-to-face TPD—as discussed in *Section 3: Models and Best Practices in Teacher Professional Development*—enables teachers to work directly with expert guides, without barriers in relation to technology, writing skills, or cultural values. Face-to-face TPD is a very effective means of enabling teachers to model instructional techniques.

However, it may be limited by the scarcity of expert facilitators and expensive to implement in large-scale projects.

Online TPD relies on computers and the Internet to give teachers access to experts, mentors, and peers via email, chat, and the Web. Online TPD also makes TPD-related content, including certificate-based online TPD courses, available to teachers around the world.

Much current research suggests that face-to-face TPD is more effective than online TPD. However, as online TPD becomes more widely utilized, and as new modes and resources are developed, these results may change.

OPEN AND DISTANCE LEARNING

Distance learning, or distance education, frequently uses the postal service to distribute learning resources—including books, photocopies, tests, videos—and to receive materials sent by students, such as papers or completed tests. Computers and the Internet may be used as well.

"Open learning" provides students with choices about where the student is while taking the course, when the student studies, and how fast the course is completed. In many cases, open-learning institutions admit all students, rather than engaging in selective admissions processes.

The two terms are often combined as "open and distance learning," or ODL. Among the first ODL institutions was the University of South Africa, which has been offering ODL courses since 1946 and is now one of the largest universities in the world, with over 100,000 students.

SELF-DIRECTED ONLINE TPD

Self-directed online TPD ranges from preparing for a social studies class by reading newspapers on the Internet, to surfing the Web for lesson plans on plant biology, to upgrading skills in a self-paced basic-algebra tutorial.

Teachers with *advanced* skills will tend to be most successful in self-directed online TPD. Requirements include:
- Access to a computer connected to the Internet
- Beginning computer skills, especially search skills
- Advanced literacy skills
- Advanced skills in a language common on the Web
- Intermediate to advanced subject knowledge
- Advanced teaching skills

Although computer skills and access are necessary, the primary challenge for teachers is to make use of the resources that they encounter online. If a lesson plan on plant biology uses examples of trees in Canada, a teacher in Zimbabwe may be able to substitute local trees in ways that support the lesson. If a project involves "cooperative learning," and bases assessment on small-group interactions, without advanced skills that teacher may still implement the project poorly.

Commonwealth Electronic Network for Schools and Education

Online education portals help focus teachers' explorations and reduce trial and error. The Commonwealth Electronic Network for Schools and Education (http://www.col.org/cense - CENSE) presents technical-

support information, hundreds of online lesson plans, and lists of online TPD courses and resources that can be accessed by the slow Internet connections available to most teachers in developing countries.

Questions for Further Discussion

CENSE and other "clearinghouses" support online self-directed TPD once teachers are connected. Policymakers may be able to provide support that helps teachers access these resources

- Where do the teachers who already use the Internet go to connect (e.g., school labs, Internet cafes, etc.)?
- What will support teachers' use of these facilities?
- How can support be provided to teachers who use the Internet for self-directed TPD?

ONLINE TPD COURSES

Online TPD courses enable teachers to benefit from many of the world's great educational institutions and educators. However, to succeed a teacher must be prepared, have access to the Internet, time to devote to the course, and a reason to complete it.

Online courses, also known as "e-Learning" courses, are distinct from other Internet resources in that they typically involve:

- Enrolment in the course, and sometimes registration at the institution that offers the course
- Structured pathways through learning resources
- Periodic assessments
- Course completion requirements (e.g., exams, reports, lesson plans, etc.)

Such courses may also involve fees, especially if credit or certification is offered.

Online TPD Courses vary greatly in their structure and goals. Some online courses are "self-paced," while others are "instructor-led" or facilitated. Online courses can address specific curricula and groups of teachers, as in the Connect-ED TPD courses in Uganda. They can help teachers build understanding of general pedagogical concepts and techniques, as in the courses offered by Harvard University's WIDE World (http://wideworld.pz.harvard.edu/). Or they can help to build online professional development capacity, as with EdTech Leaders Online (*http://www.edtechleaders.org/*) which trains educators to facilitate online TPD and create their own online courses.

Connect-ED Uganda

The Connect-ED project in Uganda (http://*www.connected.ac.ug*) has developed six TPD courses for teachers enrolled in primary teacher training colleges. Each course is self-paced—meaning that students can progress at their own speed through the materials. Each course features 15 self-paced units of study,

downloadable reading materials, a glossary, and quizzes. Interactive materials in some units offer visual demonstrations of key concepts.

However, as discussed in *Section 4: Technologies for Teacher Professional Development—Computers and the Internet,* Connect-ED at present serves only a small fraction of Uganda's 39 teacher training colleges. The online courses are best viewed as supplements to face-to-face instruction: Although they have quizzes attached to the units, they do not feature enrolment functions, or assessments that determine course completion and content mastery.

WIDE World

WIDE World's interactive online courses (*http://wideworld.pz.harvard.edu*) cover math, reading and writing instruction, advanced instructional strategies, technology integration, and other topics. WIDE World courses are based on research by experts at the Harvard Graduate School of Education

Groups of ten teachers work together in teams to download course resources, participate in online discussions, post resources for others to use, and develop lesson plans. Each team is supported by an online coach.

Teachers from around the world have taken WIDE World courses. However, enrolment costs are relatively high, ranging from US$99 for a two-session course to US$399 for a six-session course.

Questions for Further Discussion

In many developing countries, conditions for primary and secondary teachers may not permit them to participate in online TPD courses. However, the pedagogical approaches such as those in WIDE World courses may be of value.

- What infrastructural and educational improvements are needed for teachers to participate in online TPD courses?
- Who in the school system currently has the capacity to benefit from online TPD courses?
- How can those participants capture and share their new knowledge in ways that contribute to education reform?

ONLINE TPD COMMUNITIES

As discussed in *Section 9: Implementing ICT-supported Teacher Professional Development,* teachers require interaction with colleagues and mentors if TPD is to be successful. Online communities of all types have emerged as effective and—when the technology has been in place—cost-effective solutions to teachers' needs for support.

Special-interest list servers, *ad hoc* Yahoo! groups, and Web-based chat, forums and discussions can enable teachers to:

- Develop lesson plans
- Plan online collaborative projects
- Discuss pedagogy, the school-as-workplace, and subjects such as science or literature
- Post experiences, lessons learned, or self-assessments
- Engage in peer mentoring

The benefits of these activities increase when teachers are also engaged in structured TPD programs.

iEARN

Established in 1988, iEARN (http://www.iearn.org) is a non-profit global network in which teachers and young people work together on projects that enhance learning and benefit society. iEARN has served as the starting point for integrating ICT into learning for thousands of teachers, most of whom have joined iEARN on their own initiative. iEARN offers resources in many languages, including Kiswahili and Arabic.

In addition to supporting collaborative projects, iEARN offers eight instructor-led TPD courses that help teachers enter into collaborative projects. Each nine-week course addresses a school subject, such as language arts, science, math, or the environment, or a topic such as helping students cope with traumatic events.

Each course brings together teachers from at least 10 countries, ensuring that teachers who complete the course have many opportunities to arrange international collaborative projects for their students. The TPD courses complement iEARN's function as an online "meeting place" for teachers interested in collaborative projects

Questions for Further Discussion

Teachers in many developing countries may lack sufficient computers and Internet access to participate in online TPD communities. They may also lack skills in computer use, communication, and teaching practice that are necessary for their success.

However, email lists, chat and other tools offer low-bandwidth support for smaller, locally focused online TPD communities.

- How many teachers currently have Internet access and computer skills?
- Are these teachers currently involved in TPD programs?
- How could those programs benefit from communication among participating teachers?
- What form (e-mail, SMS messaging) should community communication assume?

DEVELOPMENT VS. RECURRENT COSTS FOR ONLINE TPD

Connect-ED demonstrates the feasibility of developing interactive online-learning courseware in capacity-poor countries. Organizations in other countries have also developed effective online resources for TPD.

However, the costs of developing online TPD resources—whether a Web portal or a self-paced course—are typically much lower than recurrent costs. An email discussion list offers the perfect example: development costs are nearly zero; recurrent costs for a discussion moderator, discussion archiving, and outreach are higher. And as soon as recurrent costs aren't met, the discussion ends.

Online facilitation is both challenging and time consuming. Research shows that the time required to facilitate an online course is often greater than the time required to teach the same course face to face, because students communicate more frequently and in greater detail using email.

Consider Online TPD When...

Program objectives include:

- Enabling advanced teachers to improve their pedagogical knowledge and teaching practice
- Enabling large numbers of teachers to achieve certification via TPD courses
- Providing additional support to face-to-face TPD

Teachers' capacities include:
- Intermediate to advanced language, literacy, and communications skills
- Beginning to intermediate computer skills
- Intermediate to advanced pedagogical skills

Infrastructure includes:
- Computer access and Internet connectivity
- Stable electrical power

WEB RESOURCES

- *COL Learning Object Repository*
  An online database of learning content, this repository provides software for developing online resources to Commonwealth countries free of charge. Institutions or governments can establish a shared repository by accessing free open source software from COL's LOR.
  http://www.col.org/lor
- *COL Training Toolkits*
  In co-operation with the Asian Development Bank and the International Extension College in the UK, COL has produced six comprehensive manuals for use in developing programs of open and distance learning.
  http://www.col.org/training/toolkits.htm
- *Global Distance Education Net (GDENet)*
  The Global Distance EducationNet (Global DistEdNet) is a knowledge guide to distance education designed to help clients of the World Bank and others interested in using distance education for human development. The network consists of a core site located at the World Bank and regional sites in all parts of the world, addressing four key areas: Teaching and Learning; Management; Technology; Policy and Programs
  http://www1.worldbank.org/disted

ONLINE DISTANCE LEARNING IN TPD AT A GLANCE

Roles in TPD & education

- Provides teachers access to learning resources for use with students
- Peer mentoring and teacher communities support TPD initiatives
- Accredited TPD courses help teachers upgrade qualifications

Strengths

- Anytime, anyplace—in instances where connection is available
- Teachers can interact with expert teachers and others
- Written communication (email, discussion) can prompt more reflective and considered participation
- Supports a range of learning styles
- Potential to reach large populations of teachers

Limitations

- Dependent on regular access to computers and the Internet
- Teachers must have computer, language and literacy, and teaching skills to participate effectively
- Many self-paced online courses lack high-quality or interactive content—online materials merely replace print materials
- Internet content may be overwhelming—too much and too many choices
- Online mentoring may be less effective than face-to-face
- Multimedia and interactive course materials require high bandwidth and powerful hardware

Cost profile

- Effect of online TPD on classroom practice is unclear
- Low costs when teachers access free TPD sites and content (e.g., iEARN, CENSE)
- High costs when courses have fees (WIDE World)
- Moderate content development costs (online courses, portals, and communities)
- Operating costs for facilitated courses, portals, and communities are moderate

Other considerations

- In some countries, may best be used to build capacity among master teachers, mentors, and teacher-college faculty

SECTION 9
IMPLEMENTING ICT-SUPPORTED TEACHER PROFESSIONAL DEVELOPMENT

GUIDING QUESTIONS

- What supports are in place to help teachers successfully implement what they are learning in TPD? Which of the critical supports identified in this section could be addressed to improve project implementation?
- Which organizations within the education system, such as district offices, teacher training colleges, or universities, can provide follow-up support for TPD in schools?
- In what ways can existing ICT infrastructure, including mobile phones and radio, support follow-up for current or planned TPD?
- Is the technical-support capacity for ICT-enabled TPD located primarily in the private sector, in government, or in schools? How can that capacity be augmented?

IN THIS SECTION

- Teacher Incentives
- Supporting TPD in Schools
- Follow-up Support
- Follow-up and Communications
- Mobile Phones as Support Tools
- Support from School Leadership
- Support from the Community
- Community Support for IRI
- Technical Support
- Collaborative Support
- Infrastructural Support for TPD
- Web Resources

SUMMARY

Learning does not end at the conclusion of a workshop. Teachers need continuous support, including both assistance and pressure, to implement the skills and concepts learned in professional development. Such support should include incentives to participate in TPD and to institute new techniques as they are learned and must include human, technical, administrative and infrastructural resources.

However, schools cannot hope to provide such support on their own. They need adequate resources, and school leaders who understand the goals and challenges involved in change. When any of these supports is lacking and when support efforts are not coordinated, the entire investment in TPD is at risk.

The need for on-site support is especially critical in resource-poor environments. TPD programs for poor schools must be adapted to meet the conditions in schools, focusing *only* on the types of activities teachers are able to successfully carry out. But these schools, because their need is so great, must be provided with as many resources as feasible to succeed. Available infrastructure does not need to be "state of the art," but it must enable teachers to use prescribed TPD tools and resources effectively. And it is important to remember that any meaningful project in TPD will confront significant challenges. Incorporating ICT will address many of those challenges but will give rise to new ones.

