Knowledge Maps:

ICTs in Education

What do we know about the effective uses of information and communication technologies in education in developing countries?

*info*Dev: the Information for Development program

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Contents

About These Knowledge Maps

Executive Summary: Key Findings

Knowledge Maps: Impact

(1) Impact of ICTs on learning and achievement
(2) Monitoring and evaluation issues
(3) Equity issues: Gender, special needs and marginalized groups

Knowledge Maps: Costs

(4) Knowledge Map: Costs

Knowledge Maps: Current implementations of ICTs in education

(5) Current projects and practices
(6) Specific ICT tools used in education
(7) Teachers, Teaching and ICTs
(8) Content & Curriculum issues

Theme: Planning

(9) School-level issues
(10) ICT in Education Policy issues

Appendix: Millennium Development Goals Related to Education

Bibliography

About these Knowledge Maps

Study background

Recent work at *info*Dev created a series of "Knowledge Maps" of what is known – and what isn't – about ICT use in education. These knowledge maps reveal that, despite a decade of large investment in ICTs to benefit education in OECD countries, and increasing use of ICTs in education in developing countries, important gaps remain in the current knowledge base. In addition, there appears to be a dearth of useful resources attempting to translate what is known to work – and not work – in this field for policymakers and donor staff working on education issues in developing countries*, especially those issues related to Education For All and other education-related Millennium Development Goals.*

The knowledge mapping exercise investigated ten topics:

- impact of ICTs on learning and achievement;
- monitoring and evaluation;
- equity issues;
- costs;
- current projects and practices;
- specific ICT tools;
- teachers, teaching and ICTs;
- content & curriculum;
- school-level issues; and
- policy issues

grouped into four major themes: Impact, Costs, Current Implementations and Planning.

Goals and purpose

Excerpts from a series of briefing sheets briefing outlining what is known (and what isn't) about the uses of ICTs in various ways to benefit education, especially where they may relate to the achievement of objectives associated with the education-related MDGS, have been prepared and published in the following pages.

These "Knowledge Maps" attempt to outline where important gaps in received knowledge exist, and were utilized in the formulation of recommendations in support of a series of related research projects and workshops at *info*Dev. Initially a series of internal documents, expressed demand from partner organizations and various donor staff focusing on education issues resulted in *info*Dev deciding to publish these knowledge maps, in the hope that a wider audience may find them useful as well.

The Knowledge Map briefing sheets are meant to serve as quick snapshots of what the research literature tells us about a number of key areas of information related to ICT use in

education. Taking together, they are not meant to be an exhaustive catalog of everything that is known (or is debated) about the use of ICTs in education; rather, they are an attempt to limn the general shapes of a very large body of knowledge. The knowledge mapping is meant to serve as a tool to point to key general assertions and gaps in the knowledge base of what is known about ICTs in education, especially as such knowledge may relate to the education-related MDGs. The end goal of this knowledge mapping exercise was to aid in the formulation of a number of key research questions that point to existing important gaps in the knowledge base.

Based on the findings of this knowledge mapping process, a series of related research, outreach activities and policymaker workshops is being undertaken by *info*Dev in 2005/6.

Sources

It should be noted that this knowledge mapping exercise relies totally on existing research and literature, and borrows shamelessly from it. The knowledge maps were initially meant for internal use to aid in the development of a work plan over the next year, and so explicit individual citations from the research literature are for the most part not made. That said, a list of key recommended resources is provided with each knowledge map; these resources are the primary (although not exclusive) sources from which the information presented in each "knowledge map" was drawn, and could be considered "required reading" for someone wishing to get up to speed quickly on each topic. A full listing of useful resources consulted during the knowledge mapping exercise is also presented in a bibliography.

A work in progress

*info*Dev's series of Knowledge Maps on ICTs in Education are a work in progress. The Knowledge Maps will be updated on a regular basis to reflect new developments and research. Your comments and feedback are welcome at www.infodev.org/education.

Special thanks

Special thanks for comments and suggestions on the Knowledge Maps are due to the *info*Dev team, especially Kerry McNamara; the Distance and Open Learning and Information Technology thematic groups at the World Bank (DOLIT), especially Juan Manuel Moreno and Shobhana Sosale; Robert Hawkins of the World Bank Institute; Cedric Wachholz and the ICT in Education team at UNESCO-Bangkok; and the staff and organizations affiliated with the World Links programs around the world.

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www.infodev.org/education

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Knowledge Maps: Executive Summary

Executive Summary – Key Findings

Recent work at *info*Dev created a "Knowledge Map" of what is known – and what isn't – about information and communication technology (ICT) use in education. This knowledge map reveals that, despite a decade of large investment in ICTs to benefit education in OECD countries, and increasing use of ICTs in education in developing countries, important gaps remain in the current knowledge base. In addition, there appears to be a dearth of useful resources attempting to translate what is known to work – and not work – in this field for policymakers and donor staff working on education issues in developing countries, especially those issues related to Education For All and other education-related Millennium Development Goals.

The knowledge map investigated ten topics (impact of ICTs on learning and achievement; monitoring and evaluation; equity issues; costs; current projects and practices, specific ICT tools, teaching and ICTs, content & curriculum; policy issues, and school-level issues) grouped into four major themes.

Key Findings: *Impact*

- The impact of ICT use on learning outcomes is unclear, and open to much debate.
- There is an absence of widely accepted standard methodologies and indicators to assess impact of ICTs in education.
- There is a disconnect between the rationales most often put forward to advance the use of ICTs in education (to introduce new teaching and learning practices and to foster 21st century thinking and learning skills) and their actual implementation (predominantly for use in computer literacy and dissemination of learning materials).

Key Findings: *Costs*

- There is very little useful data on the cost of ICT in education initiatives, especially those attempting to assess Total Cost of Ownership, nor guidance on how to conduct cost assessments.

Key Findings: *Current implementations of ICTs in education*

- ICTs are being increasingly introduced in education, and interest in their use appears to be growing, even in the most challenging environments in developing countries.

Key Findings: *Policy: Lessons learned and best practices*

- There are emerging best practices and lessons learned in a number of areas, but with a few exceptions (notably on 'schoolnet' development and general lessons learned), they have not been widely disseminated nor packaged into formats easily accessible to policy makers in developing countries, and have not been explicitly examined in the context of the education-related MDGs.

While much of the rhetoric (and rationale) for using ICTs to benefit education has focused on ICTs' potential for bringing about changes in the teaching-learning paradigm, in practice, ICTs are most often used in education in LDCs to support existing teaching and learning practices with new (and, it should be noted, often quite expensive!) tools. While impact on student achievement is still a matter of reasonable debate, a consensus seems to argue that the introduction and use of ICTs in education can be a useful tool to help promote and enable educational reform, and that ICTs are both important motivational tools for learning and can promote greater efficiencies in education systems and practices.

Knowledge Map on Information & Communication Technologies in Education
Topic: Impact of ICTs on Learning & Achievement

Guiding Questions:

- How are ICTs actually being used in education?
- What do we know about the impact of ICTs on student learning?
- What do we know about the impact of ICTs on student motivation and engagement for learning?

Current knowledgebase
What we know, what we believe -- and what we don't

General

- **It is generally believed that ICTs can empower teachers and learners, promote change and foster the development of '21st century skills, but data to support these beliefs are still limited**
  There is widespread belief that ICTs can and will empower teachers and learners, transforming teaching and learning processes from being highly teacher-dominated to student-centered, and that this transformation will result in increased learning gains for students, creating and allowing for opportunities for learners to develop their creativity, problem-solving abilities, informational reasoning skills, communication skills, and other higher-order thinking skills. However, there are currently very limited, unequivocally compelling data to support this belief.

- **ICTs are very rarely seen as central to the overall learning process**
  Even in the most advanced schools in OECD countries, ICTs are generally not considered central to the teaching and learning process. Many ICT in education initiatives in LDCs seek (at least in their rhetoric) to place ICTs as central to teaching and learning.

- **An enduring problem: putting technology before education**
  One of the enduring difficulties of technology use in education is that educational planners and technology advocates think of the technology first and then investigate the educational applications of this technology only later.

Impact on student achievement

- **The positive impact of ICT use in education has not been proven**
  In general, and despite thousands of impact studies, the impact of ICT use on student achievement remains difficult to measure and open to much reasonable debate.

- **Positive impact more likely when linked to pedagogy**
  It is believed that specific uses of ICT can have positive effects on student achievement when ICTs are used appropriately to complement a teacher's existing pedagogical philosophies.

- **'Computer Aided Instruction' has been seen to slightly improve student performance on multiple choice, standardized testing in some areas**
  Computer Aided (or Assisted) Instruction (CAI), which refers generally to student self-study

or tutorials on PCs, has been shown to slightly improve student test scores on some reading and math skills, although whether such improvement correlates to real improvement in student learning is debatable.

- **Need for clear goals**
  ICTs are seen to be less effective (or ineffective) when the goals for their use are not clear. While such a statement would appear to be self-evident, the specific goals for ICT use in education are, in practice, are often only very broadly or rather loosely defined.

- **There is an important tension between traditional versus 'new' pedagogies and standardized testing**
  Traditional, transmission-type pedagogies are seen as more effective in preparation for standardized testing, which tends to measure the results of such teaching practices, than are more 'constructivist' pedagogical styles.

- **Mismatch between methods used to measure effects and type of learning promoted**
  In many studies there may be a mismatch between the methods used to measure effects and the nature of the learning promoted by the specific uses of ICT. For example, some studies have looked only for improvements in traditional teaching and learning processes and knowledge mastery instead of looking for new processes and knowledge relatd to the use of ICTs. It may be that more useful analyses of the impact of ICT can only emerge when the methods used to measure achievement and outcomes are more closely related to the learning activities and processes promoted by the use of ICTs.

- **ICTs are used differently in different school subjects**
  Uses of ICTs for simulations and modeling in science and math have been shown to be effective, as have word processing and communication software (e-mail) in the development of student language and communication skills.

- **Access outside of school affects impact**
  The relationships between in class student computer use, out of class student computer use and student achievement are unclear. However, students in OECD countries reporting the greatest amount of computer use outside school are seen in some studies to have lower than average achievement (the presumption is that high computer use outside of school is disproportionately devoted to computer gaming).

- **Users believe that ICTs make a positive difference**
  In studies that rely largely on self-reporting, most users feel that using ICTs make them more effective learners.

Impact on student motivation

- **ICTs motivate teachers and students**
  There appears to be general consensus that both teachers and students feel ICT use greatly contributes to student motivation for learning.

- **Access outside of school affects user confidence**
  (Not surprisingly) Students who use a computer at home also use them in school more frequently and with more confidence than pupils who have no home access.

