Capacity building within and across countries into the effective uses of ICTs[1]

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ABSTRACT

The driving question for this review is: What are the important dimensions of capacity building for ICT integration in education that have been identified, articulated, and experienced in different jurisdictions outside of Canada, and that have not [yet] been disseminated in the traditional research publication channels. We identified 12 Research and Development (R & D) initiatives involving 14 countries that either make explicit connection between national or state policies and research & development, have national or international scope, or both.

We present the capacity building process that emerged out of studying the source, partners, activities, and results of R & D initiatives. The following dominant themes were identified: 1) The vision underlying educational reform, 2) partnerships, 3) leadership, 4) connectivity and access, 5) curriculum requirements, 6) teacher professional development, and 7) assessment of learning.

We observe capacity building mostly around a few existing innovations in education: the networked computer, knowledge building, and collaborative project-based learning.

Exciting results are growing out of the greenhouse R & D initiatives. Will efforts to scale them up lead to the loss of their rational and their innovative dimension? Too few studies consider both a leading-edge pedagogical practice of ICT-supported knowledge building in the classroom and an advanced perspective on school leadership and governance. We conclude generally that countries are acting proactively but are still far away from seeing network-supported innovative practices in teaching and learning being sustainable or adopted on a large scale. Such practices would be in coherence with the discourse on the knowledge society.

Introduction

The integration of information and communication technologies to education is underway, and policy makers are eager to see results. To show "a return on investment" would be reassuring to the public, as countries and local communities are investing access to networked computers in schools. In spite of the budgets devoted to ICTs, however, very few school learners have had good and significant access to ICTs, for instance, in the last three years. Nevertheless, a certain shift of emphasis in people's minds is taking place, as an eagerness to see results is becoming apparent. The working hypothesis of this paper is that such results depend on capacity building in the use of ICTs. Many countries have engaged in the process. There is a growing awareness that the Internet is reshaping the way people work, play and learn.

As the ImpaCT2 study points out (United Kingdom, 2001), school learners in the UK are eight times more likely to use the Internet at home than at school. Tapscott (1997) made the case that kids with access to networked computers were distancing those without access, and that the gap was growing as measured by the skills mastered by the former. If kids are not only playing, but learning as well through edutainment, schools have an even greater challenge to offer ICT access to those on the wrong side of the "digital divide".

On the one hand, the principle of equality of access to education is challenged, and the "digital divide" is a concern (see Commonwealth Secretariat, 2000), but the application of this principle, on the other hand, is also facilitated when school learners succeed an online course (Stevens, 2002). Virtual schools offer more choices to distance learners who have access to a networked computer as well as to on-site support and guidance (Barker, 2001). But the great majority of school learners are in a regular classroom, and see their teachers every school day. Early results of ICT use in student motivation and engagement have been identified, and teachers' attitudes and instructional practices make the difference (Hickey, Moore, and Pellegrino, 2001). PISA 2000 results point to the disappointing significant minority of 15-year-olds who display negative attitudes towards learning and a lack of engagement with school, Canada being one of the countries with the highest percentage (over 35%) (see http://www.pisa.oecd.org). In Quebec, boredom in the classroom is the first reason boys give for dropping out of school (Theoret & Hrimech, 1999). Wang, Haertel, and Walberg (1993) identified the learner's positive perception of his or her learning environment as a key success factor in school. There is a possibility, yet to be evidenced, that the integration of ICTs in schools and classrooms will make the (networked) learning environment more attractive to boys.

Access to networked computers predicts teachers' use, which then leads to school learners' use during class time. But access without proper support for the teacher who is willing to have students use ICTs, and without pedagogical guidance for the school learner is unlikely to lead to effective use. This is in a nutshell what researchers observe (SITES, TL-NCE, ITU)[2]. Indeed, the different ways teachers and students use networked computers lead to different learning outcomes (Scardamalia and Bereiter, 1996; ImpaCT2, United Kingdom, 2002). Becker and Riel (2000) established a clear relationship between constructivist teachers and the use of the Internet in the classroom or the school lab.

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2 SITES is the Second International Technology in Education Study, ITU is the Norwegian National Network for IT Research and Competence, and TL-NCE is the TeleLearning Network of Centres of Excellence (Canada) (1995-2002).

Cuban (2000) has voiced concern about the under-utilization of computers by teachers. He stressed: “less than two of every ten teachers are serious users of computers in their classrooms (several times a week)” (p. 1). In their longitudinal study of an Australian school with student-owned laptops, Newhouse & Rennie (2001) concluded by stressing that computers were under-utilized. When computers are used along the dominant paradigm (drill-and-practice), as opposed to learner-centred principles (American Psychological Association, 1997), the likelihood of satisfying results lessens. Recent research on cognition and learning (Bransford, Brown, and Cocking, 1999) stress the importance of creating learning situations in which students engage in authentic tasks and work collaboratively supported by ICTs. Because networked computers make available communication and collaborative tools, they support constructivist learning activities.

As this study will demonstrate, most efforts to integrate ICTs into education use a rationale that is consistent with constructivist thinking, the paradigm most likely, if not applied in a too shallow way, to prepare youngsters for 21st Century workforce and citizenship (information management skills, higher-order thinking skills, communication and collaboration skills, etc.). The practice of deeper constructivist pedagogy is a complex one. And developers of online courses face the challenge of providing more than drill-and-practice activities. Therefore, research and development (R & D) initiatives in the use of ICTs have more to meet than challenges related to access to networked computers, technical support and online educational resources in order to reach their aims, especially those related to their country’s becoming as a knowledge society (Mansell, & When, 1998).

This paper focuses on R & D initiatives conducted in countries other than Canada. We inquired into how other countries are meeting the challenges of adoption of new tools for teaching and learning, but also those related to productivity when it comes to using new tools, sustainability of use, and scalability of complex innovative experiments conducted in protected environments. R & D initiatives are compared with regard to their source, partners, activities, and results with the hope that this study will be instrumental to policy makers here in Canada, and to policy makers in other countries.

Capacity building

Capacity building is both a process and an outcome. Cheema (1997) identified four levels of capacity building: the individual, the entity, the interrelationships between entities, and the making of an enabling environment. In this study the individual is the teacher but also the student, the entity is the school, the interrelationships are those occurring between schools in the education system of a given country, and the environment presents specific social, economic, cultural, and geographic characteristics.

In her research on the impact of twin dynamics of neo-liberal reform and globalization in an Australian Institute of Technical and Further Education, Seddon (1999) depicted capacity building as forward-looking and the re-norming of educational practices. Here in this paper, capacity building refers to the process by which individuals, organizations, communities and societies become more skillful at using ICT tools for fulfilling learning objectives. It is a process in which schools and education systems from almost all countries have now engaged in, using a number of methodologies, as the articulation of the process and the assessment of ICT capacity building is still in its early stages.

School classrooms are places of information and knowledge. Given their nature and the new era, they are challenged to revisit how they manage information and conduct instruction. The challenge that they face is the result of a combination of factors, including important discoveries in cognitive science regarding how people learn, new ways of doing business in a

networked world, and the exponential growth of information (Davenport and Prusak, 1998; Delors, 1996; Stewart, 1997). Educational leaders and policy makers understand that more is at stake with ICTs than ensuring access to new technology to school learners.