This section outlines the most critical supports needed to implement and sustain ICT-enabled TPD goals at the school and classroom level. Additional information about understanding the change process and specific instructional methodologies that complement ICT use, and the types of computer hardware configurations that can best help teachers successfully integrate ICT into instruction, are detailed in the *Implementation Briefs that accompany this handbook.*

TEACHER INCENTIVES

To change their practices, teachers need support, pressure, and incentives. Both *intrinsic* and *extrinsic* incentives should be considered in the design of any TPD initiative.

Improved performance is an effective *intrinsic* incentive. Teachers will adopt an innovation when they see that it *adds value*, is *easy* to use, and when they are provided the *time and support* they need for *learning and practice.*

But self-motivation, without rewards for experimentation and innovation, is hard to sustain. Teachers, like students, need *extrinsic* incentives and motivation to persevere in the effort to improve their teaching. Extrinsic motivators can include:

- Stipends for TPD
- Promotion or job retention linked to TPD attendance, ICT use or innovative practices
- Accreditation or certification
- Access to new or additional educational resources
- Advancement through stages of additional TPD
- Micro-credit support for purchases of computers
- Merit-based pay instead of seniority-based pay (Malawi has made this change)
- Rewards and recognition by school leadership, parents' groups, and community leaders
- Compulsory participation in TPD

Every TPD project plan should address incentives and teacher motivation. A combination of intrinsic and extrinsic incentives helps teachers find satisfaction in learning while reaping tangible rewards for a job well done.

SUPPORTING TPD IN SCHOOLS

To ensure that teachers implement the innovations learned through TPD—whether active learning or using spreadsheets to record grades—teachers must have support at the school and classroom level. These include:

- Follow-up support
- Administrative support
- Technical support
- Collaborative support

When any aspect of this support is lacking, the entire investment in TPD is at risk.

CONFRONTING TEACHERS' PRECONCEPTIONS

The process of educating teachers must take into account (teachers') prior beliefs (and) experiences…Most teachers bring to the classroom an ingrained, long standing notion of the roles of teacher and student, authority, and how learning occurs. This is in constant conflict with professional development…. Teachers experience intense conflict as they explore alternative approaches which sharply contrast with embedded beliefs and values about management, curriculum, instruction (and their own authority roles and the role of the student).

L.R. Knapp & A.D. Glenn
Restructuring Schools with Technology, p. 18

Follow-Up Support

Human support for TPD is critical. Teachers need ongoing access to a follow-up person, coach or mentor. That person should be enthusiastic about improving education, invested in the success of individual teachers

and the TPD program, extremely familiar with instruction, curriculum, assessment and classroom management, and have an implicit understanding of the challenges associated with change.

When education systems lack capable mentors or coaches, long-term planning should identify potential sources of such personnel—including teacher training colleges, district offices, and universities—and cultivate their capacity to support TPD.

The "reach" of support personnel can be extended by the use of communications tools such as mobile phones, voice messaging, text messaging, Instant Messaging (IM), two-way radio, and email. In Tajikistan, IM has been used to link teachers in isolated, mountainous schools with Relief International/Schools Online project staff in Dushanbe.

Support from School Leadership

Access to an external follow-up person is critical. But *internal* support—particularly the support of school leadership—is just as important. School leaders can provide critical internal support by:
- Setting *expectations* for teachers
- Establishing a *culture and climate* that encourages and rewards change and experimentation
- Providing the *time and resources* for teachers to practice what has been learned in TPD
- Demonstrating *effective leadership,* so that everyone in the schools is working to support change

Studies of effective TPD programs, such as Chile's *Enlaces* program, identify committed and capable school leadership as the "key element" for change and as a "considerable element" in student achievement. ICT-enabled TPD projects, such as *LearnLink*, included school and ministry leaders in professional development to help leaders become "champions" in the area of ICT and instruction.

TPD project planning should address ways to "enlist" school leaders in supporting educational reform.

Support from the Community

School leaders can also enlist *family and community support* for ICT in schools. Strong school-community relationships contribute to project success by increasing their accountability. And teachers feel better about themselves and their work and treat students better when they feel valued by the community.

MOBILE PHONES AS SUPPORT TOOLS

As telephone network infrastructure advances, data communications for TPD using mobile phones becomes increasingly feasible.

How can mobile phones be used for follow-up?

- Teachers can use mobile phones for ongoing communication, including voice or text messaging, with a support person and with colleagues
- A support person can use SMS (text messaging) or email-to-SMS to send regular encouragement to teachers
- Teachers can phone in to voice-to-text Help Desk services, ask questions that are converted to text and distributed to Help Desk experts, and receive voice or SMS responses
- Audio job aids (including lesson-plan supports such as stories, pronunciation guides, and inquiry stategies) can be downloaded to mobile phones as MP3 files for use in preparation or during classes
- Short audio or video clips of class activities can be recorded on phones, then shared among groups of teachers and their mentors for analysis and feedback

Education Development Center is presently developing a program in Zambia in which teachers use mobile phones to make weekly progress reports to mentors on their use of new science kits. Questions and comments sent by the teachers will be recorded for broadcast in a 15-minute segment for a weekly teacher radio program.

SCHOOL LEADERSHIP AND TPD

Leadership (must be) supportive of teachers, in meaningful ways that give teachers decision-making authority and the time to meet together to discuss and reflect on the goals and ways to achieve those goals.

Teachers need coaching, for teachers like all learners (young and old) do not get it perfectly the first time.

Dr. Shirley Hord
Scholar Emerita, University of Texas,
Southwest Educational Development Laboratory

Austin, TX (USA)

School leaders should be encouraged to enlist family and community support by:

- Initiating outreach activities, such as visits to the computer lab or to an IRI class
- Establishing computer-lab steering committees that include community members, parents, teachers, and students
- Offering computer training or Internet use to community members
- Presenting TPD and ICT project information to parents' groups
- Helping to establish alumni organizations that support educational programs, TPD, and ICT

When schools primarily serve boarding students—often the case in rural secondary schools—school leadership should be made especially aware of the need to build bridges to *both* the surrounding community and to students' families.

Technical Support

Computers break down. If no one in the school can fix them, and the closest technical support is hours or days away, the computers are abandoned. Investment in ICT and TPD is wasted. This is the most common ICT tale in schools around the world.

Funding for technical support—including travel costs if necessary—should be part of any TPD program.

Many programs enlist upper-primary and secondary students as technical-support personnel. In its *Kids on the Block* program, SchoolNet Namibia has trained hundreds of unemployed youth in Windhoek as technical-support staff. These youth provide support for the refurbished computers that SchoolNet provides to Namibian schools. For SchoolNet schools outside of Windhoek, however, technical support remains a challenge, as there is no funding for travel for *Kids on the Block* teams.

Project planning and budgeting can improve technical support by:

- Providing schools or local technical-support providers with critical spare parts (power supplies, mother boards, hard drives, etc.)
- Extending seed funding or micro-credit to start-up computer-repair businesses
- Contracting existing private-sector technical-support providers
- Enlisting the aid of staff at Internet cafes or telecenters
- Identifying ICT projects or NGOs in other sectors—such as health or agriculture—that can assist with technical support

Approaches should be developed based on local capacity and density of ICTs. In Guinea, where radio is everywhere, there are plenty of radio repair shops. As computers become more common, options for technical support will increase.

Collaborative Support

Teachers encounter barriers when they attempt innovation in their schools. To help them overcome such barriers, and to help build *internal* expertise and capacity in schools, programs should include structures that support collaboration among teachers.

When teachers consistently share challenges and issues, they create school-based communities of practice. These collaborative communities promote and sustain school change by helping teachers to:

■ Improve their own performance, as well as that of their colleagues
■ Develop confidence
■ Become more self-motivated
■ Rely more on one another and less on external facilitators

When they work together in Communities of Practice, teachers experience collaboration, inquiry, and independent learning. Their experiences help them understand and support the same activities among students in their classrooms.

Collaboration not only improves teacher performance, it improves teacher retention: New teachers supported by a network of colleagues or by mentors are *less likely to leave teaching* and more likely to improve practice than those without such access.

INFRASTRUCTURAL SUPPORT FOR TPD

Infrastructural support for TPD extends includes items such as classroom space and electrical power, as well as the "educational infrastructure" of knowledge resources, curricula, and assessment.

Critical infrastructural supports include:
■ **Physical infrastructure**
   Tables, desks, writing materials, and classroom space; computer facilities with electrical outlets and burglar bars
■ **Technical infrastructure**
   Electrical power, Internet connectivity, radios, batteries, computer hardware and software as appropriate
■ **Manuals, guides and teaching aids**
   Print-based guides to hardware and software, instructional materials, etc.
■ **Educational infrastructure**
   Modifications to curricula, educational standards, teachers guides, and student assessments needed to support TPD

In many instances, revision of student assessment (including tests, national exams, portfolios, teacher reports, and requirements for advancement) may be the single most challenging *and* the most important step toward educational reform—and toward supporting TPD. But the most successful TPD programs are those that are integrated into comprehensive approaches to educational improvement.

See the Implementation Briefs for a more complete discussion on the technical and instructional supports needed by teachers so they can successfully implement what has been learned in ICT for TPD projects.

WEB RESOURCES

■ *BECTA ICT Advice*
   The British Educational Communications and Technology Agency (BECTA) provides practical policy, planning and organizational assistance for using ICT in schools.
   http://www.ictadvice.org.uk
■ *BECTA Schools Sector Toolkit*
   This online toolkit helps to support the recruitment, training and retention of ICT technicians for schools. Among the toolkit's features are: ICT skills for teachers; "ask an expert" features on integrating ICTs into the classroom; and a series of self-evaluation and planning tools for ICT. Though the site is directed at UK schools, most of the content is valuable from an informational perspective and much of it

can be adapted to non-UK settings.
http://www.becta.org.uk/schools

■ *Namibian Education Development and Support Network (EdsNet)*
EdsNet offers a comprehensive collection of digitized content to support teachers in the use of ICTs in schools and classrooms. The site contains local-language content, information on learning theories and instructional approaches, a list server so teachers can communicate with one another and access to lesson plans and curriculum.
http://www.edsnet.na

SECTION 10
EFFECTIVE PARTNERSHIPS FOR ICT-SUPPORTED TEACHER PROFESSIONAL DEVELOPMENT

GUIDING QUESTIONS

- Which private-sector, civil-sector or governmental organizations have stakes in the success of the country's educational improvement?
- Which organizations have stakes in the growth of the telecommunications and technology sectors?
- How do current regulations regarding school fees, hiring, and revenue generation, telecommunications access and costs, and other policy areas affect introduction of computers and the Internet in schools and teacher training colleges?
- Which organizations might be enlisted to help change these aspects of the regulatory environment?

SUMMARY

School systems often find that they must look outside of their own organizations for personnel and funding to build effective programs in TPD. Partnerships can enhance sustainability, augment capacities in ministries and schools, provide content and reduce costs.

Partnerships can also fortify projects against political demands, changes in government, and unexpected challenges. Relevant partnerships may involve ministries of education, other governmental agencies, the private sector, and civil-society organizations including non-governmental organizations (NGOs).

Local initiative and local partnerships are also important. As demonstrated by the rural Rwandese secondary school, *Group Scolaire Soeurs de la Assomption* (profiled in this section), determination and creativity lead to success at the local level.

PARTNERSHIPS TO INCREASE PROGRAM STRENGTH

TPD takes time, and yet, political reality often demands instant results. In ICT-supported TPD, outcomes such as the number of computers installed or the number of teachers trained in year one may be critical to building program support—and to building a track-record of achievement.

Increasing the number and kind of project stakeholders can buy time for projects to achieve results. In addition, partnerships strengthen the ability of projects to survive changes in government, reductions in funding, and unexpected challenges such as infrastructure failure or climate-related catastrophes.

COOPERATION WITHIN GOVERNMENT

Collaboration within government—among ministries or between ministries and the executive branch—can help reduce project costs and secure funding or other resources.

Broad partnerships *within* government and across ministries should be pursued in order to reduce costs, build understanding and support for program goals, and ensure program sustainability. Effective avenues for intra-governmental support include:

- Removing import tariffs on *all* computer-related hardware for use in schools
- Establishing "e-Rates" to provide low-cost Internet connectivity
- Channeling end-of-lifecycle computers to schools

It is critical to think through the ramifications of each measure to ensure that schools are able to benefit fully. Tariff reduction, for example, is often applied to computers themselves, but schools still must cover high tariff costs on other essential items, such as Uninterrupted Power Supply (UPS) units and printers. Available funds purchase fewer computers when the cost of peripherals is high.

Many ministries of education receive used computers donated by other parts of government, foreign embassies, development agencies and multinational corporations (MNCs). However, ministries may not have funds needed to refurbish, distribute or maintain these computers. In such instances, offering teachers the opportunity to buy computers through low-cost financing plans, or micro-loans, may yield indirect benefits, in terms of enhanced educational quality, by providing teachers with access to computers and computer-based learning resources.

MULTI-SECTORAL DEMAND

Viability depends on sufficient demand for connectivity and bandwidth beyond that of teacher education, such as from e-government, e-business, e-health.