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Knowledge Map: Impact on Learning

ICT use in education

- **Where to place computers has an impact**
  Placing computers in classrooms enables much greater use of ICTs for 'higher order' skills than placing computers in separate computer laboratories (indeed, fewer computers in classrooms may enable even more use than greater numbers of computers located in separate computer labs). Related to this is an increasing attention given to the use of laptops by both teachers and students (and in some places, 'computers-on-wheels'), as well as, to a much lesser extent, to the use of personal digital assistants and other mobile devices.

- **Models for successfully integrating ICT use in school and after school hours are still emerging**
  There are few successful models for the integration of student computer use at home or in other 'informal settings' outside of school facilities with use in school.

- **The appropriate ages for introducing computers to students are hotly debated**
  On a general level, appropriate ages for student ICT use in general are unclear. However, it is clear that certain uses are more or less appropriate, given student ages and abilities. Emerging research cautions against widespread use at younger ages.

- **ICTs can promote learner autonomy**
  Evidence exists that use of ICTs can increase learner autonomy for certain learners.

- **Gender affects impact**
  Uses of ICTs in education in many cases to be affected by the gender of the learner.

- **The 'pilot effect' can be an important driver for positive impact**
  Dedicated ICT-related interventions in education that introduce a new tool for teaching and learning may show improvements merely because the efforts surrounding such interventions lead teachers and students to do 'more' (potentially diverting energies and resources from other activities).

Comments

General comments

- A review of the research on impacts of ICTs on student achievement yields few conclusive statements, pro or contra, about the use of ICTs in education. For every study that cites significant positive impact, another study finds little or no such positive impact.
- Many studies that find positive impacts of ICTs on student learning rely (to an often uncomfortable degree) on self-reporting (which may be open to a variety of positive biases).

Applicability to LDC/EFA context

- Where ICTs are to be utilized to improve educational quality as measured by most standardized tests, few such gains are to be expected.
- With sufficient teacher training, and given the existence of a variety of enabling factors, ICTs can be used to impact the nature and types of learning in which students engage.

Some areas for further investigation and research

- How does exposure to and use of ICTs in school affect future employment?
- What is the impact of 'computer-literacy' instruction in schools?
- What is the gender impact of ICTs in education on access, use of, attitudes toward, and learning outcomes?
- How can ICTs be used to present, comment on and discuss student work, and what are the implications of such impact?
- Are some school subjects better suited for ICT integration than others?

Some Recommended Resources

to learn more ….

- *Assessing the Impact of Technology in Teaching and Learning* [Johnston 2002]
- *Changing the Conversation about Teaching, Learning and Technology: A Report on 10 Years of ACOT Research* [Apple Computer 1995]
- *Comparative International Research on Best Practice and Innovation in Learning* [Holmes 2000]
- *Consultative Workshop for Developing Performance Indicators for ICT in Education* [UNESCO-Bangkok 2002]
- *Developing and Using Indicators of ICT Use in Education* [UNESCO 2003]
- *The Digital Disconnect : The Widening Gap Between Internet-Savvy Students and Their Schools* [Levin 2002]
- *Findings from the Teaching, Learning, and Computing Survey: Is Larry Cuban Right?* [Becker 2000]
- *ICT and attainment: A review of the research literature* [Cox 2003]
- *ImpaCT2: Emerging Findings from the Evaluation of the Impact of Information and Communications Technologies on Pupil Attainment* [Becta 2001]
- *Impact of Educational Technology on Student Achievement - What The Most Current Research Has To Say* [Schachter 1999]
- *The Learning Return on our Educational Technology Investment - A Review of Findings from Research* [WestEd 2002]
- *Literacy Scores, human capital and growth across 14 OECD countries* [Statistics Canada 2004]
- *Monitoring and Evaluation of Research in Learning Innovations – MERLIN* [Barajas 2003]
- *Report on the OECD PISA Student ICT Survey* [Australian Council for Educational Research 2002]
- *The Second Information Technology in Education Study: Module 2 (SITES: M2) Case Reports* [ISTE 2003]
- *Technology and Classroom Practices: An International Study* [Kozma 2003]
- *Technology, Innovation, and Educational Change—A Global Perspective* [Kozma 2003]
- *Using ICT to Develop Literacy and Numeracy: Research Summary* [Institute of Education, University of London 2001]
- *West Virginia Story - Achievement Gains from a Statewide Comprehensive Instructional Technology Program* [Mann 1999]

About these Briefing Sheets:

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Knowledge Map: Impact on Learning

Knowledge Map is not meant to be an exhaustive catalog of everything that is known (or is debated) about the use of ICTs in education in a particular topic; rather, taken together they are an attempt to limn the general shapes of a very large body of knowledge and highlight certain issues in a format quickly accessible to busy policymakers. In general, the *info*Dev knowledge mapping exercise is meant to point to key general assertions and gaps in the knowledge base of what is known about the use of information and communication technologies (ICTs) in education, *especially as such knowledge may relate to the education-related Millennium Development Goals (MDGs)*.

Knowledge Map on Information & Communication Technologies in Education
Topic: Monitoring and Evaluation

Guiding Questions:

- What do we know about effective monitoring and evaluation practices and studies related to the uses of ICTs in education?
- What large scale comparative studies of ICT uses in education exist, and what do they tell us about the monitoring and evaluation process?
- What do we know about useful indicators related to the uses of ICTs in education?

Current knowledgebase
What we know, what we believe -- and what we don't

- **Monitoring and evaluation is not receiving the attention it warrants**
  A consensus holds that insufficient attention is paid to monitoring and evaluation issues and feedback loops during the program design process of most ICT in education initiatives.

- **The issues are known, but tools and data are missing**
  In general, many of the issues and challenges associated with ICT in education initiatives are widely known by experts and advanced practitioners in the field (although this general awareness does not appear to extend to most policymakers, donor staff and educators new to ICT use in education). However, data on the nature and extent of these issues remain limited in most places because of the lack of monitoring and evaluation tools and methodologies dealing with the use of ICTs in schools and their impact on teaching and learning.

- **Much of the work done to date may suffer from important positive biases**
  Where evaluation data is available and monitoring and evaluation projects have occurred, much of such work is seen to suffer from important biases.

- **No common set of indicators**
  Three are no common international usage, performance and impact indicators for ICTs in education. Examples of monitoring and evaluation indicators and data collection methods exist from many countries. The process for the development of ICT in education indicators is the same as the process for the development of indicators in other fields.

- **Few international comparative evaluations have been done**
  There have been very few international evaluations of impact of ICT use in education. Those that exist rely in large part on self-reported data.

- **Quantitative data related to infrastructure has been the easiest to collect**
  Quantitative data, typically related to the presence and functionality of ICT-related hardware and software, are seen as the easiest to collect, and most monitoring and evaluation indicators and collection efforts have focused on such data. In general, there has been a greater emphasis on technical infrastructure issues than on program design, monitoring and evaluation, training and on-going maintenance/upgrades issues.

- **Data collection methods are varied**
  Data collection methods are quite varied. The use of the Internet to collect data, and for self-assessment, especially in LDCs, has not been very successful and is seen as problematic.

- **A reliance on self-reported data**
  Qualitative indicators have focused to a large report on self-reported data.

- **ICTs are not being well used in the M&E process**
  There is a general belief that the communication potential of ICTs to facilitate feedback from findings of monitoring and evaluation work, to create and sustain communities of interest/practice, and to provide information and communication linkages with other communities is being under-utilized.

Comments

General comments

- *Simply put*: **A lot of work needs to be done in this area if ICTs are to become effective and integral tools in education, and if impact is to be demonstrated to donors and communities financing ICT-related initiatives in education!**
- Bias is a very real issue in most of the monitoring and evaluation work done of ICT in education issues across the board. Such biases are often introduced at the monitoring and evaluation design stage, and include a lack of relevant and appropriate control groups, biases on the part of 'independent evaluators' (who often have a stake in seeing positive outcomes), and biases on the part of those evaluated (who may understandably seek to show that they have made good use of investments in ICTs to benefit education). The opportunity for such biases (which are usually positive biases) are especially acute where there a great reliance on self-reported data.
- There appears to be a lack of institutional and human resource capacity to carry out independent evaluations of ICT in education initiatives by local organizations in LDCs (which increases the cost of such activities and potentially decreases the likelihood that the results will be fed back into program design locally).
- A general lack of formal monitoring and evaluation activities inhibits the collection and dissemination of lessons learned from pilot projects and the useful formation of necessary feedback loops for such lessons learned to become an input into educational policy. Where such activities have occurred, they focus largely on program delivery, and are often specific to the project itself.

Applicability to LDC/EFA context

- The issues highlighted above are particularly acute in most developing countries.
- Developing in-country capacity for monitoring and evaluation work will be vital if ICT in education investments are to be monitored and evaluated at less cost.
- The opportunity costs of monitoring and evaluation work related to ICT in education interventions are potentially great, as there is typically a limited number of people able to do such work, and schools typically have little room in their calendars to participate in such activities. This is especially true where control groups are needed for interventions in rural and/or hard to reach areas – particular areas of interest for educational investments targeting education-related MDGs. That said, given the potential implications of costly mistakes in this field, especially in countries with education

budgets that are severely constrained, investing in monitoring and evaluation in this field should be considered money well spent.

- Attention to equity issues needs to be included in all monitoring and evaluation efforts related to the uses of ICTs in education. While the introduction of ICTs in LDCs is seen as a mechanism to reduce the so-called 'digital divide', in most cases such introductions serve to increase such divides, at least initially.

Some areas for further investigation and research

- In general, there is a pressing need for additional work related to performance indicators to monitor the use and impact of ICTs in education.
- What would be a useful set of 'core' indicators that could be used across countries?
- How have monitoring and evaluation studies related to the uses of ICTs in education been conducted in LDCs, and what can we learn from this?
- How should monitoring and evaluation studies of the impact of ICTs in education in LDCS be conducted?

Some Recommended Resources

to learn more ….

- *Assessing the Impact of Technology in Teaching and Learning: A Sourcebook for Evaluators* [Johnston 2002]
- *Comparative International Research on Best Practice and Innovation in Learning* [Holmes 2000]
- *Consultative Workshop for Developing Performance Indicators for ICT in Education* [UNESCO-Bangkok 2002]
- *Developing and Using Indicators of ICT Use in Education* [UNESCO 2003]
- *The Flickering Mind: The False Promise of Technology in the Classroom and How Learning Can Be Saved* [Oppenheimer 2003]
- *Monitoring and Evaluation of Research in Learning Innovations – MERLIN* [Barajas 2003]
- *The Second Information Technology in Education Study: Module 2 (SITES: M2)* [ISTE 2003]
- *Technology, Innovation, and Educational Change—A Global Perspective. A Report of the Second Information Technology in Education Study, Module 2* [Kozma 2003]
- *World Links for Development: Accomplishment and Challenges, Monitoring and Evaluation Reports* [Kozma 1999, 2000]

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Knowledge Map on Information & Communication Technologies in Education
Topic: Equity issues: Gender, Special Needs and Marginalized Groups

Guiding Questions:

- What do we know about equity issues as they relate to ICTs in education, and how they are being / can be addressed?
- What is known about how ICTs can be used to reach marginalized groups (economic, linguistic, cultural, gender) to benefit education, and how ICT use may have differential impact on such groups?