Capacity building in the use of ICTs is now being pursued in many countries. Technology transfer and process facilitation agents are active in developing countries. For instance, the International Institute for Communication and Development (IICD) has a Technology Partnership Programme in eight countries: Bolivia, Jamaica, Burkina Faso, Ghana, Mali, Tanzania, Uganda and Zambia. A technology partnership programme may last up to five years and comprises the following four elements: (1) an ICT Pilot Projects Programme, which involves local stakeholders identifying demand and builds on the existing local context; (2) capacity development programmes focusing on local institutional, technical and advisory skills development; (3) knowledge sharing by disseminating information, advice, best practices and lessons learned; (4) monitoring and evaluation. In industrialized countries, ICT plans, pilot projects and/or ICT policies are put into place. At its best, capacity building is a process of envisioning the future of an education system with the support of ICTs while reaffirming core societal values, aims, and sense of identity, followed by decision regarding professional training and development, and work organization. As pointed out by Batchelor (2001), in the search for sustainable and appropriate ways to build local ICT capacities, one must adopt established planning frameworks, and this means building from the core of a community (its values) out to structures and systems. In developing countries, such a process may be cultivated by development agencies. Industrialized countries such as Canada have had special committees that have made recommendations regarding ICTs (the information highway). Education being a provincial responsibility, stakeholders have partnered with Industry Canada (SchoolNet) for ensuring school connectivity.

The issues of sustainability and scalability of innovation are tightly connected to capacity building, and Blumenfeld, Fishman, Kracjik, and Marx (2000) stress that the following three dimensions must be taken into consideration: *the technological dimension*, e.g., the Web considered as the support tool, *the epistemological dimension*, i.e., the professional learning communities' conceptual tools, and the *social dimension*, which refers to the redefinition of education, in a number of locations on the planet, based on the evolution and of the spread of new technical and conceptual tools. A similar analysis is provided in Lakkala, Rahikainen, and Hakkarainen (2001).

Applying Cheema's (1997) framework, one may ask: Are individual teachers fully aware of the network phenomenon that is unfolding and touching all sectors of society? Are they seeing the pedagogical possibilities that these new tools bring? Are they more aware of disadvantages than advantages? These questions bring to the foreground the "disruptive" nature of ICTs within an entity. In a school, whose role in society is to exercise a double function of reproduction (knowledge and culture) and transformation, the arrival of new knowledge through new tools provokes attraction but also resistance on the part of teachers. As we know, the practical nature of an innovation seems to be a determining factor in a teacher's decision to adopt it. Doyle and Ponder (1977) pointed out the functional autonomy of teachers and the state of relative isolation in which they work, by stating that the majority of technological or pedagogical innovations, in fact, is disrupted by their autonomy. Describing the teacher sometimes as "a rational adopter", sometimes as "'a stone age' obstructionist'' or, sometimes as "a pragmatic skeptic", they brought attention to the difficulty – rather, the impossibility – of introducing change from outside of the class system due to the following factors: individualism, lack of instrumentation, daily demands as well as coherency and cost problems.

When innovative teachers introduce students to the use of ICTs, learner characteristics must be taken into account as stressed by Hartley & Bendixen (2001). They build on the

literature on learners' self-regulatory skills and epistemological beliefs as mediating success in learning environments. "Access to new technologies has increased the opportunities for activities that incorporate higher order skills" (p. 25). The important point here in regard to capacity building is that scaffolding students into activities that require higher order skills is key for their success on the one hand. Better assessment of the performance of new learning environments, on the other hand, is also important.

Another issue is the alignment of educational reform frameworks, infrastructure deployment, and classroom culture and practices. Are learning projects well aligned with the curriculum in a given school, district, province or state? Have the goals of the curriculum changed as ICTs have spread in the community? Are teachers who use ICTs reassured that provincial or national learning assessments will reflect those newly redefined goals? In our experience with teacher professional development in the effective uses of ICTs, in-service and pre-service teachers feel they are taking risks when they engage their classrooms into collaborative inquiries and deep understanding of some subject matter instead of covering all the rote knowledge often associated with a specific curriculum. They doubt that learning assessments will be well aligned with their pursuits, even if they are aligned to 21st century skills and the knowledge society agenda.

With capacity building being necessary at different levels of education systems, the impact of the use of ICTs in education will likely manifest itself only in the long term. Therefore, it is with a mixed dose of hope and uncertainty that teachers participate in R & D initiatives being launched by social leaders or reformers. They are a minority, and they themselves are called teacher leaders. Ironically, the very fact of the insufficient number of networked computers accessible to school learners ensures that innovation does not precede tradition in most schools and classrooms. Meanwhile, the educational leaders that manage to create innovation in teaching and learning with ICTs are providing relevant information to upcoming initiatives and policies (e.g., the Center for Innovative Learning Technologies (CILT) in the United States).

This paper makes the assumption that capacity building in the use of ICTs challenges information management practices and knowledge practices occurring in education systems, whether at the individual (teacher and student), classroom, school (as a learning organization), school district, or department of education levels. What may have simply begun as an educational resource challenge – a new generation of computers moving into schools and classrooms – is revealing to be, as social and pedagogical expectations grow regarding their use and their impact, an element that challenges the values and identity of education systems as well as their vision and aims.

Research methodology

The methodology used in this project is a documentary case study (Yin, 1994) with a very purposive sampling of grey literature[3] (Gelfand, 2000; European Association for Grey Literature Exploitation, 2001) to capture and analyze initiatives that were not included in previous documentary reviews.

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[3] Papers, research and technical reports, committee reports, working papers, produced to inform funding bodies about the results of research projects, to support grant applications, to inform rapidly a specific scientific community, to present preliminary results at conferences or as dissertations, disseminated quickly before or without the formal publication process.

The identification of 12 Research and Development (R & D) initiatives from 14 countries[4] (see the summary table in Appendix A) is the result of cross-referencing through our participation in OECD and SITES-M2 international studies, membership in SITE (Society for Information Technology in Teacher Education), and work with the National Network for IT Research and Competence in Education (ITU, Norway), the Association for Teacher Education in Europe (ATEE), and UNESCO as well as searches in the scientific and grey literature (on paper, CD-ROMs, and the Web). For instance, to this end, SITES-M1 and M2 and OECD databases were scrutinized for relevant information, the 1994-2002 SITE proceedings were indexed, and an earlier draft of the review was brought to the attention of ATEE members through contact with president, Arno Libotton (Belgium) and the Research and Development Committee on Teacher Education and Information Technology chaired by Jordi Vivancos (Spain). Other sources were identified through personal communication with key informants in Finland, Norway, Hungary, Sweden, Hong Kong, and the UK.

These initiatives were surveyed according to their source, partners, activities, and results. For inclusion in our review, we were specifically looking for initiatives that satisfied one or both of the following criteria:

1. Explicit connection between national or state policies and research & development;
2. Extensive scale and scope: initiatives of a national or international scope or large-scale research projects undertaken by a reputable organization or individual[5].

The driving question for this review was: What are the important dimensions of capacity building that have been identified, articulated, and experienced in different jurisdiction outside of Canada and that have not [yet] been disseminated in the traditional research publication channels.