Dr. Margaret Chia-Watt
Director, Educational Development
Nanyang Polytechnic, Singapore

CONNECTED UGANDA: ENSURING PROGRAM SURVIVAL

The ConnectED Project in Uganda has, in its Phase 2 (2003 – 2005), focused on ensuring the financial sustainability of its eight sponsored primary teacher training colleges. In November 2004, the prospects for long-term success of the program were improved by concerted action on the part of three different government organizations:

- The Ministry of Education and Sport (MOES) reinstated a program under which student teachers at the NTCs could be charged fees for computer-labs
- President Yoweri Museveni, immediately afterwards, authorized the payment of teachers' fees through the Poverty Action Fund
- The Uganda Communications Commission provided a one-year grant to fund connectivity at the teacher training colleges, lowering their costs at a critical point in the implementation of their business plans

The initiatives by the MOES, the office of the president, and the communications commission establish a platform for the sustainability of ConnectED. And by bringing new stakeholders into a project run by the education ministry, ConnectED has expanded its base of support within the Ugandan government.

PRIVATE-SECTOR PARTNERSHIPS

Private-sector companies have many reasons to demonstrate "corporate good citizenship" in supporting ICT projects in TPD. They may, for example, wish to strengthen the local work force, increase potential markets for products and services, pre-empt regulatory action by prominently being seen to support 'good works' (such as contributing to humanitarian relief efforts). ICT companies may be especially motivated to contribute: Consumers only gain value from computers when they have the skills needed to use them, and schools may be helping to build these skills.

Corporate in-kind contributions for ICT-supported TPD and student learning may include hardware, software, connectivity, or professional expertise. Several multi-national corporations have developed teacher-focused training resources for use in schools. Governments may pursue private-sector partnerships to acquire these much-needed resources. However, businesses may also be centers of innovation, not only in the development of ICTs but also in the crafting of visionary goals and approaches.

In many cases, businesses establish "corporate foundations" to serve as channels for sharing resources with governments, schools, and NGOs.

Intel Teach to the Future

A program of the Intel Foundation, Intel Teach to the Future has provided TPD focused on the integration of technology into the curriculum to over 2 million teachers in 30 countries. To develop their program in South Africa, Intel Foundation consulted with the Ministry of Education, university-based education researchers, and SchoolNet South Africa to adapt their standard program for the South African curriculum. Using the Cascade model, facilitators are trained by SchoolNet SA. They then return to their schools to deliver 10 to 20 hours of professional development on integrating computers and the Internet into the South African curriculum. Between 2003 and 2006, it was projected that 30,000 South African teachers participated in the Teach to the Future program.

TerraCom Corporation

TerraCom Corporation, a telecommunications company based in Rwanda, has been awarded the contract to construct a fiber-optic communications network that will cover the entire country. Working closely with the Ministry of Education, Science, Technology, and Scientific Research (MINEDUC), TerraCom has agreed to provide Internet connectivity for all 400 Rwandese secondary schools at a low flat rate. Additional services are to include Internet-Protocol telephony (VOIP), free email and Web hosting, and templates for building school Web sites. As of early 2005, TerraCom was providing connectivity to 30 schools in the areas surrounding Kigali and Gitarama.

Questions for Further Consideration

Intel has founded an international NGO to develop a program for teachers in many countries and situations.
- What are likely to be weaknesses in the Intel Teach to the Future approach? What are the program's likely strengths? How might the weaknesses be addressed?
- Partnership with Intel Teach to the Future has resulted in cost savings to the South African government. In which areas were these cost-savings realized? To what extent might they offset critical costs in the provision of TPD and the roll-out of computers and the Internet in schools?

In Rwanda, the partnership between MINEDUC and TerraCom addresses infrastructure directly, and is intended to lead to both cost reduction and enhanced capacity at the school level. However, in the resource-

poor Rwandese economy the TerraCom partnership is limited by outside factors: electrical power remains unstable in most rural areas; only a few schools as yet have functioning computer hardware.

- Given the lack of ICTs in Rwandese teacher training colleges, how could the pre-service primary-teachers' curriculum be modified to prepare teachers for working with computers and the Internet?
- How might additional corporate partnerships—with multinational corporations, or with Rwandese corporations—support e-Readiness in the Rwandese teacher training colleges?

PARTNERSHIPS WITH CIVIL-SOCIETY ORGANIZATIONS

In many countries, civil-society organizations—including NGOs and faith-based organizations—have become lynchpins in the provision of TPD to support the use of ICTs in schools.

World Links

World Links is among the best-known NGOs focusing on the use of computers and the Internet for TPD and classroom change. Since 2000, World Links has developed programs to support tele-collaboration, TPD, and the integration of ICT and learning in Africa, Latin America, Asia, and the Middle East. In nearly all cases World Links projects have relied on partnerships with country governments. In many of its projects, World Links brings governments, local NGOs, charitable organizations such as the Gates Foundation, and donor agencies, such as the World Bank and JICA, into partnerships to fund and implement projects.

SchoolNet

In both developing and developed countries, SchoolNet organizations have been established to guide schools in the acquisition and effective use of computers and Internet connectivity. SchoolNets are organized in many different ways. Some are independent NGOs financed through grants and contracts, others are housed within ministries of education.

SchoolNets often fulfill vital functions that are outside the capacity or the responsibility of the government:

- SchoolNet Namibia trains students to provide on-site technical support through its Kids on the Block program
- SchoolNet South Africa is the lead implementing organization for the Intel Teach to the Future program in that country

THE OMAR DENGO FOUNDATION, COSTA RICA: TRANSFORMING TEACHING AND LEARNING IN PRIMARY SCHOOLS

An independent NGO, the Omar Dengo Foundation has worked with the Ministry of Public Education since 1988, engineering the transformation of primary education through the establishment of Educational Informatics Labs in over 500 schools. The Foundation has targeted its TPD efforts on helping teachers:

- Focus on specific ICT-supported activities to improve student creativity, reflection, and expressiveness
- Understand and work with the ways children learnManage flexible and nurturing classroom environments
- Guide collaborative learning to enhance cognitive and social development
- Transform mistakes and problematic situations into opportunities for student learning

The program has been both ambitious and successful—benefiting from Costa Rica's small size and its transition from an agricultural to a service-based economy, and from strong partnerships: Omar Dengo Foundation has worked not only with the ministry, but has forged strong collaborative relationships with the renowned MIT MediaLab and the international NGO World Links.

Questions for Further Consideration

The Omar Dengo Foundation and SchoolNet Uganda are primary providers of ICT-supported TPD in their educational systems. In Costa Rica, where the government launched a system-wide implementation of ICT in schools, the Omar Dengo Foundation operated under contract to the Ministry of Primary Education. In

Uganda, where schools must acquire computers on their own initiative, the MOES has established an *ad hoc* arrangement for TPD with SchoolNet Uganda.

- Based on the current number of schools with computer labs in the country, which approach to partner-delivered TPD, informal or contractual, might be most appropriate?
- Is there an organization currently prepared to deliver high-quality support? If not, how might one be developed and how might the education ministry partner with it?
- How might the SchoolNet TPD curriculum, which uses computers for project-based learning, be adapted to help teachers in schools *without* computers prepare to use ICTs to enhance the quality of student learning?
- What role might the ministry take in supporting such a change?

Consider Pursuing Partnerships to Support TPD When…

The ministry or implementing organization lacks capacity to:
- Design effective ICT-supported TPD
- Sustain delivery of TPD via site-based, Cascade or online TPD

The budget allocated for TPD does not fund:
- Development of TPD courses

Multi-national, regional or national corporations have:
- Reasons to support enhanced education
- Interest in expanding use of ICT among students and teachers
- Government protection from competition in the telecommunications sector

PARTNERSHIPS WITH SCHOOLS

One of the chief benefits provided by partnerships is increased program sustainability.

However, in terms of sustaining projects in ICT and TPD, the most important partners are *local* partners—the teachers, head teachers, students, families and others who make up the school community. The fragility and complexity of computers, the scheduling challenges of IRI, and many other problems that arise in the course of ICT projects occur on the local level, the level of the school. When schools embrace the solutions that ICT provides, they address and overcome the challenges.

SCHOOLNET UGANDA: A PARTNER FOR THE MINISTRY

SchoolNet Uganda, which implemented the Uganda VSAT Project, facilitates networking and provides TPD for its membership of 54 schools. The core of the SchoolNet Uganda approach to training is the World Links TPD curriculum, using project-based learning, collaborative learning, and independent research to integrate ICTs into the curriculum. Through 2004, SchoolNet Uganda operated without significant support or recognition from the Ministry of Education and Sport (MOES).

In 2000, the MOES started taking steps to support the introduction of ICTs in schools. These measures included developing an O-level Basic Computing curriculum (2000) and examination (2002). However, MOES provides no resources to schools in this area.

In November 2004, following the successful completion of the VSAT Project by SchoolNet, MOES issued a memorandum that required schools to allocate a portion of their annual budgets for TPD addressing the use of ICTs, and informing school heads that progress reports in this area would be required. In the brief memorandum, school heads were also advised to "take advantage of SchoolNet Uganda" for advice on how to "start/improve ICT programmes in your school." In this way, MOES helped ensure that SchoolNet would survive and grow, and that the NGO would continue to provide services that complement the ministry's support for ICTs in schools.

G.S. *SOEURS DE L'ASSOMPTION*, RWANDA
THE DRIVE FOR SUSTAINABILITY

The directrice of Group Scolaire Soeurs de l'Assomption, a secondary school in the remote village of Birambo in Rwanda, determined in 2000 that ICT would help her students succeed in their studies and in their lives after school. Electricity is adequate in Birambo, but no telephone lines are available. Consequently, the directrice decided to find funding for computers and satellite access to the Internet. Her independent efforts have to date yielded a lab of 16 computers and a VSAT terminal.

However, recurrent costs are high. The computers need replacement parts, the VSAT connection costs over US$200 per month. To reduce repairs, the directrice funded technical training for the school's informatics teacher, who now teaches a class in computer repair. That class has its own workshop, and handles most of the repairs of school computers.

To offset the recurrent costs, the directrice decided to make computers available to the villagers. She put two workstations in a separate room near the entrance of the school. That room is open to community users throughout the day. Larger training sessions take place in the school's main lab during vacations. Community ICT services are run professionally, with regular hours, competitive pricing, and quarterly budgets. The school now has a steady flow of clients who use its computers to access the Internet.

SECTION 11
EVALUATION OF ICT-SUPPORTED TEACHER PROFESSIONAL DEVELOPMENT

GUIDING QUESTIONS

- Which ICT-supported initiatives include teacher professional development? How can their evaluation be enhanced to build understanding of teachers' needs, barriers to success, and effective approaches?
- Which initiatives have plans in place for impact evaluation? How can these plans be leveraged to strengthen capacity for project evaluation?
- What will be done with the results of these evaluations?

SUMMARY

Many TPD projects achieve limited impact because specific barriers to success—including factors influencing teachers' day-to-day activities—are never identified. Many pilot projects do not lead to larger implementations because impact cannot be demonstrated. Therefore, evaluations of project impact are critical so that errors in project implementation and design can be identified and fixed, successes replicated, and progress demonstrated to funding agencies and other stakeholders.

Both *formative* and *summative* evaluations contribute to successful projects. Evaluation designs typically combine *quantitative* and *qualitative* methodologies according to experimental models that help to eliminate "confounding effects," such as bias in school selection.

Every phase of a project, from planning to implementation, should include an evaluation component. When integrated in this way, evaluation increases the effectiveness of all project phases, from goal setting to outcomes.

KEY CONCEPTS IN PROJECT EVALUATION

The impact of ICT-enabled teacher professional development (TPD) projects is often unknown. Evaluations add expense to project costs. They may be seen as unnecessary or regarded with suspicion, or organizations may lack personnel with evaluation expertise. In many instances, evaluation is limited to post-workshop surveys of teachers or post-tests of student performance.

However, monitoring and evaluation (sometimes known as "M & E") are critical to success. Monitoring and evaluation processes allow project staff to find and correct errors in implementation, to gauge impact, and to identify factors that lead to success.

Monitoring and Evaluation Defined

Monitoring encompasses supervising and observing activities and reporting on them to responsible individuals. In essence, monitoring answers the question, "What is happening here?"

Evaluation is a method of determining the overall value of an activity. Evaluation answers the question, "Is what is supposed to be happening really happening?" and assesses impact based on pre-defined criteria (outcomes, benefits, cost effectiveness, utility, etc.).

The processes of monitoring and evaluation enable:
- Project staff to review and "diagnose" the project on an ongoing basis (*formative* or *continuous* evaluation)
- Stakeholders and others to judge the project's overall success (*summative* evaluation)

The distinction between formative and summative evaluation may be understood in relation to cooking. A cook will taste the soup while it is being prepared, perhaps adding salt or another ingredient as a result of that tasting. The cook performs a formative evaluation and makes an adjustment to improve the outcome. When the soup is served, the customer may taste the soup and offer a summative assessment of the cook's efforts—"Excellent soup!" or "A bit too salty, thank you."