Current knowledgebase
What we know, what we believe -- and what we don't

General

- **Equity issues are critical -- and acute**
  It is clear that there are critical equity issues related to the uses of ICTs in education. There is a real danger that uses of ICTs can further marginalize groups already excluded or marginalized from existing educational practices and environments. That said, ICT use also holds very real promise for facilitating greater inclusion of such groups into existing educational practices and environments as well.

Special Needs and Disabilities

- **Solid documentation from OECD countries**
  There is a richly documented history of what works – and what doesn't – related to the uses of ICTs to assist in the education of students with a variety of disabilities, both cognitive and physical based on OECD experience. Certain applications of ICTs have been shown to have positive and important effects on the educational development of students exhibiting a great variety of *special needs* (including blind, deaf, and learning disabled students).

- **Accessibility issues well documented**
  There is a large and rich literature of best practices and lessons learned related to accessibility issues related to the use of ICTs in education based on OECD experience.

- **Applicability to LDC context under-studied**
  That said, there is very little study of uses of ICTs as they relate to the educational requirements and circumstances of 'special needs' students in LDCs.

- **Impact on motivation varies**
  While ample evidence exists that ICT use can have a positive impact on student motivation, such gains in motivation tend to correlate most closely with students who are already the most academically motivated and highest achievers.

Gender

- **Lots of research from OECD countries**
  There is a large and robust research literature on gender issue related to ICTs in education (access to, attitudes towards, uses of, and impact of) in OECD countries.

- **Some research from LDC experience**
  There is limited but emerging quality research into such issues in LDCs.

- **What is known has not been mainstreamed**
  There appears to be little mainstreaming of lessons learned in this area into educational practice of using ICTs in LDCs, although the need to do so is almost universally acknowledged.

Marginalized & indigenous groups

- **Impact on marginalized groups is being studied, but lessons are slow to emerge**
  While ICT is increasingly being used in pilot projects to aid in the education of marginalized and/or indigenous groups in LDCs, there is very little impact data to date on impact and cost effectiveness of such programs, and there have not been many nor case studies and lessons learned from such programs (many of which are on-going).

- **Some useful lessons from OECD experience**
  That said, there is literature on the use of ICTs to 'reach out' to marginalized and indigenous groups in OECD countries, most notably from Canada and Australia.

- **Cultural context is all important**
  It is clear that ICT in education interventions targeting marginalized and indigenous groups must place ICT-related interventions within the broader cultural and social contexts that frame education in issues in such groups more generally. Failure to do so may result in minimal (or deleterious) results from such programs.

Comments

General comments

- To date, much of the research in this area has focused on access-to-ICTs issues as they relate to equity. However, less work has been done surrounding how specific types of uses of ICTs impact equity issues as well.

- Much research has focused on the impact of ICTs on learning outcomes (which, in the case of special needs students, are in many cases more compelling than for the 'average' student), but less on the impact of ICT of on psychological, emotional and cultural issues of teachers and learners.

Applicability to LDC/EFA context

- If education-related MDGs are to be realized, new and innovative methods for reaching out to disadvantaged and special needs students need to assume greater prominence.

- At the same time, where ICTs are used in education to help meet education-related MDGs, care must be taken that such use does not further marginalize already marginalized groups.

Some areas for further investigation and research

- What is the gender impact of ICTs in education on access, use of, attitudes toward, and learning outcomes?

- How can/should educational content for dissemination via ICTs be produced to ensure inclusion?
- How do the types of learning strategies fostered by the use of ICTs impact special needs and disadvantaged students, and how do they differ by gender?
- How do different ICT applications, audio/verbal versus visual representations of educational content, and communicative modes impact communicative practices and create/reinforce/ameliorate various exclusions and inclusions as curriculum and communication methods are moved on-line?
- What are the best practices for producing, disseminating and using educational content in audio format (including via radio) for deaf students?
- How can issues related to ICT use for special needs and disadvantaged students by introduced into teacher professional development activities, and what are best practice examples of such activities?
- What are the emotional, psychological and cultural impacts of ICT use on learners from disadvantaged, marginalized and/or minority communities?
- What is the impact of the promotion of collaborative activities in groups facilitated by ICTs on students with little interest or background in computers, and what practices can better promote their inclusion?
- Are there differential impact of ICT use in education on identifiable sub-groups of boys and girls?
- How can ICTs be utilized to attract and retain out-of-school and at-risk students (for example, through improved communication and provision of alternative modes of learning)?
- How can ICTs be used to reach out to and teach illiterate youth?

Some Recommended Resources

to learn more ….

- *Effective Use of Information and Communication Technology (ICT) to Enhance Learning for Disadvantaged School Students* [Blackmore 2003]
- *Engendering ICT: Ensuring Gender Equality In ICT for Development* [World Bank 2003]
- *Gender issues in the use of computers in education in Africa* [Derbyshire 2003]
- *ICT Based Solutions for Special Educational Needs in Ghana* [Casely-Hayford 2003]
- *Inclusive Learning and Teaching - ILT for Disabled Learners* [Becta 2003]
- *Overcoming the Gender Digital Divide: Understanding ICTs and their Potential for the Empowerment of Women* [Huyer 2000]
- *Preparing Disadvantaged Youth for the Workforce of Tomorrow* [Teens and Technology Round Table 2002]
- *A Review of Good Practice in ICT and Special Educational Needs for Africa* [Casely-Hayford 2003]
- *Special Educational Needs and ICT provision* [Becta 2003]
- *Understandings of Education in an African Village: The Impact of Information and Communication Technologies* [Pryor 2003]
- *What the Research Says about Special Education Needs* [Becta 2003]

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research literature tells us about a number of key areas of information related to ICT use in education. Each Knowledge Map is not meant to be an exhaustive catalog of everything that is known (or is debated) about the use of ICTs in education in a particular topic; rather, taken together they are an attempt to limn the general shapes of a very large body of knowledge and highlight certain issues in a format quickly accessible to busy policymakers. In general, the *info*Dev knowledge mapping exercise is meant to point to key general assertions and gaps in the knowledge base of what is known about the use of information and communication technologies (ICTs) in education, *especially as such knowledge may relate to the education-related Millennium Development Goals (MDGs).*

Knowledge Map on Information & Communication Technologies in Education
Topic: Costs

Guiding Questions:

- What is known about the cost of using ICTs in education?
- What is known about costing and budgeting for ICT use in education?
- What is known about the costs of ICT-enhanced distance learning?

Current knowledgebase
What we know, what we believe -- and what we don't

General

- **Little is known about the true costs of ICTs in education**
  Few good, rigorous cost studies of ICTs in education exist in LDCs (and surprisingly few in OECD countries as well).

- **Even less is known about cost effectiveness, especially in LDCs**
  Even fewer studies of cost-effectiveness of ICT in education initiatives in LDCs exist.

- **Opportunity costs under-studied as well**
  Little research exists into opportunity costs related to ICT in education investments – this is especially relevant, and problematic, given the resource scarcities that define many LDCs seeking to meet education-related MDGs.

- **ICTs seen as playing a useful role in many LDCs by driving efficiencies in the sector as a whole**
  It may be that the most cost effective uses of ICTs to benefit education in LDCs at this time – at least in the near term – may be in their roles to improve organizational and systemic efficiencies (including use as tools to combat corruption in the education sector).

- **Widespread roll-out of ICTs in education in LDCs generally felt to be too expensive**
  Given existing resources constraints and lack of adequate supporting technical, commercial and human infrastructure, widespread, ubiquitous uses of ICTs in education are not believed to be currently possible in most LDCs.

- **More compelling evidence for use at secondary, tertiary and higher education levels**
  For cost reasons alone, UNESCO has concluded that, in many countries it is probably unrealistic to consider deploying computers in primary schools. At secondary level, where there may be strong curricular arguments for some investment, this is likely to make for significant increases in total educational expenditure if it is to allow students more than rare and occasional access to computers.

- **Computers in schools may be most cost-effective when placed in common areas**
  The few available cost figures suggest that many countries may want to deploy computers in school libraries, in teacher-training institutions and perhaps in community telecentres (although these may possibly be school-based), but stop short of seeking to do so in every classroom.

- **Best treatment of cost issues was published in 2001**
  The best general examination of relative costs of ICT initiatives to help realize education-related MDGs can be found in *Applying New Technologies and Cost-Effective Delivery Systems in Basic Education*; published in 2001, it remains little improved upon today.

Distance education

- **Economies of scale are available in distance education, but have large up-front costs**
  Economies of scale are achievable in distance education investments; such investments typically require large up-front costs (which may make them good candidates for donor support).

- **There is compelling evidence for use of distance education in teacher training**
  Teacher professional development has been shown to be less costly when delivered through distance education.

- **Cost per graduate may be much higher than cost per participant**
  Given higher drop-out rates associated with some distance learning initiatives, costs per graduate may be much higher than cost per learner.

- **Distance education provides opportunity for cost shifting**
  Distance education often allows some costs to be shifted from the public sector onto participants/learners themselves (and/or their communities). While this reduces public expenditure, it may give rise to equity issues.

Total Cost of Ownership (TCO)

- **TCO is typically underestimated in planning exercises**
  "Total cost of ownership" (TCO) is often underestimated, sometimes grossly, when calculating costs of ICT in education initiatives. Estimates of initial costs to overall costs vary widely, typically they lie between 10-25% of total cost.

- **TCO toolkits exist in OECD countries**
  TCO toolkits for education exist, based on circumstances in OECD countries. Little evidence exists of their use in LDC environments.

- **On-going recurrent costs are under-studied**
  Little research exists regarding on-going recurrent costs over time of ICT in education initiatives in LDCs.

- **There are real costs associated with successful planning for these types of initiatives**
  Costs of planning for ICT use in education are often overlooked or underestimated, but are essential.

- **Training costs are not uniform**
  Training costs of both end users and those involved in infrastructure maintenance related to ICT in education investments in LDCs vary quite widely.

- **Different types of costs vary over time**
  Hardware costs typically decrease, often quite dramatically, over time. Software costs are

typically quite low as a percentage of overall investment, and remain so over time. Maintenance and training costs vary greatly, and typically do not decrease over time.

- **Lack of guidance on how to conduct TCO studies**
  In addition to lack of data, there is a lack of case studies and toolkits on how to conduct TCO and cost effectiveness research. Where such case studies and toolkits exist, they have largely been designed for corporate settings and/or for OECD circumstances.

Internet

- **Internet connectivity costs vary tremendously**
  Costs related to the provision of Internet connectivity appear to vary greatly, both between and within countries, and depend on a wide variety of factors, including existence of existing delivery infrastructure, nature of Internet provider (public/private/monopoly), and the nature of Internet technology (dial-up, lease line, ADSL, cable, satellite, wireless).