The initiatives generally seek to identify elements of strategy that could help surpass practice shortcomings (lack of evidence on a large scale as regards learning outcomes, lack of advanced R & D projects, lack of congruent assessment tools) and fill the gaps regarding such elements as connectivity and access, classroom processes, content, and context that we characterized in our updated documentary review (Laferrière, Bracewell, & Breuleux, 2001) prepared for SchoolNet Canada. The focus of this study being what is going on outside of the country and also the United States, we do not present the specifics of R & D initiatives in North America but we refer to R & D initiatives in the US when found appropriate elsewhere in the paper.

R & D initiatives are identified by countries. Specific research papers are referred to whenever it is thought to be relevant. We survey systematically the twelve R & D initiatives identified, and also bring other evidence for a fuller understanding of the theme being described or analyzed.

The analytic framework refers to Cheema's (1997) four levels. As he pointed out, analysis of a situation may use any starting point-individual, entities or the system as a whole.

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4 Australia, Belgium, Chile, Finland, France, Greece, Hungary, Ireland, Italy, the Netherlands, Norway, Singapore, Sweden, the UK.

5 This excludes, for example, case studies undertaken by one school principal traveling in five countries during a sabbatical leave, or a rigorous study by a reputable research group in only one classroom.

Results: Reviewing the R & D initiatives

We present the capacity building process that emerged out of studying the source, partners, activities, and results of R & D initiatives. The following dominant themes were identified: 1) The vision underlying educational reform, 2) partnerships, 3) leadership, 4) connectivity and access, 5) curriculum requirements, 6) teacher professional development, and 7) assessment of learning.

We begin this presentation with a few vignettes of capacity building in the use of ICTs:

> *In Norway, the Ministry of Education, Research and Church Affairs has mandated for a period initially of three years (1997-1999), recently renewed for four years (2000-2003), the* National Network for IT Research and Competence *(ITU). ITU not only is sponsoring research projects in relevant fields, for example, web-based science or collaborative learning in virtual reality, but it also initiates teacher professional development in and with technology (the PLUTO project) for innovative ICT use in schools.*
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> *In the Australian context, the Commonwealth Department of Education, Science and Training has sponsored a large-scale research and development project, the* Innovative and Best Practice Project *(Australian Department of Education, Science and Training 2001), to look into the work of 107 schools "deeply involved in creating innovative solutions to the challenges and problems that emerge as the external world about them transforms from the post-industrial society into the knowledge society" (Cuttance & Stokes, 2001). At about the same time, the Department also sponsored an initiative to research and develop* Teachers for the 21st century *that includes research on effective programmes for beginning teachers, support for principals, as well as school-based action research.*
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> *The Dutch Inspectorate of Education is producing a series of* School Portraits *depicting innovative use of ICT in schools, not only in the Netherlands, but also in Sweden, Ireland, and Canada. The objectives are to provide inspiring examples of the possibilities of ICT that schools have discovered and effected, to make visible what is happening in schools, to provide information for policy makers and, in the longer run, contribute to the redefinition of objectives and benchmarks for education.*
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> *In Europe, the European Commission's Key Action "Improving the Socio-economic Knowledge Base" – of the Fifth EU Framework Programme (1999-2002) has sponsored the ITCOLE Project (see Lakkala et al., 2001) which looks at advanced forms of computer-supported collaborative learning and knowledge building in five countries.*
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> *In Chile, the ICT integration plan is devoted to enhancing democracy in that country (Hinostroz, 2002).*

The vision underlying educational reform

In all of the R & D initiatives that we reviewed the educational reforms are grounded in a vision of the emerging knowledge society, explicitly affirming that national educational systems must ensure that students acquire 21st century skills and become lifelong learners, and that cultural identity is to be preserved through linguistically and culturally appropriate content. In addition, many initiatives refer to a cognitive and social constructivism perspective on learning (see for example Cuttance & Stokes, 2001; European Commission, 2000). We see a proliferation of competition-oriented policy statements by Nations, States, or Unions targeting to be the "most connected…" or the "best", and very few strong statements on "education and knowledge as priceless tools in obtaining mutual understanding between nations" (Therkildsen, 2001).

In many of the cases reported in this paper capacity building is situated in a National reform of education and is undertaken first by revealing, documenting and sharing innovations in line with the envisioned reform, making accessible "thick descriptions", rich cases of innovative experiences that reify aspects of the targeted vision (see in particular Dutch Inspectorate of Education, 2001a & 2001b).

Partnerships

Forms of partnership differ according to the task at hand: Connectivity requires the contribution of private partners whereas professional development requires the contribution of those with more expertise on the professional development continuum, including teacher educators and educational researchers (e.g., Finland, Chile, Greece, Netherlands, European SchoolNet). In Scandinavian countries, municipalities are always directly involved when it comes to Internet connectivity. Partnerships between teacher education colleges, schools, and industry are happening: one of the Pluto projects in Norway has developed a partnership between a teacher education program, the National Norwegian telecommunication company Telenor, Compaq Norway, and elementary schools in Østfold for a full-scale implementation of wireless ICT in a new, pedagogical context, where all student-teachers are provided with a laptop computer with full-time wireless Internet access (Erikssen, n.d.).

Teachers are also considered partners. Shared distributed leadership in implementation of ICTs is reported as being a factor of success (participatory design is prevalent in Scandinavian countries). In R & D initiatives in the United States as well as in the European Union, university-school partnerships tend to be the norm. For countries where connectivity and access to online resources is the main concern, partnerships with private enterprise (local and global) is at the foreground.

Highly-integrated strategic planning is powerfully demonstrated in the Singapore case. For example, the National Institute for Education and the Nanyang Technological Institute have a close relationship in planning ICT educational developments (see http://eduweb.nie.edu.sg/is/RD/RD.htm#). There is a process (partnership, vision building, research, demonstration, etc.).

Leadership

The roles and dilemmas of leaders in building the capacity to achieve the reform vision are acknowledged in a majority of cases. One particularly powerful example is the "Virtual

Heads" project by UltraLab, the online component of the National Professional Qualification for Headship (NPQH) in the UK (see Bradshaw, Chapman, & Gee, 2001), taking a resolutely conversational approach, instead of simply placing previous material online for distance learning. In Australia, the teacher professional development of the Commonwealth Department of Education, Science and Training specifically includes "Quality Leaders" as one of its four key elements (see Australian Department of Education, Science and Training, 2000). To "educate school principals and other school authorities" is among the six recommendations in the final report from Computer-supported Collaborative Networks project in Europe (see European Commission, 2000, p. 5).

From our review of capacity building initiatives related to school leadership, we see that the important role of the school leader in effecting change is recognized, that early initiatives are taken to support this role, but that substantive results are not yet available on the different ways of achieving success in this area. It should be noted also that the theme of school leadership does not surface in projects where the focus is on advanced forms of knowledge building in the classroom (European Commission, 2000; Lakkala *et al.*, 2001). We hypothesize that the scope of issues, from detailed examination of collaborative knowledge building to school leadership, requires a research infrastructure which connects between different theoretical and methodological commitments, and which seems extremely rare (perhaps with the exception of CILT and ITU). Progress in achieving full coverage would require the establishment of more capacity through such interdisciplinary, long-term research programmes that could look at a systemic range of questions.