Formative and summative evaluation processes strengthen projects, enhance TPD outcomes, and help organizations build on their successes to achieve progress.

EVALUATION AS PART OF A TPD PLAN

An evaluation plan should be included *within any professional development plan*, and should enable project planners, implementers and other stakeholders to:
- Establish goals for TPD and align them with standards and measurable classroom-based outcomes
- Determine how outcomes will be measured
- Create activities that are aligned to goals and outcomes
- Select the type of technology that supports TPD goals
- Identify supports to make sure TPD goals are implemented in schools
- Allocate funding to specific project components
- Identify design, organizational, infrastructural and other influences on project sustainability
- Measure the effectiveness of project interventions
- Enable school leaders and teachers to determine whether they are achieving their goals and help them adjust practices to meet those goals

CREATING AND CONDUCTING EVALUATIONS

Evaluation should be developed and conducted by specialists in project evaluation who understand the technologies involved and the educational context in which the project takes place, including factors such as teacher capacities, curricula and student demographics. Evaluators should also understand factors arising from economic, cultural, infrastructural, and other conditions.

Quantitative methods involve collecting numerical data that can be compiled arithmetically and analyzed by statistical processes. Instruments used to collect quantitative data include:

- **Pre-and post-tests**
  Tests administered to teachers or students before and after an intervention to determine differences in knowledge and skills
- **Surveys**
  Series of questions that generate information or opinions to be analyzed
- **Classroom observations**
  Quantitatively focused observations that involve "scoring" or coding classroom interactions
- **Exams**
  Scores on national or standards-based exams aligned to TPD outcomes
- **Cost-benefit measures**
  Analyses of cost-benefit relationships, cost per teacher trained, input-output relationships, program audits, etc.
- **Performance-based assessments**
  Measures of student or teacher competency through performance of particular tasks as opposed to a test or exam
- **Other data**
  Student completion rates, teacher retention rates, demographic data, etc.

Qualitative methods involve gathering data from interviews, writing samples, and other sources that require analysis through interpretation and inference. Examples of instruments used to collect qualitative data include:

- **Interviews**
  Structured questioning, typically with one person
- **Focus groups**
  Group interviews or guided discussions
- **Case studies**
  In-depth studies of an individual example—a teacher, a school, a project—that enable rich analysis and description of a particular situation
- **Authentic and performance-based assessments**
  Portfolios of student work, teacher lesson plans, etc.
- **Other data**
  Observations, holistic examinations of student work, classroom walkthroughs, etc.

> ## FORMATIVE EVALUATION AND IRI
>
> IRI owes much of its success to the practice of continual formative evaluation. IRI programs are evaluated throughout the life cycle of the IRI project to gauge student interest, participation levels, and skills development. Evaluation occurs in part through the process of audience research during piloting phases, and through periodic interviews, observations and surveys after the program is launched. Where problems are found, they are corrected. Evaluation of IRI makes the programs responsive to student and teacher needs.

KEY STEPS IN EVALUATING PROJECTS

Many steps in the evaluation process are essential if evaluation is to meet internationally recognized standards and generate usable results. These steps include:

- Identify the goals and intended outcomes of the TPD project

- Identify the purpose of the evaluation
- Identify resources (including cost, personnel, materials and a timeline)
- Formulate evaluation questions and prioritize them
- Determine the evaluation methodology, design, and instruments that will provide answers to these questions
- Select evaluation treatment samples (e.g., schools or teachers that will participate in the project) and control samples (e.g., other schools or teachers)
- Field test the evaluation instruments
- Establish baseline data (e.g., information about conditions before the project starts)
- Collect data
- Compile and analyze data (data should be "cleaned" to be sure all responses are complete and clear)
- Document and report findings
- Make project adjustments based on evaluation results
- Continue to monitor, evaluate, analyze, document, report and adjust

ADDITIONAL SUGGESTIONS

- Evaluation should take place over time, and may extend beyond the life of a specific project. Some effects are *proximal* and can be measured soon after TPD (e.g., teacher use of radio for instruction). Some effects are *distal*—indirect effects that cannot be measured in the short term (e.g., teachers' sense of pride or happiness as a result of being able to create a web page). Behavioral and attitudinal changes, in particular, can take years to accomplish and are even harder to evaluate. Alternatively, initial impact can be superficial and short lived. Depending on project goals, evaluation should be planned to capture all relevant outcomes.
- Design is critical to evaluation. Too often evaluations rely on information collected after an intervention has occurred. When an evaluation strives to show causality, experimental design, including randomization of samples, should be used. Consider establishing system-wide standards for evaluations (e.g., desired designs, reporting mechanisms, costs for evaluation, criteria for hiring evaluators and optimal skills sets for evaluators).
- Proving a direct link between variables can be difficult because of *confounding* relationships. For example, linking improved teacher performance to Internet access could be impossible if all teachers included in the evaluation have also participated in TPD. To *control* for the confounding effect of TPD in this instance, researchers might include three groups of teachers: those with Internet access who have not participated in TPD, those who have participated in TPD without Internet access, and those who have had both TPD and Internet access.
- Triangulate methodologies. Where appropriate, use mixtures of quantitative and qualitative design. This approach gives a clearer picture of what is really happening and what it means.
- Evaluation must be governed by impeccable ethics. Evaluation should never be considered as part of public relations or funding development. Evaluators should be competent, knowledgeable, and have no vested interest in a project's success. Evaluators should be allowed to operate without political interference. The whole process of evaluation must be transparent.

WEB RESOURCES

- *Monitoring and Evaluation of ICT in Education Projects: A Handbook for Developing Countries*
  This short handbook from *info*Dev provides guidance for policymakers struggling with two key issues: What is the impact on student achievement of introducing ICTs in educational settings in developing countries? How should this impact be measured, and what are the related issues, especially as they relate to Education For All and other Millennium Development Goals?
  http://www.infodev.org/en/Publication.9.html
- *Handbook on Monitoring and Evaluation for results (UNDP)*
  This free monitoring and evaluation handbook from the United Nations Development Program is

available in French, Spanish and English.
http://stone.undp.org/undpweb/eo/evalnet/docstore3/yellowbook/

■ *ELDIS Participatory Monitoring and Evaluation*
This resource guide on participatory monitoring and evaluation promotes the involvement of a wide range of stakeholders, employing methods that allow a more equal opportunity for the expression of views and sharing of lessons.
http://www.eldis.org/participation/pme/

POSTSCRIPT
MAKING ICT PROJECTS WORK

ICT projects in education may entail great expense and complexity. The key considerations outlined here increase the likelihood of effective project design, cost-effective implementation, and impact.

Know why ICT is being used
Focus the use of ICT on enhancing the *scope* of learning activities in the classroom or the *scale* of TPD initiatives—not on learning to use computers and the Internet.

Incorporate specific tools to meet specific needs
Every technology enables specific actions and incurs limitations. Tools must be appropriate to program objectives.

Match ICT to infrastructure
Each ICT tool offers its full range of capacities when it is supported by adequate infrastructure. Select tools that will work under the conditions that exist in schools where they will be used.

Match ICT to human resources and learning resources
Enlist the aid of experts to analyze requirements in advance. Push for comprehensive analysis.

Combine different tools for enhanced impact
Use familiar and proven tools whenever possible, but *always* think creatively about technology problems and about combinations of tools that can solve them.

Prepare for complexity
The introduction of any ICT solution to a TPD program increases the complexity of the entire system. Behavior in complex systems—which include both schools and IT projects—is difficult to predict.

Remain flexible
Start small, monitor and assess results every step of the way. Plan "adaptation waypoints" at which projects will be modified to address problems.

Commit enough time and money to allow ICT to realize its potential
Every program of change in education takes time. Supporting change through ICT may increase the number of teachers that are reached, and may make changes in teacher behavior more profound. However, introducing ICT means adding more steps—for delivery and installation, content development, training of trainers, hiring of mentors, and guidance for end users in adoption of the new tools. Introducing ICT may *increase* the time required for results to emerge.

Keep in mind that ICT supports solutions; it is not the solution
ICT fails to live up to its promise when planners and policymakers focus on technology to the exclusion of more important contributors to effective education. ICT can help increase teachers' capacities but will do so only when it is used to support programs that meet the full range of human, instructional and physical requirements for successful TPD.

ANNEX
USING ICT TO TRAIN TEACHERS: IMPLEMENTATION BRIEFS

OVERVIEW

The following implementation briefs provide interested policymakers with additional information about some of the concepts presented in the main body of the handbook. Specifically, the information included in this section refers to the following two sections:

- Section 3: Models and Best Practices in Teacher Professional Development
- Section 9: Implementing ICT-supported Teacher Professional Development

The information presented in this section may also be useful to those charged with implementing specific components of ICT for TPD projects.

BEST PRACTICES AND MODELS IN TPD

EXAMPLES OF SITE-BASED PROFESSIONAL DEVELOPMENT

As Section 2 notes, site-based Teacher Professional Development (TPD) often takes place *locally*—at schools, resource centers, or teachers colleges—and is often focused on specific, locally-based problems encountered by individual teachers. Depending on the particular instructional needs, site-based teacher professional development may assume a variety of approaches, some of which are listed below. Bear in mind that these approaches may be used individually and together and may be part of both formal professional development and follow-up assistance.

Observation/Assessment

In the Observation/Assessment model, the TPD provider—perhaps a master teacher in a school, perhaps a specialist working district-wide—observes teachers in their classrooms, assessing their instructional practices and providing structured feedback.

Observation/Assessment may be used as a support measure following workshops (as it does in the Jordan Education Initiative) or periodically throughout the school year (Guinea's FQEL IRI project) as a peer coaching form of TPD. There are numerous variations on the Observation/Assessment model, from entire-class clinical observations, to 10-minute "snapshots," to "learning walk" approaches (See *http://www.institute-forlearning.org/howwk.html* for more information on "learning walks.")

OBSERVATION/ASSESSMENT AT A GLANCE

Strengths	Limitations	Cost considerations
• Mutually beneficial for observer and teacher • Observer gains new knowledge of and exposure to ways of teaching • Teacher being observed receives structured feedback which can improve practice • Overcomes isolation inherent in teaching • Builds local support for innovation and change	• Adds to teachers' time burdens • Teachers may identify needs or problems that cannot be addressed by local facilitator • Depends on expertise of local facilitator • Observer must distinguish between assessment (diagnosing lesson and providing feedback to improve instruction) and evaluation (making a judgment about performance)	• Costs involve personnel, training, supplies • May be additional costs if laptops are used for observations • If conducted by school-based peers or leaders during the school day, personnel cost is low

Table 1: Observation/Assessment

When Observation/Assessment includes helpful feedback and targets areas for teacher improvement, it can help teachers develop the full range of *basic, intermediate,* and *advanced* skills listed in Section 1, the Overview, of this handbook.

Consider using Observation/Assessment to…

- Improve teachers' instructional skills
- Assess or guide teacher implementation of computers or a new instructional approach (e.g., a learner-centered method or IRI)

How can ICT Strengthen Observation/Assessment?

- Record and display observation data using spreadsheets (as was done in the *Basic Education Support II* program in Namibia)
- Videotape teachers in action and guide teachers in viewing these videos as a form self-assessment to improve practice.

Open Lessons

In an Open Lesson model, teachers create lessons and invite colleagues (and in some cases, parents and teachers from other schools) to observe the lesson and provide feedback in a post-observation session. In contrast to Lesson Study (see the next model), the focus of Open Lessons is on *teacher* behavior. Open Lessons have a long tradition in Russia and Azerbaijan and are used informally throughout the globe. In Guinea, for example, the FQEL's *Cercles de Renforcement*[1] (a form of TPD where inspectors meet with teachers) used a modified open lesson approach with radio as part of TPD, where teachers listened to radio broadcast of a simulated lesson or observed an actual lesson and provided feedback.

Where there is structured feedback, time for discussion, and teacher incorporation of feedback into future lessons, Open Lessons can help teachers develop *basic, intermediate, and advanced* skills.

Consider using Open Lessons to…

- Help teachers with instructional design issues
- Focus on assessment and instruction

OPEN LESSONS AT A GLANCE

Strengths	Limitations	Cost profile
- Low cost - Builds on-site expertise - Teachers become more comfortable sharing and helping one another improve practice - Teaching becomes a "public" versus private activity - Can be used successfully in low-resource environments - Organized by teachers, for teachers	- Requires at least some relatively skilled teachers to serve as models - Participants may not understand how best to benefit from lessons - Only works if teachers share critical feedback (both positive and negative) - Without skilled teachers and discussion sessions managed by a skilled facilitator, an Open Lesson model can reinforce mediocre practices	- Conducted by school-based peers or leaders, so cost is low - Addition of technology (podcasting, video, audio recordings, digital images, etc.) increases the scope but adds to cost

Table 2: Open Lessons

- Implement either ICT or a particular innovation from an ICT-enabled teacher professional development project (e.g., a new reading program, the use of active learning techniques, etc.)
- Build a community of practice among teachers in which teachers learn from and guide one another
- Promote the idea of teaching as a shared and public activity, as opposed to a private and hidden one

How can ICT Strengthen Open Lessons?
- Internet-based video teaching episodes allow teachers to participate in an Open Lesson if unable to do so at their own school
- Video-based lessons can expose teachers to activities that they ordinarily do not have the opportunity to view
- Actual or simulated radio broadcasts can also provide an "audio" version of an Open Lesson
- Open Lessons can be recorded via audio and video and placed on the World Wide Web for downloads as podcasts and compressed video

Lesson Study

In **Lesson Study**, teachers collaboratively plan, develop, or improve a lesson; field test the lesson; observe it; make changes; and collect data to see the impact of the lesson on student learning. In contrast to Open Lessons, where the focus is on teacher action, the Lesson Study approach focuses on *student* actions.