- **e-Rates can improve access**
  "E-rates", or special national/regional tariffs for Internet access by schools, have been shown to increase Internet access in OECD countries, although resulting cost data may not be relevant to LDCs environments.

Costs associated with specific types of ICTs

- **Radio may be the most cost-effective form of ICT**
  Interactive radio instruction (IRI) has been shown to offer significant cost savings in some circumstances. Computers are seen to be much more costly (up to ten times more expensive), as is television.

- **Cost savings from open source and thin client solutions are (as yet) unproven**
  Many claims about cost savings from the use of "open source" software and "thin client solutions") in education have been made, but little reliable and/or persuasive hard cost data exist to support such assertions.

- **Donated and refurbished equipment can carry significant costs**
  The use of donated computer equipment contains many hidden costs that may make their usage more expensive over time than the purchase of new equipment.

- **ICT-related costs often viewed on a marginal cost basis in OECD countries**
  Use of ICTs in education is often treated on a marginal cost basis, with quality/impact gains possible as ICTs supplement/complement existing programs.

Financing mechanisms

- **Financing mechanisms are varied**
  Financing mechanisms for ICT in education initiatives are quite varied. Due to the high up-front costs and large recurrent costs, countries and communities typically employ a great variety of financing and cost recovery mechanisms.

- **Costs savings from public-private partnerships are unclear**
  Public-private partnerships are seen as an important component of financing mechanisms for ICT in education initiatives, although little research has been done in this area.

- **Cost recovery at user level is attractive, but problematic**
  Cost recovery at the user level is seen as an important tool to finance and maintain ICT in education initiatives, although many barriers (legal, regulatory, administrative, cultural, and equity) exist complicating attempts at cost recovery.

Comments

General comments

- Much work needs to be done related to the costs of ICT in education investments.
- The lack of reliable cost data in virtually all areas is quite striking.
- Given the lack of reliable cost data, the lack of reliable cost effectiveness studies should come as little surprise.

Applicability to LDC/EFA context

- Before large scale investments in ICTs to benefit education and to help meet education-related MDGs, much more work needs to be done on the cost issue.
- The relevance of existing cost data related generated in OECD countries related to ICT use in education in OECD countries is questionable for many reasons. *For example*: While labor costs in general are typically lower in LDCs, labor costs in LDCs related to the ICT sector may be much higher compared to other costs in the education sector. In addition, hardware costs may in many cases be higher in LDCs than in OECD countries, due to important restrictions, customs, taxes, less competition among vendors, etc.
- Toolkits, based on OECD experience, exist to help in measuring costs of ICT use in education, but do not appear to have been widely used in LDC contexts.

Some areas for further investigation and research

- Significant work needs to be done related to the costs of ICT in education initiatives in LDCs. All of the claims listed above found in current literature deserve additional scrutiny. Most cost studies neglect to ask perhaps the most fundamental question: Can you reach the same educational goals and objectives in a different manner at less cost ***without using ICTs***?
- What is the Total Cost of Ownership (TCO) for computers in a variety of educational settings, at both the school and system level? How should we calculate such figures?
- What are the costs/benefits of situating ICTs for use in schools outside of computer classroom?
- How can public-private partnerships be used to 'cut costs' and what are the resulting cost savings (if any)?

Some Recommended Resources

to learn more ….

- *A Chance to Learn: Knowledge and Finance for Education in Sub-Saharan Africa* [World Bank 2001]
- *Applying New Technologies and Cost-Effective Delivery Systems in Basic Education. World Education Forum Education For All 2000 Assessment* [Perraton 2001]
- *Computers in secondary schools in developing countries: An analysis of costs* [Cawthera 2001]

- *Cost analysis of information technology projects in education: experiences from developing countries. Measuring and managing the costs of ICTs in Latin American schools* [Potashnik 1996]
- *The Costs of Computers in Classrooms Data from Developing Countries* [Bakia 2000]
- *Enhancing Learning Opportunities in Africa: Distance Education and Communication Technologies for Learning* [Murphy 2002]
- *Fighting Corruption To Improve Schooling: Evidence From a Newspaper Campaign In Uganda* [Reinikka 2004]
- *Financing of Education in East Asia: EFA and beyond* [Rose 2002]
- *Sustainability Challenge - Taking EdTech to the Next Level* [EDC 2003]
- *Taking TCO to the Classroom* [COSN 2000]
- *Teacher Education through Distance Learning: Technology, Curriculum, Evaluation and Cost* [UNESCO 2001]
- *Total cost of ownership (TCO): A review of the literature* [Scrimshaw 2003]
- *The True Cost of Ownership* [McKenzie 2003]

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Knowledge Map on Information & Communication Technologies in Education
Topic: Current Projects and Practices

Guiding Questions:

- What do we know about how ICTs are being used for teaching and learning?
- What do we know about how ICTs are currently being used in education in developing countries?
- What is known about donor investments in ICTs as part of their support for education?

Current knowledgebase
What we know, what we believe -- and what we don't

How ICTs are currently being used in schools

- **ICTs are being used more and more**
  In general, uses of ICTs in education in both OECD countries and LDCs are seen as increasingly widespread and continuously growing. That said …

- **ICTs are typically used only for short amounts of time per month**
  In general we know that there is limited contact time per month using ICTs by both teachers and students, and even less time spent with reliable internet access, even in OECD countries. Contact time with ICTs and teacher- and student/ICT ratios vary widely.

- **ICT use in schools in the United States is not great**
  Even in the United States, in the areas where one would expect to potentially see the largest gains -- students acquiring information, demonstrating and communicating content understanding in specific school subjects – ICTs are used only rarely. Reasons for this include scheduling issues inhibiting access to ICTs, lack of congruence between curriculum demands and ICT use, and convenient access to ICTs.

- **Most common uses in the United States can be grouped into four categories**
  In the United States, frequent computer experiences occur primarily in four contexts: computer education (basic ICT literacy); business/vocational preparation; exploratory uses in primary school; and word processing and presentation software.

- **Very little is known about just how (and how often) ICTs are used in LDCs**
  While there is a great deal of knowledge about how ICTs are (and are not) being used in OECD countries, there is not much data on how ICTs are being used in schools in LDCs.

- **Content filtering has important impacts**
  Even where Internet access is reliable, content filtering affects access in important ways. Where internet access is available, it is often limited, in often frustrating ways for teachers and students, by content filters designed to protect students from inappropriate material. Where filters are not available, there is a greater reluctance to access the internet in school because of fear of exposure to inappropriate material.

- **Teacher use lags behind student abilities**
  Students use ICTs in much more sophisticated ways than teachers. In OECD countries,

students themselves are figuring out ways to take advantage of the communication potential of ICTs for learning in a self-organized, ad hoc manner that correlates closely with their own personal uses of ICTs in their daily lives. Communication tools and applications (such as chat, e-mail and SMS) appear to be under-utilized in education environments.

- **Use by teachers and administrators outside of school under-studied**
  There is little knowledge of teacher and school administrator use of ICTs outside of school, and how this relates to in-school use of ICTs.

Landscape of initiatives

- **ICT in education programs in Asia-Pacific are pretty well mapped**
  ICT in education initiatives in developing countries in Asia-Pacific have been well mapped and recently documented by UNESCO's Bangkok office. ICTs being used quite extensively throughout the region in education activities.

- **ICT in education programs in Africa have been mapped to a decent extent**
  In Africa, Schoolnet Africa and imfundo (through its KnowledgeBank) have done a decent job of cataloguing ICT in education initiatives in Africa, although most data appears to be a few years old. It is notable that, even in some of the most challenging environments, such as those found in the first twelve countries participating in the so-called Fast Track Initiative (FTI), most of which are in sub-Saharan Africa, ICTs are being used to help meet education objectives. Interestingly ICTs are mentioned explicitly (if obliquely) in the official government requests to participate in the FTI. That said, such initiatives are almost all small pilot projects, loosely (if at all) coordinated with other education initiatives (and the Ministry of Education), and often in partnership with outside NGOs and donor agencies.

- **Less is known about ICT use in education other developing countries**
  No comprehensive mapping exists of ICT in education initiatives throughout Latin America (although initiatives in some individual countries are quite well documented), the Caribbean or Eastern Europe/Central Asia.

- **It is very difficult to identify ICT components in donor-supported education projects**
  It is extremely difficult to identify where donor-supported education initiatives, including those funded by the World Bank, utilize ICT components, and, where such components *are* identifiable, it is quite difficult to identify the size of such investments, for a variety of reasons.

- **Donor education experts often have little knowledge of ICT use in education issues**
  Many task managers working on education projects in donor agencies have incomplete knowledge of uses of ICTs for education in their countries. It is surmised that this relates to the fact that most ICT interventions in the education sector in many developing countries – especially the most poor, and especially in Africa – have been through small, uncoordinated pilot projects. In addition, there is a tension in many donor organizations between those who feel that the use of ICTs in education is an unaffordable luxury for countries struggling to meet Education For All (EFA) targets, and those who feel that, given the pressing and often seemingly intractable challenges faced by these countries, it is hard to see how some targets can be reached without considering the use of ICTs.

Typical uses for ICTs in education in donor-supported projects

- **ICT components in donor-supported education projects can be divided into five categories**
  Where large scale donor-supported education projects exist that utilize ICTs in the target countries to benefit education, ICTs components typically help in (a) supplying computers and connectivity and building school computer labs; (b) enabling instruction in computer programming and computer literacy; (c) (to a lesser extent) developing and disseminating new curricula in electronic format; (d) distance learning (especially as it relates to teacher professional development); and (e) enabling better administration in the education sector (particularly through the development of education management information systems, or EMIS).

- **Where ICTs are used for learning, they are chiefly used to present and disseminate information**
  Where ICTs are used in donor-supported projects at a large scale in teaching to support subjects other than computer programming and computer literacy in the target countries, they are typically used as tools for *presentation*. While the justification for and rhetoric surrounding such implementations often cite the potential role of ICTs to promote and develop a set of "twenty-first century skills" related to critical thinking, information evaluation and reasoning, collaboration and international awareness, in most cases ICTs are largely used in schools to teach ICT skills.

Issues in identifying ICT components in World Bank (and other donor-supported) education projects

- **No common vocabulary for ICT use in education projects**
  There is a lack of consensus about definitions of ICTs as used in education. Perhaps for this reason, no comprehensive mandated standards exist with which ICT components in education projects can be coded.

- **Existing data is dicey**
  Existing World Bank studies and figures related to the ICT components in World Bank education projects are problematic. The methodologies used in the studies are either highly questionable and/or very difficult to reproduce, and never explicit. Internal World Bank data is incomplete and/or confusing relating to the uses of ICTs in World Bank education projects.