The Center for Innovative Learning Technologies (CILT) in the United States is a distributed center designed to serve as a national resource for stimulating research on innovative, technology-enabled solutions to critical problems in K-14 learning. Their approach is to foster and conduct collaborative research and development in areas that promise significant advances in learning (see http://www.cilt.org). One of the founding institutions of CILT is SRI International in Menlo Park, California. In 2000, it commissioned research design papers on behalf of the Office of Technology of the US Department of Education (http://www.sri.com/policy/designkt/found.html).

Another example of leadership is provided by the Commonwealth countries. Their Action Plan endorsed in Halifax (November, 2000) put ICTs in education as first element:

> *The use of ICT should be actively and systematically promoted through strategic initiatives that link countries, agencies, the private sector and NGOs in key projects to expand access to education, increase flexibility of delivery and improve on quality. The projects should also serve to bridge the "digital divide" in the Commonwealth. (p. 2)*

Connectivity and access

At the onset of the process, capacity building in the use of ICTs means electronic connectivity and basic training for teachers. Informatics and network specialists are called upon to provide expertise. Technical training in the use of ICTs is provided in all R & D initiatives. SITES-M1 (see Pelgrum & Anderson, 1999) provided basic information in this regard, and a number of R & D initiatives keep track of the degree of penetration of ICTs into schools and classrooms (see the benchmarking provided by Commission of the European Communities, 2002). Even in advanced ICT plans (e.g., the Netherlands) learning about software does not disappear as there are new tools teachers and students want to be able to utilize.

The very fact that connectivity is also a phenomenon outside of school raises the capacity of access to ICTs. Striking examples are provided by Norwegian teens using Nokia phones and SMS to communicate with one another. Wireless access is now an alternative, and leading companies such as Nokia, Apple, Sony, and IBM are converging technologies for greater connectivity and more flexible access.

Access to different technologies (ICTs) is likely to lead to different uses, and results. Educational technology research has often compared tools but, as pointed by Zhao, Byers, Pugh, & Sheldon, 2001), most of those studies did not provide an ecological view of the use of such tools. For instance, when ICT access is high, school learners may engage in extended projects, as pointed out by Law (2002), a Chinese researcher for SITES-M2. Moreover, the affordances provided by one type of generic tools (e.g., browsers, search engines, email, discussion forums) or specialized tools (e.g., ideation tools like *Inspiration*, digital video editing tools like *iMovie,* visualization tools like *CoVis* (Pea, 1993), and knowledge building tools like *Virtual-U VGroups* or *Knowledge Forum*) must be considered, as did ITCOLE, when assessing results.

Access for all

ICT access may be needed for all school learners, but countries differ in the means and capacity to achieve this aim. In Europe, for example, Nordic countries (Denmark, Finland, Sweden, and Norway), as well as the UK, have more than three times the EU average in terms of the number of Internet-connected computers in schools[6]. In the leading countries in Europe, we can see an emerging configuration of circumstances and outcomes consisting of low-cost broadband[7], use of Internet at home, ratio of Internet-connected computers in schools, use of computers in the workplace (both for work and training), and government use of Internet to provide services. There are signs that cost of Internet access is associated with Internet penetration in homes and schools, but there are no simple correlations. Access at low-cost does not warrant use, as indicated by the cases of France (low-cost for broadband and low penetration in households) and the UK (high cost of broadband and high penetration in households).

The trend is to provide basic ICT tools for students to use for specific learning purposes. The Web now being the standard for online software, Canadian specialized client-server applications such as FirstClass (used, for instance, in the UK and the Netherlands) and Knowledge Forum (used in the European CSCL R & D initiatives, see European Commission, 2000) have taken steps to move to become Web-based.

When access problems get resolved and fade into the background, technical support must remain readily available. Moreover, it is at this point of capacity building that pedagogical and cultural issues become more salient. Access leads to use and innovative practices begin to happen.

Curriculum requirements

Mastery of ICT skills precedes integration of those skills into the curriculum. In programs that spell out ICT skills to be mastered, a link to the curriculum can be traced. Although those

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6 The figures in this paragraph come from Commission of the European Communities (2002) and Norwegian Ministry of Trade and Industry (2001).

7 Either ADSL (Asymetric Digital Subscriber Line) or cable.

skills are taught more often than not as a subject matter in and of itself, project-based and problem-based learning that combine two or more subject matters are mentioned in documents describing R & D initiatives (see Dutch Inspectorate of Education, 2001a). In Canada, teachers have registered over 22 000 projects with the GrassRoots Program (SchoolNet). In the U.S., Blumenfeld, Kracjik, Marx, & Soloway (1991) and Kracjik *et al.* (1994), Harris and Grandgenett (2002), Penuel and Means (2000), and others have reported on R & D initiatives where project-based learning has been observed at a rather intensive level.

Learning projects, however, may remain peripheral to or extra-curriculum as in Hong Kong (see Law, 2002). Whereas the teacher's conceptions of him-herself as teacher and of the curriculum may be here a factor (White & Purdom, 1996), so may be the conceptions of their colleagues and administrators. Actually in Hong Kong this is a government demand. If the perception is that the use of ICTs is challenging the official curriculum instead of enabling its accomplishment, little progress is likely to be made toward the achievement of the vision that led to the release of funding for buying networked computers in the first place. The Singapore R & D Initiative indicates a clear understanding of this critical phase of capacity building.

But not all educational administrators are in the position of Singapore, a tightly knit system given the size of the country, which managed to have its students get the best results of all in math (TIMMS study). To their credit, they are willing to take risks; they understand that creative thinking is required in today's world. Slightly larger systems such as the Netherlands, Norway, and the UK are moving in the same direction. Whether small or large, education systems are likely, however, to count leaders and other administrators that hesitate to envision the necessary changes that their educational system would require in order to adapt to the so-called knowledge society.

Envisioning ICTs as an alternative for reaching remote students is another option. Accessibility to education is already a well entrenched value and widely applied principle. Few ICT R & D initiatives, however, are explicit in the matter as far as the K-12 sector is concerned (European Commission, 2000). Nevertheless, online courses are multiplying.

Development of content and software

Educational resources that reflect a specific country's culture(s) are important. But designers know that content and software development is expensive, and entrepreneurs would like to sell what they produce outside of their own country (see the World Education Market event to take place in Lisbon in May 2002). The likelihood that countries like Chile and other developing countries like Malaysia (see Gaible, 2001) may have to rely on some external help for accessing online content is strong. In this sense, the on-line classroom will challenge the locally established curriculum. Moreover, do developers have the capacity to provide learners with online opportunities to construct content, or are they perpetuating teacher-centred learning using a new mode of delivery? The transfer to the Web of already-existing content for paper- and video-based course delivery may be an indication that course quality is not really improving along the lines of what is known today regarding how students learn (Bransford *et al.,* 1999).

Teaching for understanding

In our 2001 review (Laferrière *et al.*, 2001), we made the two following observations: 1) Internet and learning projects are broadening the curriculum; 2) there is a greater range of construction of content by school learners. Teachers' conceiving of themselves or the textbook as the main sources of information in the classroom are likely to doubt the value of sending students to online resources to get and select information, and formulate answers to challenging questions or problems (European Commission, 2000; Lakkala *et al.,* 2001).