Relief International/SchoolsOnline projects in Jordan, Tajikistan and Azerbaijan employ a blended and abbreviated Lesson Study/Open Lesson approach. During workshops, teachers spend the middle two days of the workshop creating and modifying a learner-centered activity that uses ICT. They pilot it with colleagues on the final two days of the workshop. They receive feedback from peers, are provided time to refine the lesson based on this feedback, and implement this refined lesson upon return to their schools. However, the best and fullest examples of Lesson Study are found in Japan and China, and increasingly in the United States, Canada, Australia and Europe.

Consider using Lesson Study to…

- Help teachers with instructional design issues and instruction
- Shift teachers' focus from what is being taught to how students learn
- Promote whole school collaboration, peer-based learning and communities of practice

LESSON STUDY AT A GLANCE

Strengths	Limitations	Cost considerations
• Focuses on student learning • Process of pilot testing, observing and refining helps teachers better understand the curriculum-design process • Collaborative—teachers learn from and with one another • Helps build communities of learning and practice • Community-based, collaborative model of ongoing professional development—a strategy for sustaining teacher skills	• Time and labor intensive. Not a short-term professional development strategy • Demands a certain level of expertise in curriculum, content, instruction and assessment be available in schools • May be difficult to coordinate and sustain • Tends to be restricted to cohorts of teachers within a school, as opposed to the whole teaching staff • Involves multiple iterations of a lesson before it attains high quality	• Generally low cost • Cost is associated with time, materials and personnel involved • Involves costs of providing an outside facilitator to help instruct and facilitate lesson study

Table 3: Lesson Study

- Deepen teachers' knowledge of core teaching areas (content, curriculum, instruction and assessment)
- Integrate evaluation into lesson design

How can ICT Strengthen Lesson Study?
- ICT can be thoughtfully integrated into the lesson, not as an add on (technology for technology's sake) but as a tool to promote higher order learning (learning with technology)
- Videotaping the lesson study process, and sharing it via the Internet, can be useful for others eager to learn about lesson study

Because of the time, degree of collaboration and intensive planning, reflection and refinement, Lesson Study is probably best geared toward teachers with advanced skills looking to further enhance them or toward helping teachers at an intermediate level attain *advanced* skills.

Study Groups

Within **Study Groups** teachers collaborate, as a single large group or in smaller teams, to solve a common problem or create and implement a plan to attain a common goal. During the collaboration process they may use print-based resources, classroom materials (such as work created by students) and their experiences, as part of their approach to the problem.

Variations of the Study Group approach occur in TPD workshops, in which teachers must plan an activity to take back to their school or create an action plan to address a particular school-based problem.

If teachers are provided the time, support and facilitation for SGStudy Groups and if they see the fruits of their labor, Study Groups can help teachers move toward *intermediate* and *advanced* skills.

Consider using Study Groups to…

- Address school-based issues that are not only instructional in nature, but that may affect school operations or broader issues (e.g., teacher absenteeism, equitable education for girls)
- Promote whole-school collaboration, peer-based learning, and communities of practice
- Deepen teachers' knowledge of core areas of teaching (content, curriculum, instruction and assessment)

How can ICT Strengthen Study Groups?
- Enable teachers to find information (teacher portals and web sites), create information (Office software, multimedia programs, web editors), and communicate within and across schools (bulletin boards, Instant Messaging, email, list servers, blogs, wikis, and cell phones)

STUDY GROUPS AT A GLANCE

Strengths	Limitations	Cost considerations
• Goal oriented • Can bring a sense of purpose, school-based learning and collaboration to teaching • Builds on what teachers already informally do	• Time consuming • May be difficult to coordinate, implement and sustain • If not managed well, meeting diligently, doing assigned work, and following through, they can easily disintegrate • Can be accomplished without a facilittaor, but it is better to have a trained facilitator to mediate teacher learning and group dynamics	• Low cost • Cost is associated with time and personnel involved • May involve costs of providing an external, ongoing facilitator to help instruct and facilitate Study Groups

Table 4: Study Groups

- Using productivity tools, such as word processing, spreadsheet and electronic presentation software, help teachers to create reports, action plans, balance sheets and presentations which may be needed to support teacher study

Inquiry/Action Research

In an **Inquiry/Action Research** approach, teachers form teams based upon a common interest (helping students with reading difficulties, addressing needs of female students, etc.). They *select* an issue, *investigate* and *research* it, *plan* possible actions to remedy it, *take action, observe* and document results, *reflect* on outcomes, and *create* an action plan to address this issue. While Study Groups are broad in their focus, Inquiry/Action Research tends to be more focused on issues related to instruction.

Inquiry/Action Research involves the use of higher order skills (researching, synthesis), a more surgical instructional approach (targeting areas of instructional difficulty), a good deal of teacher time, and if ICT is used, more advanced computer applications (spreadsheets, databases, and possibly statistical software packages). It is most likely a useful TPD choice for teachers who already have *advanced* skills.

Consider using Inquiry/Action Research to…

- Assist teachers in identifying and ingsolving problems and issues related to instruction
- Build site-based communities of practice
- Empower and strengthen the capacity of teachers to provide mutual assistance, support and instruction

How can ICT Strengthen Inquiry/Action Research?
- Enable teachers to find information, share it, and communicate in their area of interest within their school and across schools
- Help teachers create reports, action plans, balance sheets and presentations needed to support teacher study, using data analysis tools (spreadsheets and databases) and display tools (word processing, electronic presentation, web editing tools) and communication tools (email, bulletin boards, blogs)
- Communicate with colleagues in other sites who may have expertise or prior experience around this same issue

Case Studies

In a **Case Study** approach, teacher teams examine components of classroom instruction and apply what has been learned to their own classrooms. This approach uses print, the Internet, and/or video Case Studies of

INQUIRY/ACTION RESEARCH AT A GLANCE

Strengths	Limitations	Cost profile
• Helps teachers become more thoughtful practitioners • Empowers teachers to take action, search for questions and solve problems • Helps teachers begin to create, gather, and use data—rather than anecdotal evidence—to make empirical and informed decisions about instruction	• Teachers should only address problems or questions within their area of influence • Can be complex and demand higher level of teacher skill and competencies • Can be difficult to implement and sustain, particularly in small schools and environments with a low knowledge base	• Cost for outside facilitator, travel to school site, follow up • Possible stipends for additional time after school • Main cost is associated with time

Table 5: Inquiry/Action Research

Strengths	Limitations	Cost profile
• Video examples could be downloaded and burned to CD/DVDs • Video examples can be created locally with handheld video camera or mobile phones	• Use of video is powerful but assumes Internet connection with good bandwith or at least CD/DVD player • Need skilled facilitator to structure conversations	• Involves technology: computer, Internet, good bandwith, or video camera with TV/VCR or CD/DVD player

Table 6: Case Studies

classroom episodes. Case Studies differ from Open Lessons in that they involve more in-depth analysis of all elements of instruction. **Video Case Studies** have been used in Egypt's New Schools Program, though the degree to which this has been doneis unclear. Video Case Studies are an attractive TPD option since they allow teachers to "see" one another's classes. As digital recorders fall in price, computers (on which video can be edited) become more common, and video editing becomes easier, educational organizations may begin to build their own "libraries" of video Case Studies for teacher training purposes.

Where Case Studies offer opportunities for observation, discussion, reflection and transfer of learning to one's own classroom, they are helpful for developing teachers' *intermediate and advanced skills*.

Consider using Case Studies to…

■ Help teachers begin to identify essential elements of good instruction
■ Build a repertoire of shared practice among teaching staff
■ Assist teachers in understanding how to implement, organize and manage any new classroom innovation (e.g., the use of one computer as part of a learning station activity)

How can ICT Strengthen Case Studies?
■ Video clips of classrooms may be used for Case Studies in schools or settings where no "suitable" Case Studies exist
■ The Internet can provide additional information and examples to support teacher Case Study analysis and
■ Teachers can use the Internet to gather curricular and content resources so they can begin to approach the level of instruction observed in the Case Study

Mentoring

In a **Mentoring** model, older or more experienced teachers guide and assist younger or novice teachers in all areas of teaching. Mentoring can be structured as a one-to-one approach, or as a many-to-many approach in which several mentors and less-experienced teachers work together as a team. Research and interviews with Delphi panel participants for this Handbook point to mentoring as one of the most important elements in successful TPD. Mentoring is also popular among teachers because it provides recognition for and builds on their experiences and aspirations, and it helps promote confidence.

Research with teachers serving in post-conflict areas of Afghanistan and Ethiopia demonstrates that acknowledgement of teachers' experiences and the development of confidence as a part of TPD has positive

2 Winthrop, R. & Kirk, J. (January 2005) Teacher Development and Student Well Being. In *Forced Migration Review*, (22) p. 21. Available : http://www.fmreview.org/FMRpdfs/FMR22/FMR22full.pdf

effects for teachers and students.[2] Many online TPD programs, such as Harvard's *WIDE World*, used by teachers in Namibia and Uganda, and Namibia's Online Distance Learning program involve short-term mentoring that lasts the several weeks required for completion of a course.

Mentoring helps reduce the anxiety and sense of isolation that can keep teachers from trying new approaches in their classrooms. Mentoring also serves as a non-formal or semi-formal method of ensuring accountability: teachers can complete TPD, demonstrating mastery of the targeted knowledge and skills that they never import into their classrooms. Once an effective mentor-mentee relationship is established, however, novice teachers are both better supported in and more accountable for those first steps toward implementing something new.

Face-to-face mentoring, when focused on instructional issues, can help teachers develop *basic, intermediate* and *advanced* skills. Telementoring, because it generally involves the use of computers and requires literacy and typing skills, is more useful among teachers with *intermediate* and *advanced* skills.

Consider using mentoring to…

- Support gains made in trainings, Open Lessons, and other models of professional development
- Provide new teachers with ongoing feedback, guidance and support
- Lessen the personal and professional isolation of teachers who are new, reside in remote geographic areas, and/or teach in one-room or small schools
- Improve the teaching practices of para-teachers and uncertified teachers

How can ICT support mentoring?
- Enable teachers to use email, online chat, cell phones, or telephones to communicate with mentors outside their immediate areas (telementoring)

MENTORING AT A GLANCE

Strengths	Limitations	Cost considerations
• Face-to-face Mentoring: low cost • Provides access to information, role modeling, good instructional practice, assistance as needed, and personal support • Can allow new teachers to collaborate and form relationships with colleagues within and across schools • Where Mentoring programs are in place, teacher attrition rates drop and teachers report greater job satisfaction	• Requires participation of knowledgeable teachers with good teaching and personal skills • Labor intensive • Mentor and "mentee" (the teacher being mentored) may not get along • May reinforce teacher's isolation unless Mentoring supports team-based or collaborative activities • Needs incentives to function (e.g., paying mentor increases accountability) • Mentor teacher must feel he/she is getting something from relationship, so any Mentoring program must build in strategies for mutual learning • Harder to maintain a relationship if mentor and mentee do not have opportunities to meet • Telementoring is highly dependent on functioning technology. If technology fails, communication will most likely cease. • Telementoring involves degree of literacy and facility with computers (composing and sending an email, using chat)	• Stipend for mentor to assure continued participation • Cost of computers, Internet , or other communication tools (cell phones, two-way radio) • Training costs—training on computers, Internet, email and chat

Table 7: Mentoring

- Provide access to online resources, experts, coaches and learning communities through educational Web sites and portals
- Offer teachers learning spaces, bulletin boards, *Web logs* (blogs), teacher *wikis*, and e-mail discussion groups (listservs)
- Provide support at a time and location convenient to teachers
- The solitary act of writing to a mentor can often prompt reflection and self-assessment among teachers—which are critical factors in professional growth.

Professional Development Schools[3]

Professional Development Schools often take the form of a partnership between a school and a local teachers college. A cluster of teachers is identified within the school as "master teachers." Teachers are chosen for their overall skills but receive additional instruction in Mentoring and collaborative approaches at the teachers college or through another means (e.g., an online course).

Student teachers at the teachers college enroll in practica (or internships) with the master teachers, gain hands-on experience implementing specific classroom techniques, return to the teachers college for more instruction, and upon graduation are placed in this same school where a master teacher becomes their mentor for the year.