- **No standard coding at the World Bank**
  There is no standard coding for ICT components in World Bank, or other donor-supported, projects. Where codes have been developed, they typically focus more on the presence of easily identifiable, physical information infrastructure components (computers, routers, televisions, software purchases) than on other 'softer' components, especially those related to services (training, curriculum development, systems integration, custom software development, on-going maintenance). In addition, procurement guidelines and thresholds often obfuscate the presence of ICT components, which are often believed to be purchased piecemeal and/or combined with other goods or services. This is true for the World Bank as for other donors (including the Asian Development Bank and the European Commission/Union).

- **EMIS implementations are widely used and easy to find**
  Documentation relating to the use of EMIS, explicitly mentioned in official EFA documents as important ICT tools to use related to EFA goals, is easy to find. Based on feedback from World Bank education task managers and other ICT in education practitioners, such components of education projects are mostly of less interest than the uses of ICTs as teaching and learning tools.

- **The PAD is the best source of information at the World Bank**
  The best source of information about the existence of ICT components in World Bank education projects is the "project appraisal document" (PAD). However, anecdotal evidence suggests that ICT components in such projects, even when they are identifiable, are often not implemented as outlined in the PAD, and it is difficult to determine where such changes have occurred, given current reporting guidelines and practices.

- **ICT investments are often multi-sectoral**
  By their very nature, investments in ICTs are often multi-sectoral, and thus uses of ICTs to benefit education can be found in projects mapped to other sectors (and thus considered to be 'outside' the education sector). This is an artificial / bureaucratic distinction that may well result in a systematic underestimation of the impact of ICTs investments on education in donor-financed projects.

Comments

General comments

- Locating and identifying the uses of ICTs to benefit education in developing countries is a tedious, difficult, time-consuming and *ad hoc* task.
- No standard reference or methodology exists for identifying such investments.
- Observations and conclusions on how ICTs are actually used in schools are drawn almost exclusively from OECD experience. Little such data exists for LDCs, and essentially none for countries most at risk of meeting education-related MDGs.

Applicability to LDC/EFA context

- If ICTs are to be useful in helping to meet education-related MDGs, it will be necessary to be able to easily identify where such investments have been made, and their magnitude, so that comparative and cost/benefit analyses can be conducted. Currently, this is not easily possible.
- Emerging evidence from OECD countries suggests that even massive investments in ICTs in schools may not bring about the desired changes in teaching and learning processes unless such investments are supported by similar initiatives to improve access to ICTs *outside* of the school environment. This is potentially especially important for uses of ICTs to support EFA goals, as effective use *in school* may require high levels of access *outside school* if gains in such investments are to be maximized, especially where ICTs are to be used for communication purposes.

Some areas for further investigation and research

- How should ICT components in education projects supported by donors be identified and quantified?

- How does access to and use of ICTs outside school impact the use and impact of ICT use in school?

Some Recommended Resources

to learn more ….

- *Best Practices for Technology Utilization in High Schools: A Delphi Research Report* [Clark 2003]
- *COL Experiences in ICT for School Education* [Menon 2003]
- *Distance Education and Technology in Sub-Saharan Africa* [Saint 2000]
- *Experts' Meeting for Documenting Experiences in the Use of ICT in Education and SchoolNet Operations* [UNESCO 2003]
- *ICTs in African Schools Workshop: Workshop Report* [SchoolNet Africa 2003]
- *Information and Communication Technologies @ the World Bank: Overview of Roles of Central Units* [World Bank 2004]
- *IICTs and MDGs: A World Bank Perspective* [World Bank Group, 2003]
- *Information Infrastructure: The World Bank Group's Experience* [Barbu 2001
- *Imfundo KnowledgeBank* [imfundo 2004]
- *Integrating ICTs into Education: Lessons Learned* [UNESCO-Bangkok 2004]
- *Metasurvey on the use of Technologies in Education in Asia and the Pacific (2003-2004)* [Glen Farrell 2003]
- *New Perspectives for Learning: Insights from European Union funded Research on Education and Training* [European Commission DG for Research 2003]
- *Task Managers' ICT Toolkit: A Route Map for ICT Components In World Bank Projects* [World Bank 2004]
- *Task Managers' ICT Toolkit: Good Practice for Planning, Delivering, and Sustaining ICT Product* [World Bank 2004]
- *Ten Lessons for ICT and Education in the Developing World* [Hawkins 2000]
- *Technology in World Bank Education Projects: An Operational Review – Fiscal Years 1997 to 2000* [Georgiades, unpublished]
- *World Bank Projects Database* [World Bank 2004]

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Knowledge Map on Information & Communication Technologies in Education
Topic: Specific ICT Tools

Guiding Questions:

- What is known about which ICTs are most useful to benefit education?
- What do we know about the usefulness, appropriateness and efficacy of specific ICTs (including radio television, handheld devices, computers, networked computers and the Internet) for educational purposes?
- What do we know about the use of open source and free software in education?

Current knowledgebase
What we know, what we believe -- and what we don't

General

- **The Internet is not widely available in most LDCs; radio and TV are**
  Broadcast technologies such as radio and television have a much greater penetration than the Internet throughout much of the developing world, and the substantial gap is not expected to be closed soon.

- **Radio and TV can have high start-up costs, and reinforce existing pedagogical styles**
  Educational initiatives that utilize radio and television typically have quite high initial start-up/capital costs, but once they are up and running, on-going maintenance and upgrade costs are much lower (making initiatives utilizing radio and TV for distance learning in the educations sector particularly appealing for donor support in many cases). One-to-many broadcast technologies like radio and television (as well as satellite distribution of electronic content) are seen as less 'revolutionary' ICTs in education, as their usage is seen as reinforcing of traditional instructor-centric learning models, unlike computers, which many see as important tools in fostering more learner-centric instructional models.

- **Radio instruction has been used widely and is reasonably well studied**
  Radio instruction in formal education has been well studied, especially the links between the use of radio in combination with school-based educational resources and a variety of pedagogical practices.

- **TV has been used with success in a few places**
  Television has been utilized successfully as a mechanism for reaching out-of-school youth in a number of countries, especially in Latin America and China, and the results of such projects have been widely disseminated.

- **In some cases, where markets have been liberalized, ICTs are used to distribute educational content regionally within a country**
  Market liberalization has in many countries allowed for the development of locally- (as opposed to centrally-) controlled distribution channels that utilize ICTs (like radio and the Internet, and to a lesser extent television) to create and broadcast educational content more targeted to the needs of specific communities, and as a result have a greater flexibility to employ local languages.

- **CAI is not highly regarded by experts and in OECD countries, but still receives much interest in LDCs**
  The usefulness of computer-aided instruction (CAI), in which computers are seen as simple replacements for teachers, has been largely discredited, although there appears to still be great interest in CAI in many LDCs where computers are being introduced.

- **It is unclear where to place computers to make sure they are used most efficiently**
  There is very little research on the most appropriate placement of computers in schools, or in the community, used to achieve various learning objectives.

- **Multi-channel learning is a useful concept**
  The emerging practice of 'multi-channel learning', which focuses on enriching the educational experience by engaging all resources that are available to help effect incremental change by coordinating the various ways to connect learners with information, knowledge, and stimulation, and to mediate those interactions, provides valuable insight into how blended learning approaches can be delivered and tailored in areas of great resource scarcity.

- **Satellite is much hyped, but under-studied**
  While satellite broadcasting of electronic educational resources is thought to hold much promise, there are few case studies of successful implementation of satellite broadcasting to small LDCs.

- **New Internet technologies hold promise, but are not yet operational**
  Emerging Internet technologies, especially recent and emerging wireless protocols (including 802.11, and shortly WiMax), are thought to hold much promise for providing connectivity to remoter areas, but projects utilizing such technologies are for the most part in pilot or planning stages, and face many regulatory hurdles.

- **Mobile Internet centres (vans, etc.) are being deployed as a way to reach rural areas**
  A number of educational initiatives utilizing mobile Internet centres have been piloted in the past decade, but little cost and impact data has emerged from such projects.

- **Community telecentres are a hot topic, but successful, replicable models have not yet emerged**
  Community telecentres (sometimes based in schools) have be touted as important tools to provide access to learners (including teachers engaged in personal enrichment and professional development opportunities) to ICT's outside of formal school settings.

- **The use of handheld devices is just now receiving serious widespread attention**
  Little research has been done on uses of handheld devices (including personal digital assistants and mobile phones) in education.

- **'Free software' holds promise, but costs and impact are still not well documented**
  The uses of 'free' software is widely touted as a cost effective alternative to the uses of proprietary software (especially Microsoft products), but research in this area is largely advocatory in nature.

Comments

General comments

- We know that technology changes – rapidly – and newer, more cost effective and more powerful technologies will continue to emerge of potential use in education. At the same time, evidence shows that, once installed in schools, ICTs continue to be used for the life of the functioning life of the technology, whether or not newer, more cost effective and powerful technologies emerge (especially as upgrade paths are seldom part of initial planning).
- Much of the publicly available information about the effectiveness of particular ICT tools is generated by the companies who market such products and related services.

Applicability to LDC/EFA context

- While it is clear that it is the application of various ICTs that are the most important determinants of the effectiveness of such tools in education, the choices of tools are quite varied and each has its own advantages and disadvantages. Policymakers and donor staff are often bombarded by information and studies from vendors on the suitability of their products or services, and there is a need for further, independent research on the appropriateness on specific tools with potential to help meet education-related MDGs.

Some areas for further investigation and research

- What models exist for the effective utilization of ICTs to support on-going professional development for educators?
- What are the best practices for mainstreaming pilot projects involving interactive radio instruction (IRI) at the Ministry of Education, and how are such projects managed and maintained over time?
- Where should computers reside if they are to have the greatest learning impact in education?
- Is the use of ICTs as in-class presentation mechanisms a cost-effective use of technology?
- How have/can handheld devices (including SMS-enabled mobile phones) be used to support education (especially related to the professional development of teachers and school administration), and what are the emerging best practices?
- How can existing community and interactive radio networks outside the education sector be used to benefit education?
- What successful models exist for opening ICT facilities in schools to the wider community?
- Does the use of so-called "open source software" offer compelling benefits in education?
- What models exist on effective public-private-community partnerships in education for ICT equipment provision and maintenance?

Some Recommended Resources

to learn more ….

- *African Tertiary Institutions Connectivity Study (Draft Report)* [Steiner 2004]

- *Applying New Technologies and Cost-Effective Delivery Systems in Basic Education. World Education Forum Education For All 2000 Assessment* [Perraton 2001]
- *Free Open Source Software - A General Introduction* [Wong 2004]
- *Interactive Radio Instruction: Twenty-three Years of Improving Educational Quality* [Bosch 1997]
- *Integrating ICTs into Education: Lessons Learned* [UNESCO-Bangkok 2004]
- *Learning With Handhelds: Findings From Classroom Research* [Vahey 2003]
- *Open Source as Appropriate Technology for Global Education* [Carmichael 2004]
- *Schoolnet Toolkit* [UNESCO-Bangkok 2004]
- *The Use of Information and Communications Technology (ICT) in Learning and Distance Education* [Intelecon Research 2000]

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Knowledge Map on Information & Communication Technologies in Education
Topic: Teachers, Teaching and ICTs

Guiding Questions:

- What do we know about successful pedagogical strategies utilizing ICTs for teaching and learning?
- What is known about effective teacher professional development?
- What do we know about the impact of ICTs on teacher performance?
- What do we know about the impact of ICTs on teacher motivation?