The notion of the hidden curriculum is enlightening here, that is, what is learned through how instructors proceed in the classroom: rote knowledge of deep understanding, obedience or freedom of choice, conformity or creativity, tradition or innovation? The Singapore Master Plan appears more explicit than others as to the necessity of providing learners with opportunities to be creative and develop higher-thinking skills. Is this vision translated into the curriculum? Is learning assessment aligned with the vision?

Rare are the R & D initiatives that approach capacity building with such integrity. Rather, superficial teacher professional development tends to be the next step of a national strategy.

Teacher professional development

Literature on innovation suggests that use is at first mechanical; next, routines develop and, later, professional use may be observed. Educational research is suggesting that innovative teachers may not be dependent on new technology when it comes to transforming their practice. Rather Becker & Riel's (2000) correlational study suggests that they may be teachers rising to the occasion in order to offer their students more opportunities for active engagement in learning. Those teachers need support (technical, administrative, and collegial) more than formal professional development (see Owston, 2002). Their own reflective practice for effective ways to integrate ICTs into teaching and learning is already a form of professional development.

Innovative teachers are likely, building on Rogers' notion of the "early adopters", 1995) to learn with other innovative teachers; see the emerging online communities of practice in the Netherlands and Hong Kong. Innovative teachers learn with their students. They let their students learn together. Learning situations become more realistic when classrooms get online to address authentic problems with first-hand resources; the successful online classroom combines information technology with appropriate pedagogy (see Laferrière *et al.*, 2001). Innovative teachers take external constraints as a challenge (e.g., lack of online resources). For instance, they may engage their students into creating materials, and create materials of their own. Hence, they make their work more visible when creating and publishing materials on the Web.

Another group of teachers (see Rogers' innovation curve, 1995) are also very committed to their professional development, but are waiting to see the results of those using ICTs for teaching and learning. Is good practice from innovative teachers enough to convince "the early majority" (of adopters) to start experimenting with ICTs as Roger's perspective on innovation would like us to think?

Building community

The notion of learning communities in teacher professional development for and with ICT is making progress. A review of publications in the proceedings of SITE (Society for Information Technology in Teacher Education) reveals that the number of articles mentioning "learning community" goes from one in 1994, nine in 1996, 31 in 1998, and to 54 in 2000. In addition, many national teacher organizations include on-line tools for professional communities as a critical means of achieving the long-term goals of renewal (see for example the Australian Council for Computers in Education, 2001). Current online support networks are viewed essentially as human networks of interaction and they are clearly identified as potent ways of developing new practices. Cases include the LUNA web and the Pluto project in Norway (Norwegian National Network for IT Research and Competence - ITU, 2002), *Log on to literacy*,

EdNA Online, VECO, and the Woollongong University's knowledge building community (Australian Department of Education, Science and Training, 2002). One Australian initiative (Australian Department of Education, Science and Training, 2002) has reviewed existing models of teacher professional development in ICT in school systems and relevant approaches to pre-service education in tertiary institutions across all Australian states and territories. Among the outcomes is the identification of "connectivity" as the key: "Connecting on-going teacher professional learning to student learning; connecting learning about ICTs to learning with ICTs; connecting educational reform in schools to educational reform in universities" (p. 2). The project currently focuses on "collaborative activities aimed at facilitating the sharing of information about the identified models, particularly through the use of online networks" and is scheduled to report in June 2002.

Including pre-service teacher education

In the US, the Department of Education's PT^3 R & D initiative is intended to build capacity of schools of education in using ICTs in pre-service teacher education. Since 1999, PT3 has awarded over 400 grants to education consortia to help address the challenge of teachers using ICTs. "Profound changes in the way teachers are taught are necessary to meet the demand for teachers prepared to educate 21st century learners", is stated on the front page of the supporting website (http://www.pt3.org). Three types of grants are awarded: 1) capacity ($120,000, 1 yr.); 2) implementation ($335,000, 3 yrs), and catalyst ($ 586,000, 3 yrs).

The same level of investment by a likewise R & D initiative in Canada would mean that more than one faculty of education out of two would receive funding. The only TL-NCE project relating to the same aims and means received close to the equivalent of a catalyst grant $520 000, but over a seven-year period. The Dutch government has also invested substantive funding in designing new learning environments for pre-service teachers (see Dutch Inspectorate of Education. (2001a). Faculties of Education in the Netherlands are engaged in experimental teacher education with the support of ICTs, and special funding is even higher that what is being awarded in the United States (see reports on their teacher education reform at http://www.efa.nl/publicaties/english.html).

Assessment of learning

Learners' thinking becomes more visible (see studies reported by Laferrière *et al.*, 2001). Researchers in the ImpaCT2 study in the UK asked school learners to draw a map of "Computers in my world" and then to list all the items in the drawing. In addition, the students were asked to write about computers for "a visitor from another world who has never seen one". Both the concept maps, with their labeled items, and the writing task offer the researchers access to rich, complex data on the child's representations of the place and the use of ICTs. Similarly, with a much smaller sample but with more complex data sets for each student, the Computer-Supported Collaborative Learning Network Project in five European countries (European Commission, 2000) included a focus on the nature of the cognitive exchanges taking place in computer-supported collaborative learning environments such as Knowledge Forum.

Attention to learners' thinking is also a matter of philosophy of education. For instance, we stated in a previous review (Laferrière *et al.,* 2001) that higher levels of control by learners are called for as classrooms are getting more online. Another observation was the following one: Online resources boost student interest and motivation in the classroom through a greater diversity of learning goals, projects, and outcomes. The ITCOLE R & D initiative points to conscious attempts to scaffold school learners' development of higher-order thinking skills (Lakkala *et al.,* 2001).

Hartley and Bendixen (2001) call for research on the relationship between learner characteristics and ICT impact. Stressing that alternative schooling (online courses) is often for those "struggling in the regular setting", they indicate that "the skills necessary for learning activities on the Web are similar to self-regulation skills" (p. 24). They argue that those skills that impact students' use of online materials should be studied.

That is to say that providing access to ICTs is not sufficient in and of itself. Five years ago, the ACOT R & D initiative in the US arrived at the same conclusion (Sandholtz, Ringstaff, & Dwyer, 1997). Too few initiatives are like those pursued in Italy and Greece (see European Commission, 2000) or in Singapore, where activities provide learning opportunities for students to use ICTs in a meaningful and intellectually challenging way.

Analysis

R & D initiatives have either attempted to reach learners on a broad scale or they have focused on a rather limited number of learners from a few schools. Hereafter, we call the latter the greenhouse approach, and the former the field approach. We examine the issues of technology adoption, productivity, sustainability, and scalability in both cases.

The initiatives and projects that we reviewed have in common a discourse on the knowledge society, but they differ in how they approach the practical and methodological consequences of this perspective. Some initiatives (for example the ITCOLE project, see Lakkala *et al.*) take very seriously the implications of a knowledge-centered schooling experience (see Bransford *et al.,* 1999).

Adoption of ICTs is the first milestone, and when early adopters (cf. Rogers' innovation curve, 1995) reach it, education systems request that they be productive, and learning outcomes are expected (see ImpaCT2 in the UK). Not only is the productivity of an innovation the target, but also sustainability and scalability (see the National Science Foundation requirements for funding in the US). Whenever the renewal of funding is made possible for R & D initiatives, they must demonstrate results: for example, strong partnerships, successful designs, learning outcomes, or influence on policy development.