Over time, cohorts of highly trained younger teachers are created at the Professional Development Schools. As they gain experience, these younger experts can become mentors in other schools or can help extend the program of Professional Development Schools to other teachers colleges. (Note that this model for the expansion of Professional Development Schools is yet another variation of the cascade approach, but one in which entire cohorts of teachers are deployed in ways that enable them to provide mutual support for advanced teaching and learning.)

Professional Development Schools can help meet the needs of *in-service* teachers as well. Teachers from schools in the region visit the Professional Development School for a week's stay, observe classes, engage in study—of content areas, teaching practices, or ICTs—and develop lesson plans that they then test in a class at the Professional Development School. In this approach, a classroom of students who have already experienced active-learning or other pedagogies becomes an instrument supporting the visiting teacher as she or he experiments with similar techniques.

Professional Development Schools exist primarily in the United States, Canada and Europe. Chile's highly successful ICT-in-education program, *Enlaces*, uses components of the Professional Development School model in teacher training. Professional Development Schools can exist in areas where schools and teachers colleges are nearby. However, for a Professional Development School to be successful, there must be core groups of effective teachers at both the teachers college and at the partner school.

Professional Development Schools can also take the form of partnerships between high performing and low performing primary or secondary schools. As part of a project thatthatbegan in January 2006, four teachers at the American School in Mexico City, in conjunction with Mexico's Secretaria de Educación Publica (SEP), provide professional development inICT integration to several local public secondary schools. This professional development involves workshops, reciprocal classroom observations and resource sharing, and follow-up assistance to targeted secondary school teachers.

Professional Development Schools can help teachers who have *basic* skills develop *intermediate* and *advanced* skills.

3 Darling-Hammond, L. (February 1998). Teacher Learning that Supports Student Learning. In *Educational Leadership* (55), 5. pp. 6-11. Fulton, K., Burns, M. & Goldenberg, L. (December 2005). *Teachers Learning In Networked Communities: A Strategy. In Phi Delta Kappan.*

PROFESSIONAL DEVELOPMENT SCHOOLS AT A GLANCE

Strengths	Limitations	Cost considerations
• Works where teachers colleges have a relationship with nearby primary school • Collaborative approach that involves teacher colleges and schools working together to improve teacher quality (or high resource schools such as private or international schools and local national or public schools) • Connects teacher's "school" learning with professional learning • Provides several supports for the new teacher—teacher college as well as a school-based mentor	• Can only occur in areas where teacher colleges are near primary schools with cohorts of good teachers • Requires structured management of student- and master-teacher postings to ensure continuity • Only works where course of study for prospective teachers is more than one year in length • Issues of logistics and coordination between two organizations (school and Teachers' College)	• Costs of training school-based teacher cohorts • May involve travel costs between teachers college and school • Possible costs of additional courses (online and face-to-face)

Table 8: Professional Development Schools

Consider using Professional Development Schools to…

■ Strengthen the relationship between teachers colleges and schools

■ Serve as a form of *new teacher induction*: PDSs can help smooth the transition from cTeachers college to primary school because each new teacher has previously completed a practicum at this school

■ Leverage resources (e.g., primary school teachers can use the computers at the teachers college to practice ICT skills)

■ Create a community of practice among teachers colleges and schools

■ Improve teachers' conceptual and instructional skills by providing continuous access to teachers college–based instructors and school-based master teachers

■ Develop a core of highly qualified "master teachers" at various schools

How can ICT support Professional Development Schools?

■ Teachers can use email, online chat, cell phones, or telephones to communicate with colleagues in other schools

■ Create "centers of excellence" in technology integration that provide hands-on practice for teachers from all schools

■ Establish communities of practice between master teachers at the Professional Development School and faculty at the partnering teachers college to tighten the link between pre-service TPD and student practica

■ Enable student and master teachers to communicate via email, chat or mobile phone when student teachers return to teachers colleges or are posted to other schools

Dual Audience, Direct Instruction

The model typically involves the use of interactive radio, interactive television or virtual schools to deliver instruction directly to classrooms.* Programs support student learning and at the same time guide the

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* The virtual high school model has been used in low-resource, rural areas of the United States where there is a shortage of certified teachers. A non-qualified classroom teacher and a certified online teacher work together to provide instruction to students. The online teacher creates lessons, grades student work and provides feedback to students via email. The classroom teacher manages the classroom, making sure students are on task. The classroom and online teacher correspond via email, telephone and chat about subject area, instruction, etc. LLittle research is available on this as a reliably effective model of TPD, although teachers who have been interviewed state that it has helped them with content, assessment and instruction.

teacher through the step-by-step conduct of the lesson. The classroom teacher and the radio or television "teacher" co-teach students but the classroom teacher and students are also co-learners.

This model benefits both of its intended audiences: students receive higher-quality instruction; teachers gain hands-on experience of classroom practices. Dual Audience Direct Instruction can help teachers explore active-learning pedagogies, manage discussions, and other unfamiliar or under-utilized techniques.

Successful examples of the Dual Audience Direct Instruction approach include interactive radio instruction (IRI) as it has been implemented in many countries; Mexico's *Telesecundaria* program, involving interactive television-supported instruction; and Louisiana's (USA) Algebra I project, involving in-class, Internet-supported instruction. The Dual Audience Direct Instruction model can be strengthened by creating teacher training programs that complement the use of radio, television or the Internet in the classroom. IRI has been used to upgrade instructional quality in Guinea and Nigeria and to upgrade teachers' skills in Mali and Guinea.[4]

Radio, because of its cost, reach, simplicity and ease of integration is the most popular of these dual audience instruction tools. With over 200 million children out of school, half of whom live in countries recovering from conflict, radio offers access to education in a way that no other tool can approach.

Dual Audience Direct Instruction can help teachers develop *basic* and *intermediate* skills. Because it is so highly directive and structured, it leaves little room for teacher improvisation or adaptation and is less effective for developing advanced skills.

Consider using Dual Audience Direct Instruction to…

■ Increase access to education in rural and other isolated environments
■ Increase the quality of instruction in those environments
■ Develop teachers' skills in specific classroom techniques and pedagogies
■ Gain specific benefits of ICTs (e.g., scale, low cost, access to content) through the use of radio or television in situations in which computers cannot be used as a result of inadequate capacity (on the part of teachers, technical support, project managers, et al)
■ Introduce education in areas of conflict where students are denied access to the formal education system

DUAL AUDIENCE DIRECT INSTRUCTION AT A GLANCE

Strengths	Limitations	Cost considerations
• Structure is useful for teachers with minimal or no content and instructional skills • Except for virtual school model, the technology is easy to learn • Fits into the existing classroom structure	• High capital costs • Cost of and access to Internet if Web-based virtual school model is used. Must be reasonable bandwidth to permit online exchanges between in-class student and teacher and online teacher • Model is highly structured, with little room for improvisation • Virtual schools model demands literacy and some degree of technical skills on the part of the teacher • Technology dependent. If there is a problem with technology or broadcast signal, learning does not occur. This can be mitigated somewhat by including teachers' guides for all programs.	• Involves technology: radio, television and Internet • High production costs and content and curriculum development costs • Television is especially costly • Need Internet connectivity for Web-based programs (virtual school) • Costs of paying online teacher salary for virtual school model • Intensive instructional design process is time and cost-intensive

Table 9: Dual Audience Direct Instruction

4 Ministry of Education, Science and Technology (2005). ICT in Education Options Paper, p. 16. Nairobi: Government of Kenya.

FINDING TIME FOR TEACHER PROFESSIONAL DEVELOPMENT

Good quality professional development takes time. Teachers are typically overworked, and finding time to participate in professional development activities can be a major constraint. There are many strategies for making time available for teacher improvement. Some take teachers out of their regular teaching duties, so do not add to their work hours. Others require teachers to put in extra time.

Strategies to gain release time for teachers from their normal duties:

1   Use substitutes or release students.
2   Use parents, adult volunteers or older students to watch a class.
3   Have local inspectors or school directors teach the teacher's class. This will help to reorient them to the practicalities of classroom instruction.
4   Purchase teaching time by using permanent substitutes, retirees, community members.
5   Use technology—radio, TV, video, podcasts, or audio taped lessons—with a head student.
6   Substitute appropriate radio or television programming for regular instruction.
7   Schedule an outside activity/trip with volunteer leaders and chaperones.
8   Use independent study to let students work on something that interests them or on a special project.
9   Involve students in community service activities.
10 Use very large classes on occasion for special topics and exposure to outside activity.
11 Restructure time by permanently altering teaching responsibilities, teaching schedule, the school day, or the calendar.[5]

Strategies that require time in addition to normal teaching duties:

1   Schedule professional development after school hours and provide some compensation or reward for summer or weekend work.
2   Schedule a common planning time for teachers.

5 Adapted from Corcoran, T.B. (June 1995). Helping Teachers Teach Well: Transforming Professional Development. CPRE Policy Briefs. New Jersey: Consortium for Policy Research in Education.

IMPLEMENTING ICT-SUPPORTED TEACHER PROFESSIONAL DEVELOPMENT

UNDERSTANDING CHANGE: TYPES OF "ADOPTERS"
Understanding Change

The change associated with ICT is rapid and dramatic. In contrast, people and organizations tend to resist change or embrace it slowly. This tension demands the presence of a school-based or local "change agent"[6]. School leaders and on-site support staff (or "follow up" persons) can best help teachers—and lessen their own frustration—if they understand the change process. With this in mind, the following points should be kept in mind when implementing ICT for teacher professional development projects

- Not every teacher will react to an innovation (ICT, a new way of instruction) in the same way—some will embrace the innovation; others will reject it. In working with teachers, it is important to understand that there are "change types" who will exhibit similar patterns of behaviour toward a proposed change. Of course, not every person falls neatly into such categories but knowledge of such change types is useful.
- Even if teachers *want* to use computers or radio for instruction, they will approach this use with a number of concerns. The concerns vary in stages from how something (e.g., radio) affects them (*self concern*) to how they can use it (*management*) to how it fits with their teaching (*adaptation*). By identifying the teacher's level of concern, the support person better target assistance to the teacher. For example, if one teacher is concerned about management of 80 students and 4 computers, the support person must work with the teacher to address these management issues. If another is concerned that the radio teacher will usurp his authority in the classroom, the support person must work on allaying these concerns.
- Teachers' concerns will change in response to each new innovation or each incremental change in innovation.[7] The more dramatic the expected change, and the more intense the teachers' concerns, the more help they will need.
- Teachers' concerns around an innovation and their willingness to use it depend upon a number of factors:
  - *Complexity:* A teacher may feel more anxious about a computers, which is a complex tool, versus a radio, a simpler tool.
  - *Support*: Teacher ability to implement an innovation depends upon the amount of available support.
  - *Expectations*: The more dramatic the expected change, and the more intense the teacher concerns and the more help teachers will need.
- If ICT use is kept simple, expectations are modest, and ongoing support is provided, teachers are more likely to implement innovations at the school level.

The process of change is long and protracted (some research points to three to five years for change to occur). In creating and conducting professional development programs, it is important to be able to identify and understand change "types" in order to set realistic goals for TPD. As the table below illustrates, a small percentage of people are *innovators* and will jump on board any innovation. A slightly larger group (*resistors*)

6 This is the term used by Hord, S., Rutherford, W.L., Huling-Austin, L., & Hall, G.E. (1987). *Taking Charge of Change.* Austin: Southwest Educational Development Laboratory.
7 Hord, S., Rutherford, W.L., Huling-Austin, L., & Hall, G.E. (1987). *Taking Charge of Change*, p. 54. Austin: Southwest Educational Development Laboratory.

Innovators
These are people who, by nature, always want to try new things. They like to be at the front of the process and embrace innovation.

Innovators are a small percentage of any group.

Early Adopters
These are people who are typically opinion leaders. They have the respect of their colleagues and other teachers. These influential people are not as adventurous as innovators, but typically keep track of new ideas and initiatives to see what might be worthwhile. If they decide to use ICT, their opinions and actions will influence others around them.

Though not as small in number as innovators, *Early Adopters* are also a small percentage of any group.

Early Majority
These people are a bit more conservative than the early adopters. They are "deliberate." They adopt new ideas just before the average member of any group does, but don't tend to keep track of ideas and initiatives that might be new and exciting.

Early Majority comprise a significant portion of any group.

Late Majority
Late majority people go along with a change, not out of belief, but out of necessity or inevitability. They are concerned about doing a good job according to existing standards and methods, so they are slow to risk of a new approach.

Late Majority represent a significant portion of any group (typically one third).

Resistors
Resistors are highly resistant to and never accept change, preferring the status quo. A program may not be able to impact such people or may impact a small percentage of them, and then only in a marginal way.

Resistors are a small, but often very influential, percentage of any group.

will simply refuse to embrace whatever change is being promoted. Most people fall in the middle of these two positions as *early adopter, early majority* and *late majority* types.

This schema is not fixed in stone. Individuals can fall into different categories for different innovations. A teacher may be an *early adopter* of IRI but a *resistor* when it comes to computers. The rate of change is impacted by ease of use and the available support.