Current knowledgebase
What we know, what we believe -- and what we don't

General

- **Training is key**
  Teacher training and continued, on-going relevant professional development are essential if benefits from investments in ICTs are to be maximized.

Role of the teacher

- **Teachers remain central to the learning process**
  A shift in the role of a teacher utilizing ICTs to that of a facilitator does not obviate the need for teachers to serve as leaders in the classroom; traditional teacher leadership skills and practices are still important (especially those related to lesson planning, preparation and follow-up).

- **Lesson planning is crucial when using ICTs**
  Teacher lesson planning is vital when using ICTs; where little planning has occurred, research shows that student work is often unfocused and can result in lower attainment.

Pedagogy

- **Introducing technology alone will not change the teaching and learning process**
  The existence of ICTs does not transform teacher practices in and of itself. However, ICTs can enable teachers to transform their teacher practices, given a set of enabling conditions. Teachers' pedagogical practices and reasoning influence their uses of ICT, and the nature of teacher ICT use impacts student achievement.

- **ICTs seen as tools to help teachers create more 'learner-centric' learning environments**
  In OECD countries, research consensus holds that the most effective uses of ICT are those in which the teacher, aided by ICTs, can challenge pupils' understanding and thinking, either through whole-class discussions and individual/small group work using ICTs. ICTs are seen as important tools to enable and support the move from traditional 'teacher-centric' teaching styles to more 'learner-centric' methods.

- **ICTs can be used to support change and to support/extend existing teaching practices**
  Pedagogical practices of teachers using ICT can range from only small enhancements of

teaching practices using what are essentially traditional methods, to more fundamental changes in their approach to teaching. ICTs can be used to reinforce existing pedagogical practices as well as to change the way teachers and students interact.

- **Using ICTs as tools for information presentation is of mixed effectiveness**
  The use of ICTs as presentation tools (through overhead and LCD projectors, television, electronic whiteboards, guided "web-tours", where students simultaneously view the same resources on computer screens) is seen to be of mixed effectiveness. While it may promote class understanding of and discussion about difficult concepts (especially through the display of simulations), such uses of ICTs can re-enforce traditional pedagogical practices and divert focus from the content of what is being discussed or displayed to the tool being utilized.

Teacher technical abilities and knowledge of ICTs

- **Preparing teachers to benefit from ICT use is about more than just technical skills**
  Teacher technical mastery of ICT skills is a not a sufficient precondition for successful integration of ICTs in teaching.

- **'One-off training' is not sufficient**
  Teachers require extensive, on-going exposure to ICTs to be able to evaluate and select the most appropriate resources. However, the development of appropriate pedagogical practices is seen as more important that technical mastery of ICTs.

- **Few teachers have broad 'expertise' in using ICTs in their teaching**
  Even in the most advanced school in OECD countries, very few teachers typically have a comprehensive knowledge of the wide range of ICT tools and resources.

- **In OECD countries, the use of ICTs to promote 'computer literacy' is seen as less important than in using ICTs as teaching and learning tools**
  In OECD experience, the use of technology in everyday teaching and learning activities appears to be more important than specific instruction in “computer classes”. While the development of technology skills is seen to have a role in the teaching and learning process, it is more important as an enabler of other teaching and learning practices, and not too important in and of itself. Schools that report the highest levels of student ICT-related skills and experience are often not those with heavy computer course requirements, but rather ones that made use of ICTs on a routine basis throughout the teacher professional development and the teaching and learning process.

- **Students are more sophisticated in their use of technology than teachers**
  In OECD countries, there appears to be a great disconnect between student knowledge and usage of ICTs the knowledge and abilities of teacher to use ICTs. This suggests that teacher inexperience and skill deficiencies may often be an important factor inhibiting the effectiveness of ICT use in education by students.

Teacher usage of ICTs

- **Teachers most commonly use ICTs for administrative tasks**
  Teachers most often use ICTs for 'routine tasks' (record keeping, lesson plan development, information presentation, basic information searches on the Internet).

- **More knowledgeable teachers rely less on "computer assisted instruction"**
  Teachers more knowledgeable in ICTs use utilize computer assisted instruction less than other teachers who use ICTs, but utilize ICTs more overall.

- **How teachers use ICTs is dependent on their general teaching styles**
  Types of usage of ICTs correlate with teacher pedagogical philosophies. Teachers who use ICTs the most -- and the most effectively -- are less likely to use traditional 'transmission-method' pedagogies. Teachers who use more types of software tend to practice more "constructivist" pedagogies.

- **Teaching with ICTs takes more time**
  Introducing and using ICTs to support teaching and learning is time consuming for teachers, both as they attempt to shift pedagogical practices and strategies and when such strategies are used regularly. Simply put: Teaching with ICTs takes more time (estimates vary on how much extra time is required to cover the same material; 10% is a common estimate).

Teacher confidence and motivation

- **Few teachers are confident users of ICTs**
  Few teachers are confident in using a wide range of ICT resources, and limited confidence affects the way the lesson is conducted.

- **Fear prevents many teachers from using ICTs**
  In OECD countries, many teachers still fear using ICTs, and thus are reluctant to use them in their teaching.

- **ICTs motivate (some) teachers, at least at the start**
  At least initially, exposure to ICTs can be an important motivation tool to promote and enable teacher professional development.

- **Incentives must be developed to promote effective teacher participation in continuing professional development**
  Teachers require additional motivation and incentives to participate actively in professional development activities. A variety of incentives can be used, including certification, professional advancement, pay increases, paid time off to participate in professional development, formal and informal recognition at the school and community levels and among peers, reduced isolation, and enhanced productivity.

- **Access to ICTs is the most significant factor in whether teachers use them**
  The most significant factor for continuing the development of teachers' ICT-related skills is for them to have regular access to functioning and relevant ICT equipment.

Subject knowledge

- **Teachers' subject knowledge influences how ICTs are used**
  The way ICT is used in lessons is influenced by teacher knowledge about their subjects, and how ICT resources can be utilized and related to it.

- **Teacher content mastery and understanding of student comprehension make ICT use more effective**

The evidence shows that when teachers use their knowledge of both the subject and the way pupils understood the subject, their use of ICT has a more direct effect on student achievement.

- **Exposure to new/additional information via ICTs is not enough**
  The effect on attainment is greatest when pupils are challenged to think and to question their own understanding, rather than on exposure to new and additional information.

- **ICTs can aid teacher self-learning in subject matter**
  By providing access to updated and additional learning resources, ICTs can enable teacher self-learning in his/her subject area.

Teacher professional development

- **On-going teacher training and support is critical to the successful utilization of ICTs in education**
  Teacher training and professional development is seen as the key driver for the successful usage of ICTs in education.

- **Teacher professional development is a process, not an event**
  Traditional one-time teacher training workshops have not been seen as effective in helping teachers to feel comfortable using ICTs, let alone in integrating it successfully into their teaching. Discrete, 'one-off' training events are seen as less effective than on-going professional development activities.

- **Introducing ICTs expands the needs for on-going professional development of teachers**
  Effective ICT use in education increases teachers' training and professional development needs. However, ICTs can be important tools to help meet such increased needs, by helping to provide access to more and better educational content, aid in routine administrative tasks, provide models and simulations of effective teaching practices, and enable learner support networks, both in face to face and distance learning environments, and in real time or asynchronously.

- **Successful teacher professional development models can be divided into three phases**
  Successful on-going professional development models can be divided into three phases: pre-service, focusing on initial preparation on pedagogy, subject mastery, management skills and use of various teaching tools (including ICTs); in-service, including structured face-to-face and distance learning opportunities building upon pre-service training and directly relevant to teacher needs; and on-going formal and informal pedagogical and technical support, enabled by ICTs, for teachers, targeting daily needs and challenges.

- **Effective teacher professional development should model effective teaching practices**
  Effective teacher professional development should approximate the classroom environment as much as possible. "Hands-on" instruction on ICT use is necessary where ICT is deemed to be a vital component of the teaching and learning process. In addition, professional development activities should model effective practices and behaviors and encourage and support collaboration between teachers. On-going professional development at the school

level, using available ICT facilities, is seen as a key driver for success, especially when focused on the resources and skills directly relevant to teachers' everyday needs and practices.

- **Training in assessment methods is important**
  Professional development should include methods for evaluating and modifying pedagogical practices and expose teachers to a variety of assessment methods.

- **Effective professional development requires substantial planning**
  A needs assessment should precede the creation of and participation in teacher professional development activities, regular monitoring and evaluation should occur of these activities, and feedback loops should be established, if professional development is to be effective and targeted to the needs of teachers.

- **On-going, regular support for teachers is crucial**
  On-going and regular support is essential to support teacher professional development and can be facilitated through the use of ICTs (in the form of web sites, discussion groups, e-mail communities, radio or television broadcasts).

Enabling factors

- **A variety of changes must be implemented to optimize teacher use of ICTs**
  Shifting pedagogies, redesigning the curriculum and assessment, and providing more autonomy to the schools help to optimize the use of ICT. With sufficient enabling factors in place, teachers can utilize ICTs in as 'constructivist' a manner as their pedagogical philosophies would permit.

- **Functioning technical infrastructure is (obviously) crucial**
  Teachers must have adequate access to functioning computers, and be provided with sufficient technical support, if they are to use ICTs effectively.

- **Introducing ICTs takes time**
  Adequate time must be allowed for teachers to develop new skills, explore their integration into their existing teaching practices and curriculum, and undertake necessary additional lesson planning, if ICTs are to be used effectively.

- **Support from school administration and the community can be important**
  Support of school administrators and, in some cases, the surrounding community, for teacher use of ICTs is seen as critical if ICTs are to be used at all, let alone effectively. For this reason, targeted outreach to both groups is often necessary if investments in ICTs to support education are to be optimized.

- **Communities of practice can be important tools to support teacher professional development**
  The existence of formal and informal communities of practice and peer networks can be important tools to support ICT in education initiatives and activities. Such support mechanisms can be facilitated through the use of ICTs.

- **Lessons learned from introducing ICTs in education need to be shared**
  As the introduction of ICTs to aid education is often part of a larger change or reform process, it is vital that successful uses of ICTs are promoted and disseminated.

Comments

General comments

- There appears to be general consensus from OECD experience as to the most effective pedagogical practices for teachers when using ICTs.
- In addition, the barriers impeding the successful development and delivery of effective pedagogical practices are also generally agreed upon.