When capacity building is approached at the vertical level (e.g., a research team working in a few classrooms or schools), more advanced classroom activities and processes and learning outcomes tend to be reported (the greenhouse approach) (e.g., ITCOLE). Large-scale R & D initiatives report results in a horizontal manner (e.g., ImpaCT2). In both cases, Cheema's (1997) four levels of capacity building apply.

Capacity building at the individual level (micro level)

Formal and informal skills development to access ICTs and accomplish tasks and solve problems with these new tools is the first step or a pre-requisite: all initiatives offered basic (technical) training in the use of ICTs or built on already existing skills.

Professional teachers make most decisions at the classroom level. Their options are of a pedagogical nature, and for that they must see possibilities that the use of ICTs will open for student learning and value those possibilities. ICT integration is linked to the adoption of new roles in the classroom for the teacher and students (Sandholtz *et al.,* 1997; SITES-M2). Almost all R & D initiatives alluded to new teacher and student roles. "Gains and pains", according to La Velle and Nichol (2000), "must be clear to participants both initially and during training, implementation and assimilation" (p. 99). For instance, a classroom that is electronically networked is likely to be less and less a closed system, and more and more an open system as

its members take advantage of online human and material resources and tools.

The responsibility for lifelong learning is shifting to the individual learner, and there are teachers that hear the message as learners themselves. Large-scale R & D initiatives provide the obvious, basic training in the use of ICTs. Collaborative learning among teachers is frequently observed, but authentic or informal teacher professional development is not an activity officially recognized. Moreover, there are more demands on the teacher who integrates ICTs to his or her teaching and student learning: more dialogue, more visible work, more risks, etc. (Dede, 1998; Means, 2000a). Capacity building is likely to fall short without adequate incentives or proper salary structures. These are, along with accountability, important elements of capacity building at the individual level. But even with that, as pointed out by Cheema (1997), this is no guarantee that the teacher, outside of a proper organizational context, will be productive or effective.

Moreover, at the individual level, we can also mention that the discourse is scarce in R & D initiatives for children that are gaining capacity by using technology out of school. No trace of recognition of experiential learning is on the horizon, with few exceptions such as NotSchool by UltraLab (see http://www.ultralab.ac.uk) or the Norwegian National Network for IT Research and Competence – ITU (2002) Kairon web-based collaborative game project).

Capacity building at the entity level (meso level 1)

A learned teacher in the use of ICTs needs resources (e.g., access for classroom students to networked computers and relevant software), and support (technical, administrative, and collegial). This is more likely to occur in a school where an infrastructure exists: a clear vision of how ICTs is likely to contribute to the school's mission, and of development goals, functions, systems and resources. In some cases, the supportive entity has become an online community of practice (see the support provided through ITU in Norway; see Moonen & Voogt, 1997); and the same could be noticed in Canada, for instance, in the McGill TLPDS Net, the Knowledge Forum Institute and the Education Network of Ontario).

When moving up to the level of the educational institution, the issue of connecting different planes of analysis becomes even more crucial than when looking at the classroom. Capacity building at the institution level is mostly about the alignment of school governance and pedagogical practices. The *activity theory* framework has been employed successfully, mostly in Nordic countries, to describe the unfolding of innovative practices in schools. This approach affords grasping "complex interconnections between several aspects, such as: theories of learning and instruction, […] teacher's roles, […] institution's educational praxis and tradition, organisational and administrative arrangements, […] properties of ICT (information- and communication technology) and available software, […] etc. Any changes associated with one of these aspects will inevitably *influence* and *change* the others" (Fjuck & Ludvingsen, 2001). Many innovative efforts tend towards the organization of the school as a learning community (see Breuleux & Libotton, in press). A first cluster of features concerns the driving motivation of the community, either in terms of a highly engaging project that is shared by all participants and captures their higher expectations, or in terms of a pressure to change, precipitated by a state of crisis. A second cluster concerns positive institutional orientations towards support, change, and risk taking. A third cluster concerns the shared values of the community: trust, respect, inclusiveness. Finally, a fourth important cluster points to the importance of an active and reflective involvement on the part of all participants. These clusters closely parallel the four fundamental features identified by Jerome Bruner in the work of Ann Brown (Brown, 1997) to foster communities of learners: agency, reflection, collaboration and culture. The major obstacles that the schools seem to encounter in attempting to become a learning community

can be stated in terms of an organizational culture that clashes with the values fundamental to learning communities: bureaucracy, fear, resistance to change, etc. In addition, the existing structuring of work (for example, task fragmentation, time scheduling and priorities) can stall the growth of the learning community within the organization.

Capacity building through interrelationships between entities (meso level 2)

Organizations and groups interact with others for a common purpose, should we say. Aligning educational units that perform different responsibilities in a school, a school district, or an education system as a whole is the next level of capacity building in the use of ICTs. Here we provide the following table (see Table 1) as indicative of the operations needed, for instance, to align professional development activities, classroom activities and processes, assessment activities, and evaluation research activities. Table 1 presents illustrative cases that we have reviewed, from four capacity building "lenses": professional development, classroom activities and processes, assessment of learning, and evaluation research. The Table *structure* represents the ambition of fully realized capacity building: professional development initiatives would support the development of innovative classroom processes, with new and appropriate forms of assessment, and these would form a data base from which evaluation research can look at the achievement of better learning. The Table *content*, however, illustrates that this ideal is rarely achieved, and that there are important and recurrent gaps in the capacity-building initiatives that we have actually encountered.

For productivity challenges to be met in the use of ICTs, the different quadrants of a particular education system would need to be filled. For example, in Australia, there is acknowledgement that an assessment system is needed for ICT skills and knowledge. Meanwhile a large-scale case study is proceeding with evaluating the results of ICT integration to teaching and learning. Another example is provided by the ITCOLE initiative (Lakkala *et al.,* 2001) where researchers report on computer-supported collaborative learning and collaborative knowledge building, but there are no signs that the assessment activity system accounts for such learning. Given the fact of the popularity of project-based learning with teachers using ICTs with their students, is Norway the closest to alignment with its strong project-based learning tradition?

Table 1. Illustrative cases (4 lenses on innovative practices)

	Professional Development (PD) Technology and pedagogy Learning community (agency, reflection, sharing, culture)	**Classroom activities and processes** Classroom organization and management In and out of the classroom	**Assessment of learning** On paper or with a computer	**Evaluation research** School-based case studies
Australia	"Teachers for the 21st Century"; includes leadership development. Embedding PD in work practices; teacher reflection and agency. "Models of teacher PD for ICT integration"- R&D project.		Underdeveloped is assessment of information technology skills and higher-order thinking skills, competencies and non-cognitive outcomes. Australian education systems are currently developing a national system for monitoring students' information technology skills and knowledge (Ainley, Banks, & Fleming, 2002)	Large-scale case study of 107 innovative schools (ICT being one component).
Europe (ITCOLE – Finland, Greece, Italy, Netherlands)	Implicit/Tacit	Computer-supported collaborative learning. Collaborative knowledge building. Knowledge management. Real-world, authentic contexts.		Strong theoretical and methodological commitments to Design experiment, ethnographies, case studies. Very purposive sampling of innovative practices.
European Commission (Computer-supported Collaborative Learning Networks)	A reflection on the Changing role of the teacher is underway in collaboration with the Commission française de l'UNESCO	Educational technology is to be used to help create a community of learners who build knowledge together. Equipment, information networks, but also teachers, learners and learning methods are included		Ecologically valid action research. Protocols of communications between students and between students and teachers. Case studies and small-scale, informal comparative experiments. Tests that measure the cognitive, metacognitive, and motivational effects of Collaborative Learning Networks.
England ImpaCT2	Online professional development (including "Virtual Heads" for school principals)			Case studies (including the use of children's conceptual mapping as qualitative data).