Even though innovators may be most likely to embrace change, they are **not always** the best models for other teachers who may think that the innovators are too innovative, different, or talented to be emulated. Instead, teachers are often more willing to follow the example of the early adopters, who are often considered reliable barometers of the validity of innovations and also tend to be faculty leaders in other areas.[8]

COMPUTERS IN CLASSROOMS OR LABS?
Getting Computers into Classrooms

Computers are only valuable when they are being used. Teachers will only use computers when they are available, in proper working order, and when they are seen as *adding value* to their regular scope of work.

The eventual goal of any TPD project focused on *integrating* computers into teaching and learning should be to place computers in teachers' classrooms. This is the most effective way to help teachers and students to integrate computers into the learning process and indeed to transform that process itself. However, the notion of computers in classrooms may be viewed with alarm or with overt skepticism because of the many logistical, instructional and physical challenges that such an idea raises.

8 Dimock, K.V., Burns, M. & Heath, M. (2001). *Applying Technology to Restructuring and Learning: How Teachers Use Computers in Technology Assisted Constructivist Learning Environments*, p. 55. Austin: Southwest Educational Development Laboratory.

What are some of these challenges?

- **Infrastructure**
  Providing electricity and security for classrooms. Many schools, especially traditional structures, cannot accommodate computers.
- **Security**
  Equipment may break or be stolen.
- **Classroom management**
  How can teachers distribute use of 5 computers among 75 students?
- **Instructional**
  How can teachers use computers to improve student learning?
- **Conceptual**
  Computers in classrooms contravene dominant paradigms of ICT as a separate area of study in the curriculum

	Well suited to:	Considerations
Computer labs	• Traditional instruction • Computer-aided instruction (drill and practice software) • Easy maintenance and security • Lower capital and recurrent costs[9] • Equalizing access (everyone can use the lab) • Good for teaching ICT skills	• "Pull" factor: Teachers must bring students to the computer lab. • 45-60 minutes per week access to a computer does little to enhance teacher and student ICT skills • Integration of ICT into subject areas is difficult with labs (lab is "booked" and classes must wait to use computers) • Labs tend to focus instruction on "one size fits all" approach • Skills instruction tends to be divorced from content • "Tragedy of the commons:" Keeping ICT in a lab makes computers the private domain of lab manager or teacher and removes responsibility for their care and use from classroom teacher • With 1:1 student to computer ratio, students tend to interact with computers instead of collaborating with classmates • Once the novelty wears off, teachers may be less inclined to bring students to lab
Computers in the classroom	• Integration of ICT into subject areas • Learner-centered instruction • Many schools in developing countries have successfully integrated computers into the classroom (e.g., public schools in Latin America, the Caribbean) • Provides anywhere anytime access to ICT • Enables much greater use of ICTs for "higher order'" skills (fewer computers in classrooms may enable even more use than greater numbers of computers located in separate computer labs[10]). • Ever-present physical reminder that computers must be used (students will agitate for their use.)	• "Push" factor: Computers are brought to teachers and students. • Must be more than one computer in a classroom. If only one, teacher tends to regard it as his/her private property. • Adding computers to classrooms alone does not ensure improvement of student achievement. • Intensifies importance of professional development and on-site/local technical support • Teachers need to learn to use and integrate technology in their classrooms. This process results in changed beliefs about how to improve students' understanding, competence and performance.[11] • Typically more expensive than a computer lab

9 A McKinsey & Company study, found that classroom model with a computer for every 5 students and a high speed T-1 connection would cost about four times as much as computer lab model in up-front investments and a little more than 3 times the per student recurrent cost. Project analysis in Egypt found that significant economies of scale were possible if larger laboratories were used. See Bakia, M. *The Costs of Computers in the Classroom: Data from Developing Countries.* In *TechKnowLogia* 1 (4). Available: http://www.techknowlogia.org/TKL_active_pages2/CurrentArticles/main.asp?FileType=HTML&ArticleID=370
10 InfoDev. (March 2005). *Knowledge Map on Information & Communication Technologies in Education Topic: Impact of ICTs on Learning & Achievement.* Available: http://www.infodev.org/files/1152_file_KnowledgeMap_ICTsEducation_impact.pdf
11 Sandholtz, J.H., Ringstaff, C., Dwyer, D.C. (1997). *Teaching with Technology: Creating Student-Centered Classrooms.* New York: Teachers College, Columbia University.

Arguments against computers in classrooms have been used in every country where classroom integration of computers has been proposed. Solutions to infrastructural and financial challenges—including security, electricity, and even the cost of hardware—can in many cases be found through proven alternatives. Instructional issues—ranging from how to manage use of a few computers in a crowded classroom to how to properly integrate computers into teaching and learning—are *better* addressed when computers are readily available in classrooms than when access is restricted to computers labs.

Research demonstrates that when it comes to technology *less can be more*: A smaller number of computers placed in classrooms can be used more effectively for teaching and learning than *more* computers in a computer lab. Teachers and students are more likely to improve their technology skills when they have immediate and frequent access to technology and when it is used in the service of a curricular task. [12] Students can explore, conduct research, write reports, and create presentations, all within the context of a particular subject area. And because computers can allow students to learn in a variety of ways, computers in classrooms can move instruction away from a passive, teacher-centered model of instruction to one that is more conducive to student problem solving, written communication, and creativity—skills identified as necessary for 21st-century success.[13]

Computers in classrooms demand space, suitable infrastructure, and a secure environment (burglar bars) all of which add to cost and may be difficult to introduce on a large scale. Most schools likely do not have the facilities to permit a computer anywhere, least of all in classrooms. But some schools do have such facilities, or could create such upgrades. Therefore, policymakers can begin with these schools in a phased in basis, over a period of several years. This may be accomplished through the following strategies:

Smart or Model Classrooms Model: A "pod" of four computers and a projection device in one-to-two classrooms per school. These classrooms are identified as "smart (or model) classrooms" based on certain criteria. Teachers in these classrooms receive intensive TPD in integration and serve as models for their colleagues.

Characteristics	Strengths	Limitations
• Some variation of this approach can be found in numerous developing nations—for example, computer clusters in public schools in Mexico and the Caribbean. • These teachers receive ongoing TPD (basic computer skills and integration of ICT for student learning), technical and instructional support, and agree (through written means if necessary) that computers will be used as part of instruction and taken care of or they will be removed and given to another teacher. • To ensure equity, incrementally build capacity, and properly phase in such an approach, schools could rotate classrooms, assigning two new teachers to the "smart classroom" each subsequent year.	• Places ICT in classrooms where students can access it as needed for learning. This helps with integration. • Pilot version of "computers in classrooms." Policymakers and leaders can evaluate strengths and weaknesses of approach and fix it. • No need for major remodeling or reconstruction of whole school to accommodate computers in all classrooms.	• High student to computer ratio may create classroom management problems for teachers. • How helpful are four computers for 80-100 students? • May not be the physical space for computers. • Teachers may resist the idea, fearing they will be blamed if computers are damaged.

12 Harrison, C., Comber, C., Fisher, T., Haw, K., Lewin, C., Lunzer, E., McFarlane, A., Mavers, D., Scrimshaw, P., Somekh, B. and Watling, R. (2002) *ImpacCT2: The Impact of Information and Communication Technologies on Pupil Learning and Attainment*. London: DfES and Becta. See also Leach, J. (2004.) *The Potential of Hand Held Computer Technology to Serve the Needs of Teachers' Education in Africa Rural Settings*. OpenNet. Available: http://www.ece.uth.gr/OPENnet/conferences/ecer2004/fullpapers/Leach.pdf; and Dimock, K.V., Burns, M. & Heath, M. (2001). *Applying Technology to Restructuring and Learning: How Teachers Use Computers in Technology Assisted Constructivist Learning Environments*. Austin: Southwest Educational Development Laboratory.
13 These skills were identified by a panel of Delphi experts assembled for the creation of this Handbook.

Computers on Wheels: These are carts which, typically, securely store 20 laptop computers which can be wheeled from classroom to classroom. (They may include a printer).

Characteristics	Strengths	Limitations
• COWs can be stored in a safe secure area and wheeled to classrooms as needed • Or laptops may be distributed among several classrooms, thus transforming several classrooms into "smart classrooms".	• Can be shared among classrooms as needed • Laptops are portable and have a 2-hour battery life • They provide access to computers even within crowded classrooms, without significant remodeling or installation of additional electrical outlets, or needing to reserve space • COWs can be also used in support of ICT-embedded teacher professional development programs.[14] • Teacher is only responsible for computer when using it. • Shares the strengths associated with labs (one secure centralized storage area, localized infrastructure) but are also available to classrooms.	• May be difficult to wheel carts across rough terrain or up and down steps • Laptops are portable and more easily stolen than a desktop • More expensive than desktops to repair • Laptops have a higher unit cost than desktops. • Can suffer from the same "tragedy of the commons" situation where as communal property, no one is seen as responsible for their upkeep and maintenance.

Teacher leasing system for laptops: Rather than providing computers to schools, policymakers may wish to create laptop leasing programs for teachers.

Characteristics	Strengths	Limitations
• Offer teachers their own laptop with low or no interest loans • Use available funds to purchase projection devices that connect to laptops • Comes with the stipulation that the laptop be used as part of instruction for students.	• Help diffuse technology skills by providing teachers with increased access to computers both at home and in school, • Frees schools from having to purchase computers • More feasible given the increase in refurbished equipment and the promise of low-cost laptops.	• Guarantees that computers will be used in a traditional, teacher-centered way (as a lecture tool) with students having no hands on access to hem • Will only work where there is reasonable absorption capacity—enough people with enough money to want to buy a computer • Responsibilities for upgrading and maintenance issues must be settled

14 Rusten, E. (2002). Configuration of School Technology: Strategies and Options. In *Techknowlogia*. Available: http://www. techknowlogia.org.

Alpha Smarts: *Alpha Smarts* are portable word processors into which students and teachers can type text.

Characteristics	Strengths	Limitations
• Text is inputted into portable *Alpha Smarts* and can then be transferred into any software application that contains a blinking cursor via a cord or through an infrared connection.	• *Alpha Smarts* have a very long battery life • Much less expensive than both desktops and laptops • Portability • Can allow for classroom-based computing if desktops or laptops in classrooms are not an option. • Sturdy, lightweight, low cost • Share the strengths associated with labs (one secure centralized storage area, localized infrastructure) but are also available to classrooms.	• Where *Alpha Smarts* are to be employed in classrooms (in concert with computers), TPD must help teachers understand how to coordinate and integrate the use of both the handhelds and computer. • Ease of theft • Not as versatile as desktops or laptops • Do not provide Internet access or other software applications • Lack of local language versions

Handheld computers: "Handhelds" (In this instance, Palms Pilots, Portable Digital Assistants) and "tablets" (Tablet PCs, digital tablets, e-slates) are used extensively in the U.S., Canada and Europe as a lower cost alternative to computers (Palm pilots and other PDAs can be used with computers. They must be periodically connected to and "synched" with computers so their information can be safely stored in the event of battery dying). Teachers who use handhelds are generally positive about them. The *EduVision* project in western Kenya uses "E-slates" (a wireless digital tablet) that connects to a base station in the school and a satellite radio receiver. The base station processes the information from the satellite transmission and turns it into a form that can be read by the handheld E-slates.

Characteristics	Strengths	Limitations
• Used extensively and successfully within the U.S, Canada and Europe as a more mobile, personal and cost-effective alternative to desktop computers • South Africa and Egypt, the Digital Education Enhancement Project (DEEP) demonstrated the efficacy of handhelds for teacher professional development in rural and urban schools • Digital tablets allow user to write by hand with stylus (pen-like instrument). Handhelds can recognize handwriting and can also use a portable keyboard. • Digital tablets cut down on the need to teach typing and keyboarding skills	• Handhelds, such as Palms, are much less expensive than both desktops and laptops. Tablet PCs are comparable to laptops in expense. • Portability • Sturdy, lightweight • Can increase time using technology, motivation and collaboration and communication • Study with 100 US teachers indicated that they are perceived as 'effective instructional tools', with the potential to have a positive effect on pupil learning.[15] • Shares the strengths associated with labs (one secure centralized storage area, localized infrastructure) but can be distributed to classrooms.	• TPD must help teachers understand how to coordinate and integrate the use of both the handhelds and computer. • Ease of theft • Not as versatile as desktops or laptops • Small screen makes viewing difficult • Though increasingly powerful, handhelds don't offer the range of software applications of computers • Must be "synced" on a regular basis with laptop. When battery dies, information is lost. • As cell phones become more powerful, they will offer same applications as handhelds. • Digital tablets are more expensive than handhelds or Alpha Smarts

15 Leach, J. (2004.) *The potential of hand held computer technology to serve the needs of teachers' education in Africa rural settings*. OpenNet. Available: http://www.ece.uth.gr/OPENnet/conferences/ecer2004/fullpapers/Leach.pdf.

CLASSROOM MANAGEMENT MODELS (MANAGING THE LIMITED COMPUTER ENVIRONMENT)[16]

Computer integration into curricular activities is the most promising route to enhancing student learning and helping students learn technology skills. Yet if computers are to be placed in a classroom, how will the teacher assure equity of access and control of the class when there are so few computers and so many students?