Applicability to LDC/EFA context

- ICTs are used in education in two general ways: to support existing 'traditional' pedagogical practices (teacher-centric, lecture-based, rote learning) as well as to enable more learner-centric, 'constructivist' learning models. Research from OECD countries suggests that both are useful, but that ICTs are most effective when they help to enable learner-centric pedagogies.
- However, studies of ICT use in LDCs suggest that, despite rhetoric that ICTs can enable new types of teaching and learning styles, for the most part they are being used to support traditional learning practices.
- Additional barriers to effective use of ICTs in education may well be present in LDCs beyond those identified from OECD experience.

Some areas for further investigation and research

- Can the same types of pedagogical practices and transformations thought to be enabled by the introduction of ICTs be introduced and maintained in environments where ICTs are not used?
- How can we measure outcomes of ICT use by teachers resulting from participation in professional development activities?
- Which types of ICTs can provide the most effective and relevant support for professional development, including enabling peer networks, and how?
- How are ICTs currently being used at the pre-service level (if at all) to train teachers in LDCs, and what can we learn from such use?
- What are the most successful and relevant strategies for using ICTs to change pedagogical practices?

Some Recommended Resources

to learn more ….

- *Breaking Down the Digital Walls: Learning to Teach in a Post-Modem World* [Burniske 2001]
- *Building Capacity of Teachers/Facilitators in Technology-Pedagogy Integration for Improved Teaching and Learning* [UNESCO 2003]
- *E-learning for Educators - Implementing the Standards for Staff Development* [National Staff Development Council 2001]
- *Enabling Teachers to Make Successful Use of ICT* [Peter Scrimshaw 2004]
- *ICT and pedagogy: A review of the research literature* [Cox 2003]

- *ICT Supporting Teaching - Developing Effective Practice* [Becta 2002]
- *Impacts of ICT in education. The role of the teacher and teacher training* [Jager 1999]
- *Information Technology: Underused in Teacher Education* [Milken Family Foundation 1999]
- *The Missing Link in Educational Technology: Trained Teachers* [Carlson 2002]
- *Multichannel Learning Maximizes Scarce Resources in Developing Countries: A theory evolves from years of practical experience* [EDC 2001]
- *Teacher professional development on ICT Use in Education in Asia and the Pacific: Overview from Selected Countries* [UNESCO-Bangkok 2004]
- *Teachers … Training … and Technology* [Haddad 2000]
- *Technology, Innovation, and Educational Change—A Global Perspective* [Kozma 2003]
- *Teacher professional development on ICT Use in Education in Asia and the Pacific: Overview from Selected Countries* [UNESCO 2004]
- *Teacher Professional Development in the Use of Technology* [Carlson 2002]
- *Technology in Teacher Education: A Closer Look* [Bielefeldt 2001]
- *Towards a Strategy on Developing African Teacher Capabilities in the Use of ICT* [Schoolnet Africa 2004]
- *What styles of computer training enhance teachers' competence and confidence to use ICT?* [Edmondson 2002]
- *What the Research Says about ICT and Teacher Continuing Professional Development* [Becta 2003]

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Knowledge Map on Information & Communication Technologies in Education
Topic: Content & Curriculum issues

Guiding Questions:

- What is known about how ICTs can enhance access to and dissemination of educational content?
- What is known about the relationships between ICT use, curricula and standardized testing?
- What is known about language and content issues related to ICT use in education?

Current knowledgebase
What we know, what we believe -- and what we don't

- **"Accessing information" is the main use of ICTs in education**
  "Access to information" is considered to be one of the most important benefits of the uses of ICTs in education. Accessing information -- not using ICTs for communication purposes -- is the most common use of the Internet in schools beyond providing a tool for the development of basic computer literacy skills.

- **Learning materials in electronic format are most useful when they are directly linked to the curriculum**
  The absence of educational content directly linked to curricula is one of the key inhibiters of ICT use by teachers and learners.

- **Creating digital/electronic content is difficult, and expensive**
  Adapting and/or digitizing curricular content for access via ICTs is a lengthy and expensive process. This holds for digitized content accessible on PCs, and is especially true with regards to educational television and video production. Radio dissemination may offer cost savings. The large up-front costs related to the adaptation and/or digitization of curricular content for access via ICTs may make such initiatives attractive for donor aid.

- **Simply importing educational content is to be avoided**
  Where indigenous educational content expertise familiar with the uses of ICT does not exist, it is necessary to have international and local groups work together. Simply importing existing educational content and expertise from abroad is fraught with difficulties; total reliance on local companies and organizations is often not practical in the early stages.

- **Digital clearing houses and evergreen curricula are useful**
  Establishing a clearing house or digital libraries of ready-to-use and customizable ICT-based resources promotes better use of ICT in teaching and facilitates quick and easy access to resources for making lesson plans and for teaching.

- **Evaluation of 'imported' content for cultural relevance must not be neglected**
  Guidelines, resources and mechanisms for evaluation of content are critical if such content is to be culturally relevant.

- **Digitizing content has important equity implications**
  Because of large up-front costs in digitizing content, minority language use may suffer when

ICTs are introduced in education and minority language users are at risk of becoming further marginalized. Because of limitations in using minority languages to disseminate content via the Internet, radio may provide a more appropriate mechanism for disseminating content in minority languages.

- **ICT use in testing requires new processes**
  When ICTs are introduced into the testing and assessment processes and procedures, such processes and procedures need to be evaluated and possibly reconfigured.

- **Public-private partnerships can be key**
  Public-private partnerships are often crucial for the development of digital content.

- **ICT use often promotes English language use**
  ICT-enabled teaching and learning is often seen as an important vehicle for the development of English (and other *linguas francas*) language competencies by teachers and learners. This is especially true with science and mathematics instruction, which are delivered in English in many countries where English is not an indigenous or dominant local language. This raises important issues related to learner equity and access to education.

- **Intellectual property issues are very real**
  Intellectual property issues are of tremendous importance when developing digital content for use in education. Ownership of content developed is a key issue to consider. Licensing of content is often an option, but may contain hidden costs.

- **Official guidelines and directives enhance use of ICT-enabled content**
  Guidelines from the Ministry of Education relating to the integration of ICTs in and with the curriculum greatly facilitate the use of ICTs in schools.

Comments

General

- At first glance, content issues related to ICT use in education might seem to some to be of minor importance. After all, access to the Internet (to cite one example) means access to an entire world of educational resources. Access to the Internet provides access to seemingly endless sets of educational resources -- and indeed it does. However, experience shows that there is a dearth of educational resources in a format that makes them easily accessible and relevant to most teachers and learners in LDCs, especially as they relate to a given country's current curriculum.
- Experience tells us that, unless electronic educational resources are directly related to the curriculum, and to the assessment methods used to evaluate educational outcomes (especially standardized testing), lack of appropriate and relevant educational content is actually an important *barrier* to ICT use in schools.

Applicability to LDC/EFA context

- The applicability of all content issues noted above to an LDC/EFA context is quite clear. The use of ICTs to create, disseminate and/or access educational content can have profound impacts on issues of equity and access to education.

Some areas for further investigation and research

- What are the best practices for creating electronic/digital curricular content?
- What is the relationship between uses of ICTs, curricular issues and standardized testing?
- What special issues relate to the creation, dissemination and use of curricular content in indigenous languages?

Some Recommended Resources

to learn more ….

- *Enhancing Learning Opportunities in Africa: Distance Education and Communication Technologies for Learning* [Murphy 2002]
- *ICTs in African Schools: Using Information and Communication Technologies (ICTS) in Education: Challenges for Curriculum Integration and Strategies for Success in African Schools* [Ngu 2003]
- *Interactive Radio Instruction: Twenty-three Years of Improving Educational Quality* [Bosch 1997]
- *Integrating ICTs into Education: Lessons Learned* [UNESCO-Bangkok 2004]
- *IT in Education Innovation for Development - Interfacing Global and Indigenous Knowledge* [UNESCO-ACEID 2003]
- *The Second Information Technology in Education Study: Module 2 (SITES: M2) Case Reports* [ISTE 2003]
- *Teacher Education through Distance Learning: Technology, Curriculum, Evaluation and Cost. Summary of Case Studies: Brazil, Burkina Faso, Chile, China, India, Mongolia, Nigeria, South Africa (two studies), United Kingdom* [UNESCO 2001]
- *Schoolnet Toolkit* [UNESCO-Bangkok 2004]

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Knowledge Map on Information & Communication Technologies in Education
Topic: School-level Issues

Guiding Questions:

- What is known about effective planning for ICTs in schools at the school level?
- What do we know about necessary school-level infrastructure to support ICTs in education?

Current knowledgebase
What we know, what we believe -- and what we don't

- **Much is known about what work at the school level**
  A great deal is known about what works – and what doesn't – related to implementations of ICT in education initiatives at the school level, based on both OECD and LDC experience.

- **Good documentation is available**
  Good documentation exists of specific practices and models for a great number of issues based on experience in the United States and the United Kingdom. The Commonwealth of Learning and UNESCO have adapted the models and lessons learned from such experiences, together with other experiences from LDCs, into a very useful *Schoolnet Toolkit*.

Comments

General comments

- Best practice exists for most issues relating to uses of ICTs in education at the school level.

Applicability to LDC/EFA context

- Despite the wealth of documentation mentioned above, little if any of this knowledge and information appears to have been incorporated into planning for and delivery of ICT in education initiatives in LDCs, where the 'same old mistakes' are often made again and again.

Some areas for further investigation and research

- The greatest need related to this topic is for existing knowledge and information to be delivered to the relevant people in charge of ICT in education initiatives in LDCs, as well as those (in donor agencies, NGOs and the private sector) who advise or contribute to such initiatives. Short workshops could be delivered to target countries preparing to scale up ICT in education initiatives to transmit such lesson learned.
- What are successful examples of how ICTs have been introduced and maintained in schools?
- What types of information must be provided to schools to aid in the introduction and maintenance of ICT-related equipment and to promote ICT-related instruction?

Some Recommended Resources
to learn more ….

- *British Educational Communications and Technology Agency (Becta) Tools and Services*
- *Consortium for School Networking (COSN) Studies and Toolkits*
- *ICT and School Management A Review of Selected Literature* [Passey 2002]

- *Integrating ICTs into Education: Lessons Learned* [UNESCO-Bangkok 2004]
- *A Review of the Research Literature on Barriers to the Uptake of ICT by Teachers* [Becta 2004]
- *Schoolnet Toolkit* [UNESCO-Bangkok 2004]

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Knowledge Map on Information & Communication Technologies in Education
Topic: Policy Issues

Guiding Questions:

- What is known about which areas are of particular relevance for ICT use in the education sector?
- What is known about effective policy frameworks for the uses of ICTs?
- What is known about the role of ICTs in educational reform and change?
- What is known about how ICTs can be used to enhance educational efficiency at the local, regional and national level?
- What is known about how ICTs can be used to enhance educational planning?
- What do we know about the necessary enabling environment to support the introduction and on-going maintenance of ICTs in the education sector?
- What is known about how to scale up and deliver national ICT for education programmes?
- What is known about how ICTs can be used to combat corruption in the education sector?