BECTA.org.uk UltraLab	Open University large-scale online courses on ICT training and use			Interpretations. Participatory research (involvement of teachers and pupils).
Netherlands	Modeling of innovative teaching and learning with ICTs Online professional development	A project-based learning program similar to SchoolNet Canada is being put into place		
Norway	A priority in the Government Plan. Research in Teacher Education Technological-Pedagogical Restructuring (PLUTO). Organizational and pedagogical innovations within the institutions, based on the full integration of ICT. National network for innovation in teacher education (LUNA)	Grounded in the strong Norwegian tradition of project-based learning. Open and flexible learning processes. Progressive inquiry model. Virtual reality and collaborative learning. Web-based learning in science.	Portfolios (exploratory stage)	Case studies of teaching and learning as cognitive and socio-cultural practices (including the use of activity systems as an interpretive framework). Design experiments.
Singapore		Studies are being conducted on questions such as "Fostering Scientific Inquiry in Schools through Computer-Supported Collaborative Learning",by Tan Seng Chee	Electronic portfolios	
Sweden	ItiS (IT in Schools) Technology and pedagogy	Changes in methods of working Teachers do not consider that teacher-pupil relations have changed as a result of ITiS, and that pupils have not been involved in choosing development work to any great extent.		Survey and in-depth qualitative studies of the effects of the ItiS. professional development. Investigate pedagogically-oriented competence development for teachers in work teams participating in ITiS Data from 620 on-line surveys directed at participating work teams (approx. 4,000 teachers). Teachers respond that they participate in ITiS in order to generate new ideas about pedagogical methods of working, that ITiS has increased awareness of different ways of regarding learning in a school environment and stimulated reflection on learning (including

				the teachers' own learning) and working methods. The teachers also agree that co-operation in the work teams has improved.
United States CILT SRI	Video cases provide visible models of innovative teaching Online communities of practice are getting established	Kids do things, interact, get feedback Visualization activities	Standards movement makes adventurous learning almost impossible. Development of assessments for Tomorrow's Classrooms (Means, 2000)	Questions asked by innovative policy makers: What complex of knowledge, skills and other attributes should be assessed? What classroom processes (task, activity, idea) may elicit those behaviors?
International SITES/OECD European Union Asian-Pacific Region (APDIC), and other developing countries	Basic training is provided, but professional development for specialized tools is the result of specific communities of practice that are discovering the Web as a way of support, communication and collaboration between practitioners.	Conversations and inquiry among classrooms from different countries		SITES/OECD case studies ICTs R & D Grant Programmes offered by APDIC

An attempt to summarize the capacity building process from a substantive point of view is presented in Figure 1. The graphic represents, at the top, connectivity and support that are necessary conditions for access, and together these three contextual factors enable the emergence of new possibilities, in practice settings. New ways of informing, communicating, and collaborating take place along a range of didactic, constructivist, or knowledge-building pedagogies. These, in turn, have important implications for assessment practices, standards, and objectives. On the right hand side of the diagram the vision underlying the educational project of the collectivity –either nation, state, municipality, or school– tends to connect the establishment of a socio-cognitive infrastructure (connectivity and support), commitment to a specific assessment paradigm and practices, as well as, potentially, the emergence of new possibilities. In the case of the latter connection, the link is more questionable, as indicated in the Figure: the educational project, as reified in "master plans" or governmental policy documents, does not lead *directly* to the realization of new possibilities; the link is much more complicated and our analysis concludes that the detour through an appropriate socio-cognitive infrastructure is an obligatory passage. It is that kind of *indirection* that makes the implications of policy work so unpredictable.