Unlike the *ICT as a delivery system* approach or *ICT as content* approach, the *ICT for integration* approach, especially within the context of learner-centered instruction, means that students *cannot* all complete the same assignments at the same time—management of limited computer resources is critical. The following classroom management strategies can help teachers better integrate computers into the instructional process.

- **Learning stations model (student-computer ratio: 25:1)**. Students are organized into five teams of five (the number of team members can be smaller but should not be higher than this) and are assigned to a certain "station." Each team member has a particular role (leader, recorder, time keeper, etc.). Each station represents a particular activity. For example, at station 1, students might read a passage from a textbook. At station 2, they write a group report about it. Station 3 is the computer where they type the story. At station 4, they review their work. At station 5, they add drawings to their story.

After a certain period of time (30 minutes or an entire class period), teams rotate to the next station and begin their assigned task. By the end of the day or several days, each team will have rotated through all stations and completed their assignment. Learning station models work best if each station has a roles for each team member as well as instructions for completing the tasks at that station. The computer can be one of the learning stations. For extremely large classes, the teacher can have 3 sets of learning stations (25 students each).

Learning stations are used in schools throughout the globe.

- **Distributed task model (student-computer ratio: 15: 1)**. This model is useful for carrying out more complex projects that require different skill sets and levels of expertise. It is also a good model of peer-based computer instruction. Students are organized into teams of 15 and given a task (for example, creating a newspaper). The team further subdivides according to topic: Some will report on the environment, some on sports, some on a local issue, etc. They write their story by hand and organize a time to sit at the computer with writers who guide them in typing and formatting their portion of the newspaper article on the computer. When they finish, the next set of reporters meets with writers who guide them through the same process. The remainder of the team edits the final copy.
- **Collaborative groups model (student-computer ratio: 15-to-1)**. In the collaborative groups model, each small group is responsible for creating some component of the whole group's final product. For example, a team may be assigned a project-based scenario: how can we ensure clean water in our community?[17] Students are organized into 5 teams of 15. One subgroup of the team designs the water filtration system, another gathers materials, another documents the process and another group creates a *PowerPoint* presentation of it. Each has contributed a different piece of the larger final product.

Clearly, the above sorts of activities could not be conducted in a computer lab, in part because computer placement provides little area for groups of students to work comfortably on and off the computer. Further, there simply would not be enough time, and the low student-computer ratio or 1:1 student-computer ratio would result in students interacting with the computer and not with each other. For this reason, providing teachers with a few computers in their classrooms—at least in a few classrooms—leads to integration in a way that computer labs could not.

16 Burns, M. (June 2002). *Technology, Professional Development and Changing Practice.*
Technology Horizons in Education Journal. Available http://www.thejournal.com/magazine/vault/A4070.cfm
17 This is based on an actual activity in which students at Amilcar Cabral Primary School (Conakry, Guinea) created a water filtration system using items from home.

LEARNER-CENTERED INSTRUCTIONAL METHODS

Learner-centered instruction may not be a well understood concept. Is it one instructional method or several? What do learner-centered classrooms look like? Learner-centered instruction is indeed a "suite" of instructional methods, all of which have the student, not teacher, doing most of the work. The following table presents four of the more common learner-centered methodologies used in primary (and secondary) instruction.

Another learner-centered model is case-based instruction, though this is most commonly employed at a tertiary level and in professional schools, such as law and medical schools.

Project Oriented Learning	Problem Based Learning	Inquiry-based Learning	Collaborative Learning[18]
• Begins with organizing issue: Builds on students' knowledge or interests • Provides a meaningful and authentic context for learning • Students design the process for reaching a solution. • Students are responsible for accessing and managing the information they gather • Evaluation occurs continuously. • Students regularly reflect on what they're doing. • A final product (not necessarily material) is produced and is evaluated for quality. • The classroom has an atmosphere that tolerates error and change.	• Begins with a problem situation • Is ill-structured—there is no one way to solve problem • Problem is a real world one so the context is meaningful and authentic (real) • Focuses on higher order skills (problem solving, analysis, evaluation) • Learners must be self directed • Students work collaboratively to solve problem • Evaluation occurs continuously. • Students regularly reflect on what they're doing. • A final product (not necessarily material) is produced and is evaluated for quality. • The classroom has an atmosphere that tolerates error and change.	• Open-ended learning that begins with a question for inquiry or investigation • Emphasizes the development of questioning and problem-solving skills • Students take the role of scientists or mathematicians. • Observe and question; hypothesize; conduct tests to support or contradict their theories; analyze data; draw conclusions from experimental data; design and build models; • Engage in trial and error • Analyze and reason carefully • Students work collaboratively to solve problem • Evaluation occurs continuously. • Students regularly reflect on what they're doing. • A final product (not necessarily material) is produced and is evaluated for quality. • The classroom has an atmosphere that tolerates error and change.	Team-based learning that focuses on students learning together. It contains the following characteristics: • Interdependence: Everyone has a role and everyone's contribution is important in the overall product • Participation is unique and necessary: Everyone is accountable • Individual and group responsibility • Comfortable atmosphere: mistakes are tolerated and different viewpoints are respected Cooperative learning is a variation on collaborative learning, requiring less collaboration and more independent work among team members.

18 Johnson, D.W. & Johnson, R.T. (1991). *Learning Together and Alone.* Englewood Cliffs, N.J.: Prentice Hall.

GLOSSARY

Activity: Generally refers to a process or set of actions performed by teachers and students; may be substituted for "lesson."

Assessment: Any of a variety of procedures used to obtain information. Includes numerous types of measurement of 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, fiber-optic cable, wireless or T-1 line.

Blog: A Web log or publicly accessible journal that is kept online. Blogs allow for comments and feedback by readers. Teachers with computer and Internet access can keep blogs documenting new approaches in the classroom and associated concerns and successes, while their colleagues, from across the country or across the globe, can read and comment on their observations.

Broadband: A range of frequencies wider than that required for voice communications. Also a term used to describe systems and equipment with wide bandwidth that can carry these ranges of frequency.

Chat (a.k.a Instant Messaging): An informal online way of directly connecting people who are online at the same time. AOL Instant Messenger (AIM), ICQ, or IChat are free "chat" applications.

CAI: Computer Assisted Instruction typically involves content, problem sets, and feedback adjusted by a computer to reflect student performance by addressing specific deficiencies.

Case based instruction: Cases are factually-based, complex problems written to stimulate classroom discussion and collaborative analysis. Case teaching involves the interactive, student-centered exploration of realistic and specific situations. As students consider problems from a perspective which requires analysis, they strive to resolve questions that have no single right answer.

Collaborative learning: An instructional methodology characterized by the following characteristics[19]: 1) Positive Interdependence, 2) Individual Accountability, 3) Social Skills, 4) Face to Face Interaction, and 5) Group Processing

Computer technology (a.k.a Technology): Computer hardware and software, as well as any devices that can be connected to computers, such as display devices, peripherals, probes, graphing calculators, televisions, and VCRs.

Connectivity: Refers to technologies that specifically allow computers and other electronic devices to communicate with one another, particularly the use of such telecommunications technologies, such as email, the Internet, chat.

Cooperative learning: A structured, systematic instructional strategy in which small groups of students work together toward a common goal. Cooperative learning may be considered a subset of collaborative learning. There are numerous forms of cooperative learning (e.g. group investigations, peer tutoring, etc.)

19 CLRC.com. (2005). *Cooperative Learning* http://www.clrc.com/pages/dwj.html

and each has its appropriate application depending on the nature of the student population and the type of educational outcome to be fostered.

Cost-benefits analysis: A process that compares costs of an intervention with the monetary value of benefits of the intervention. Results can be used to determine whether interventions provide specific benefits to intended groups. The results of such analyses of such programs can be ranked to determine overall value.

Curriculum: Generally defined as a fixed course of study for a particular subject area at a certain developmental point (e.g., age or grade). It is a sequence of learning opportunities provided to students in their study of a particular content area (biology, Arabic, etc.) Curricula can be divided into *units* (for example in biology, there are units on cells; on the skeletal system, etc.). Units may be divided into smaller segments of study, often referred to as *lessons*.

Digital audio: Sound files that are stored in binary files (1s and 0s) versus analog format. Digital audio enables sounds to be recorded, stored, downloaded and played on many different devices such as digital tape recorders, MP3 players, and computers (via the Internet).

E-learning: The use of electronic applications and processes to learn. E-learning applications and processes include Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. Content is delivered via the Internet, satellite TV, DVD, and/or CD-ROM.

Handheld computer: Any type of computing device that is small enough to be held in one's hand or kept in a pocket or similar small space. Also referred to as *portable digital assistants* (PDAs). A handheld may be operated with a small pen-like instrument (stylus) or an attached keyboard.

ICT: Information and Communication Technology. Any piece of technology (mainly digital but also analog) that allows users to create, store, display information in all its forms (text, images, video, audio) and communicate it over distance. For the purposes of this handbook, ICT includes computers, television, handheld computers (e.g., Palm Pilots), radio, audiocassettes, DVD and CD players, and cell phones and the convergence of any of these technologies.

Innovation: A program, project, process or practice that is new to an educational system, school, teacher or student.

Inquiry-based learning: A process in which teachers create situations where students take the role of scientists or mathematicians. 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: In a technical sense, interactivity refers to a two-way electronic communication system (such as a telephone, cable television, or a computer) that involves a user's orders (as for information or merchandise) or responses (as to a poll). Interactivity presumes some degree of cognition and reflection on the part of the user and active intellectual involvement with the computer application. Not all software applications are equally interactive.

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

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 or work on real-world projects; employ real world tools; collaborate with peers; and are given greater responsibility and voice in how their work will be assessed.

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.

Lesson study: A structure for teacher collaboration involving lesson planning, observation of teaching and discussion of the results, followed by revision and re-teaching.

List server: An automatic electronic mailing system that facilitates two-way, fully interactive discussions open to the public; lists within private circles; and/or one-way lists that deliver announcements, newsletters, or advertising. Previously posted list server e-mail messages are stored in the list server's searchable archives and often are rich sources of information.

MP4: Developed by the Moving Picture Experts Group (MPEG), MP4 (and MP3) are audio compression standards for encoding music so it can be transmitted via the Internet or another network. An **MP3 Player** is a piece of technology that allows a user to listen to MP3 files.

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.

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

Pedagogy: The science of teaching and the methods used to teach. Synonymous with "instruction" and "methodology."

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.

Post-test/Pre-test: Tests administered to teachers or students before and after an intervention to determine its effectiveness.

Problem-Based Learning (PBL): An instructional strategy in which students solve a real-world problem. PBL activities are often ill structured; involve cooperative teaming; anchor all learning to a larger task or problem; and support the learner in developing ownership for the overall problem or task. Tasks are generally complex, involving higher order thinking and students must often identify resources, overcome problems with data, and must decide upon the content and format of the information gathered.

Project-based Learning (PBL – a.k.a Project-oriented Learning or POL): An instructional strategy that builds upon students' knowledge or interests; provides meaningful and authentic contexts for learning; allows students to access and manage the information they gather; and design the process for reaching a solution.

Scalability: The ability to modify an innovation to support a larger number of users or to address all users in a targeted problem area, or the ability to increase or decrease size or capability in cost-effective increments with minimal impact on the unit cost of business. Includes such dimensions as impact (the degree of transformation in practice) and reach (the number of teachers or schools influenced).

Simulation software: A computer program that imitates a process or set of activities in order to approximate a certain learning environment. Simulation software can be used in situations where the real activity is too expensive or dangerous to conduct otherwise. For example, flight-simulation software allows a user to participate in many of the same actions and decisions as a pilot, but without actually flying a plane.

Sustainability: Sustainability refers to the ability of a program, project or intervention to continue its activities for the long term, in a healthy state and in a resource-conservative and resource-efficient manner.

Technology integration: The use of technology by teachers and students as a tool to support curricular goals, enhance instruction, and ultimately improve student learning. Unlike simple technology *use*, which focuses on computer itself, integration implies that the technology is blended into and coordinated with both instruction and curriculum, but is not the focus of either.

Thin-clients: Thin-clients are desktop appliances or network devices that link a keyboard, monitor and mouse to a server where all applications and data are stored, maintained and processed.

Two-way radio: A radio that can both transmit and receive information (e.g., a walkie talkie).

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

World Wide Web: **An information-distribution method that operates via the Internet to enable users to access information resources linked to Uniform Resource Locators (URLs) or other codes. Web "pages" are displayed in browsing software, and may contain links (often called "hypertext") to other resources.**

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Appropriate Uses of ICT for Teacher Professional Development in Developing Countries

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- Recognize best practices and essential supports in the use of ICT for TPD in order to evaluate proposals of national, regional, and local scale

- Propose types of TPD and ICT implementations that can achieve specific objectives in relation to educational improvement

- Identify cost considerations, potential partnerships, evaluation requirements and other factors essential to the planning of effective ICT-enabled TPD

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