Current knowledgebase
What we know, what we believe -- and what we don't

General

- **There is general agreement on the most important issues and best practices**
  There is general agreement on issues impacting ICT in education policy decisions, and the broad lessons learned from ICT in education initiatives in LDCs to date. Both the general issues and general lessons learned in this regard have been well documented. Case studies and specific best practices in policy formulation and delivery have not been well documented.

- **Introducing ICTs raises important equity issues**
  The use of ICTs in education is seen to have a great effect on equity issues in education. They are seen to preferentially advantage schools and learners in urban areas and in locations where existing infrastructure is the best in a country.

- **Changes and innovations in technology come much faster than changes in the education system**
  The product cycle of most ICT-related products is much faster than the 'life-cycles' of education change and reform. This disconnect is important. Many studies cite the usefulness of ICTs to instigate and implement educational reform as a strong reason to undertake ICT investments in education in the first place. A lack of congruence between the timelines for role out of educational reform efforts and the role out of supporting ICT tools (hardware, software, training) is a potential area of great concern, as reform may be dependent on technologies that are no longer available (and/or supported). Even within a particular educational reform process, or indeed where no reform process is on-going, the pace of technological innovation outruns the pace of institutional innovation.

Existing policies

- **Different parts of government are responsible for ICT in education policies in different countries**

There does not appear to be a standard coordinating body responsible for the formulation of a country's ICTs in education policies. In some countries this is strictly the purview of the Ministry of Education (which may have a separate ICT in education policy, or fold ICTs strategies into existing education policies), while in others it is handled by the Ministry of Science/Technology (if such an institution exists) as part of a larger technology or information policy, although in most cases there is no national policy at all.

- **There is no database of existing policies**
  There is no standard repository for existing ICT in education-related national policies, although regionally the European Union has done a good job of collecting them for European countries, as has UNESCO-Bangkok in the Asia-Pacific region.

- **Successful policy requires consultation with a diverse group of stakeholders**
  It is believed that the formulation of successful policies related to ICTs in education must include not only the Ministry of Education, but also a variety of stakeholders from other government ministries, as appropriate (often this includes the Ministry of Finance, the PTT and ministries related to science/technology/IT, labor and rural development), communities and other civil society groups (including NGOs) and the private sector.

Scaling up

- **Little is documented about the 'scaling up' of ICT in education initiatives in LDCs**
  Little documentation exists related to the "scaling up" of large scale ICT in education initiatives in developing countries, whether as expansion of pilot projects or from scratch.

- **Models for scaling up are quite varied**
  Models for large scale ICT in education initiatives are varied and appear to be specific to individual developing country circumstances. In some instances, these are purely government funded and directed initiatives (as in China), public-private partnerships (as in the Indian state of Karnataka), private sector initiatives directed by government (as in Malaysia), or non-governmental organizations, either affiliated with government at some point in their development (as in the cases of Chile and Thailand) or not (as is the case in the Philippines and Uganda).

- **Schoolnets are a useful tool**
  "Schoolnets" are seen useful mechanisms both for introducing pilot initiatives in ICTs in education and as vehicles for investments at scale. Issues and guidance on developing and maintaining schoolnets have been well documented.

Reform, organizational, management and efficiency issues

- **ICTs can be important drivers for educational reform**
  Introducing ICTs in educational systems has been used as important mechanism and driver for educational reform efforts in some countries. In this context, ICTs can be utilized in many ways: as both a lever for organizational change, as a vehicle to introduce new teaching and learning practices and/or as an enabler of restructuring of the educational system.

- **ICTs can help in anti-corruption efforts in the education sector**
  ICTs may be useful tools in helping to combat corruption and leakage/shrinkage in the education sector. Wide dissemination of information about education budgets, objectives

and priorities down to the village and school level using existing media (radio, television, print) and Internet-related technologies (web sites, discussion boards, e-mail, accessed in schools and/or at community telecentres).

- **ICTs can aid decentralization**
  ICTs may be useful tools in facilitating the process of decentralization that is occurring as part of, or concurrent with, the efforts of Ministries of Education to meet education-related MDGs.

- **ICTs are vital for data collection and analysis**
  ICTs can be used to facilitate education-related data collection and processing efforts in ways previously not possible. Pilot projects have shown installed basic IC infrastructure can be used to enable data collection efforts in remote areas more quickly, inexpensively and effectively than using tradition methods. One example: using handheld computers to collect EFA-related population data, which is uploaded to installed computers in schools and community telecentres, and then transmitted to central location for loading into the national EMIS.

Comments

General comments

- Given the lessons learned from the explosion of pilot ICT in education initiatives in developing countries over the past decade, and the stated interest in many countries in exploring how/if such lessons may be relevant to the urgent needs to achieve education-related MDGs, the time appears ripe to include discussion of potential uses of ICTs in the education planning process in some countries, as relevant and desired.

Applicability to LDC/EFA context

- Where countries are interested in learning from existing pilot initiatives in using ICTs in education to help meet education-related MDGS, and/or where government is interested in utilizing ICTs at scale to meet such goals, additional work in the policy arena would (obviously) be directly applicable to such countries.

Some areas for further investigation and research

- How can/should EFA-related issues as they relate to the uses of ICTs be included in the decision-making processes of education officials?
- Existing knowledge and information on this topic needs to get into the hands of key decision makers.
- What ICT in education policies are currently in place, and how they address EFA-related issues?
- How can ICTs be used to facilitate the decentralization process underway or contemplated in many Ministries of Education?
- How can ICTs be used to combat corruption in the education sector?
- What are the best practices from implementing education management information systems (EMIS)?
- What regulatory issues exist related to connectivity and information access issues as they relate to the education sector, and what guidelines and best practices have emerged?

Some Recommended Resources

to learn more ….

- *Emerging Trends in ICT and Challenges to Educational Planning* [Hernes 2001]
- *Fighting Corruption To Improve Schooling: Evidence From a Newspaper Campaign In Uganda* [Reinikka 2004]
- *A Framework for Understanding ICTs-related Innovations in Primary and Secondary Education & Policy Recommendations* [SEPRYDEM 2002]
- *ICT and Educational Reform in Developing and Developed Countries* [Kozma 2002]
- *ICT in Education Policy-Makers Toolkit* [UNESCO-Bangkok unpublished draft]
- *Masterplan II for IT in Education* [Ministry of Education, Singapore 2002]
- *A Retrospective on Twenty Years of Education Technology Policy* [Culp 2003]
- *Technology in American Schools - 7 Dimensions for Gauging Progress - A Policymaker's Guide* [Milken Exchange on Education Technology 1999]
- *Technology in Schools: Education, ICT and the Knowledge Society* [Hepp 2004]
- *Thwarted Innovation: What Happened to e-learning and Why* [Zemsky 2004]
- *Towards a Strategy on Developing African Teacher Capabilities in the Use of* ICT [Schoolnet Africa 2004]
- *The World of ICT in Education: A Seminar for Policymakers* [World Bank Institute 2002]

About these Briefing Sheets:

*info*Dev's series of Knowledge Maps on ICTs in education is intended to serve as quick snapshots of what the research literature tells us about a number of key areas of information related to ICT use in education. Each Knowledge Map is not meant to be an exhaustive catalog of everything that is known (or is debated) about the use of ICTs in education in a particular topic; rather, taken together they are an attempt to limn the general shapes of a very large body of knowledge and highlight certain issues in a format quickly accessible to busy policymakers. In general, the *info*Dev knowledge mapping exercise is meant to point to key general assertions and gaps in the knowledge base of what is known about the use of information and communication technologies (ICTs) in education, *especially as such knowledge may relate to the education-related Millennium Development Goals (MDGs).*

The Education MDGs

Millennium Development Goals (MDGs) related to Education

Goal 2. ***Achieve universal primary education***

Target 3. Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of schooling

Goal 3. ***Promote gender equality and empower women***

Target 4. Eliminate gender disparity in primary and secondary education, preferably by 2005, and to all levels of education no later than 2015

Education For All (EFA) Goals

(from the *Dakar Framework for Action*)

Goal 1. ***Early childhood care and education***

- expanding and improving comprehensive early childhood care and education, especially for the most vulnerable and disadvantaged children;

Goal 2. ***Universal Primary Education***

- ensuring that by 2015 all children, particularly girls, children in difficult circumstances and those belonging to ethnic minorities, have access to and complete free and compulsory primary education of good quality;

Goal 3. ***Learning needs of all young people and adults***

- ensuring that the learning needs of all young people and adults are met through equitable access to appropriate learning and life skills programmes;

Goal 4. ***Adult literacy***

- achieving a 50% improvement in levels of adult literacy by 2015, especially for women, and equitable access to basic and continuing education for all adults;

Goal 5. ***Gender equality***

- eliminating gender disparities in primary and secondary education by 2005, and achieving gender equality in education by 2015, with a focus on ensuring girls' full and equal access to and achievement in basic education of good quality;

Goal 6. ***Education equality***

- improving all aspects of the quality of education and ensuring excellence of all so that recognized and measurable learning outcomes are achieved by all, especially in literacy, numeracy and essential life skills.

Notes on the Dakar Framework for Action

Strategy #10: *Harness new information and communication technologies to help achieve EFA goals*

¶*69*: Information and communication technologies (ICT) must be harnessed to support EFA goals at an affordable cost. These technologies have great potential for knowledge dissemination, effective learning and the development of more efficient education services. This potential will not be realized unless the new technologies serve rather than drive the implementation of education strategies. To be effective, especially in developing countries, ICTs should be combined with more traditional technologies such as books and radios, and be more extensively applied to the training of teachers.

¶*70*: The swiftness of ICT developments, their increasing spread and availability, the nature of their content and their declining prices are having major implications for learning. They may tend to increase disparities, weaken social bonds and threaten cultural cohesion. Governments will therefore need to establish clearer policies in regard to science and technology, and undertake critical assessments of ICT experiences and options. These should include their resource implications in relation to the provision of basic education, emphasizing choices that bridge the 'digital divide', increase access and quality, and reduce inequity.

¶*71*: There is need to tap the potential of ICT to enhance data collection and analysis, and to strengthen management systems, from central ministries through sub-national levels to the school; to improve access to education by remote and disadvantaged communities; to support initial and continuing professional development of teachers; and to provide opportunities to communicate across classrooms and cultures.

¶*72*: News media should also be engaged to create and strengthen partnerships with education systems, through the promotion of local newspapers, informed coverage of education issues and continuing education programmes via public service broadcasting.

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infoDev is an international partnership of bilateral and multilateral development agencies and other key partners, facilitated by an expert secretariat housed at the World Bank. Its mission is to help developing countries and their partners in the international community use information and communication technologies (ICT) effectively and strategically as tools to combat poverty, promote sustainable economic growth and empower individuals and communities to participate more fully and creatively in their societies and economies.

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