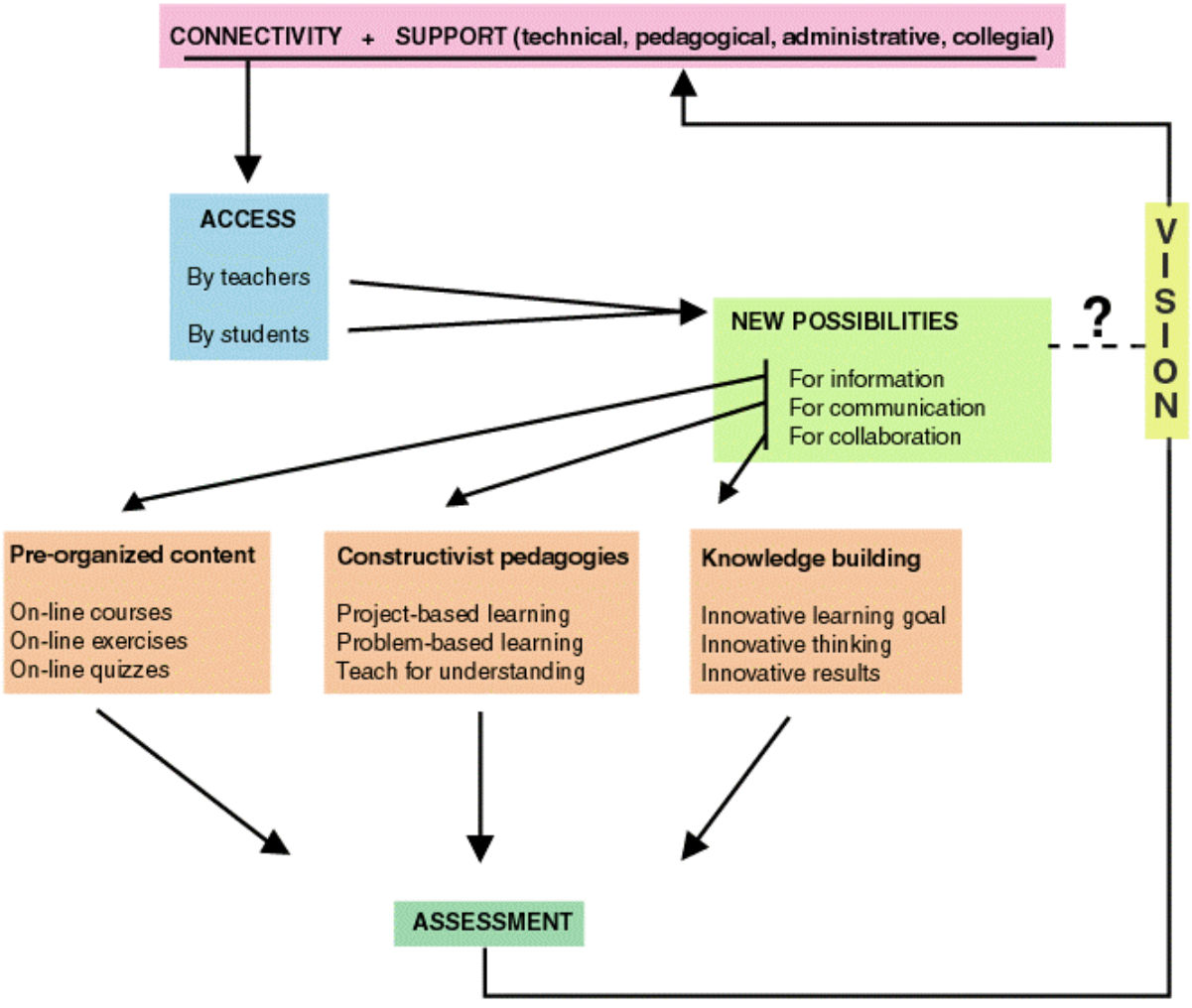

Figure 1. A capacity building process

Impact related to the use of ICTs may, of course, be assessed by other criteria than those related to professional development activities, classroom activities and processes, and learning outcomes. Flexibility of use is often advocated, and so is time saving in the conduct of certain activities. In countries such as Norway where the school and the municipality are closely bound, impact is likely to differ. In Singapore, a country deliberately seeking to transform its education system through ICTs, the tension between reproduction (of a winning system as far as the learning of math is concerned) and transformation may exacerbate if the assessment of higher-order thinking skills doesn't provide the results expected. And in the European Union, what is to be the impact of ICTs on teacher mobility?

Capacity building by devising an enabling environment (the macro level)

Adoption challenges are being met as education systems improve student/computer ratio, provide basic technical training, and identify ways in which ICTs may be integrated into curricular activities.

For capacity building to be sustainable, individuals, entities and systems require, as emphasized by Cheema (1997), a positive enabling environment that addresses cross-sector issues relevant to all parts of society – the state, civil society and the private sector.

Many countries want to have a leading role in ICT use for teaching, learning, and content development. For that to happen, high-level negotiations between stakeholders are needed. Questions such as the following ones might be worth asking: Is education system x capable of reaching social consensus with regard to the adoption of the socio-cognitive perspective as recommended today by learning specialists? Or is it engaged in active trade of educational online programs or leading international projects?

Developing countries such as Jamaica (Crawford, 2001) have the aim of changing their economy by engaging in ICT capacity building. Each country has to look at what it wants to be as it harness ICTs to improve the efficiency, accessibility and quality of the learning process within its education system. We suggest that, whatever the status of a country may be, a comprehensive and holistic approach is likely the most effective way to benefit from synergies and ensure that the impact of ICT deployment is optimized (See also http://www.opt-init.org/framework/pages/2.3.3.html).

Conclusions

For Canada to meet the performance indicators CMEC has set, we must understand that capacity building is an evolutionary process that can become endangered and, therefore, needs to be cultivated with "care and courage" (COMMITT, 1996). R & D initiatives that were reviewed are an indication of efforts toward more or less systemic approaches of continuous organizational learning demonstrated by education systems in order to improve the ability and capacity of individual teachers and schools to make the most effective and efficient use of the ICTs they can access.

Our study was especially concerned with Indicator 2, *Internet connectivity and activity,* and Indicator 6, *Innovation.* To build capacity for innovation, new classroom processes (activities) need to occur, and the roles of teachers and learners in the classroom need to be accommodated (see the learning community and the knowledge building models). But one would be ill-advised to think that the pupils to computer ratio (Indicator 1) has been met in Canadian schools (16, 500 schools) and classrooms. The same regarding Indicator 2, Obstacles to fuller use of ICTs. ImpaCT2 in the United Kingdom is a courageous study initiated by policy makers; exemplary as capacity building and promising as it involves school teachers and

students in the pursuit of rigorous understanding. In our review we have witnessed many such remarkable profound changes in the conduct of research, towards awareness of practice and policy.

Policy making as ICT-enabled knowledge work. Many of those involved in conducting the R&D initiatives reviewed indicate a belief that they have produced information of value to policy makers. For example, Ferry de Rijcke, coordinating the School Portrait initiative of the Dutch Inspectorate of Education, was quoted recently (Fichera, 2002) to say:

> *"At this moment the [Dutch] Ministry of Education is working on a policy plan for ICT after 2002. We have provided them with a report that sums up the results of the last four years in the daily practice of schools. The minister has sent this report to Parliament. I am convinced that our findings and recommendations will play an important role in their decisions".*

There is an assumption that, because the message has been sent, it has been received. In the specific case of the Netherlands, and more generally elsewhere, it remains to be seen how the policy makers will use the information, and to what extent the information provided is in line with the goals and processes of policy making. Certainly there is evidence from the past that more dialogue and collaborative sense making between the different actors would be beneficial. We see a need, and definite potential, to integrate into policy work the same kind of ICT-based renewal of practice that we see or hope to see in other types of knowledge work, in schools and in the workplace, leading to organizational agility, joint enterprise, shared interpretation, negotiation of meaning, sense-making, deep understanding, and knowledge building (see, for example, Hesselbein, Goldsmith & Somerville, 2002; Lipman-Blumen, 2000). Now that information on capacity building in different countries is available increasingly rapidly, on an ongoing basis, what are the obstacles preventing policy makers to use this information in a constructive way to direct and monitor the advancement of policies and practices?

A momentum at risk. Our review of initiatives abroad reveals that Canadian know-how in ICT integration developed, for instance, by the Knowledge Forum Research Team, TeleLearning NCE, and SchoolNet, is now underpinning many strategic projects overseas. It is worth noting, for example, that an impressive proportion of Internet contents in French, currently, is from Quebec; but it is equally worth wondering how long this edge will exist. Therefore, it seems that many jurisdictions in Canada are at a turning point, and have the option of driving on the current momentum. But this momentum is at risk. To education systems that are building capacity into effective use of ICTs, we offer the following concluding analytic remarks and questions:

- Smaller countries (Singapore, Netherlands, Finland) have a more integrated plan. How will smaller countries' agility play out in the long range? Through which R & D initiatives can larger countries develop synergies and achieve similar agility?
- Some countries put more pressure than others on teachers (England and Hong Kong). It is important for an education system to count on its teaching force. What are the characteristics of R & D initiatives that will best reflect the professional cultures in Canada when it comes to teacher learning?
- Innovators are found at all levels of education systems (elementary and secondary school teachers, administrators, public servants, university-based teacher educators and educational researchers). However, it is in elementary classrooms that computers are more "naturally" used. How can educations systems in Canada develop an R & D initiative that parallels the Netherlands for increasing ICT use in secondary schools?

- Few studies consider both a leading-edge pedagogical practice of ICT-supported knowledge building in the classroom and an advanced perspective on school leadership and governance. But exciting results are growing out of the greenhouse R & D initiatives. How can Canada plan to scale–up such initiatives so that their rationale and innovative dimension are not lost?
- In the classroom, capacity building is observed mostly for a few existing innovations: the networked computer, collaborative project-based learning, and knowledge building. How can education systems in Canada maintain or initiate R & D initiatives that will especially take advantage of innovations grown in Canada (see the TeleLearning-NCE results), and that serve today as models for other countries seeking to take further steps in ICT capacity building?
- Innovation is embodied in the technology plans of the countries that we surveyed. Does renewal end with the late majority adopting an innovation? Is capacity building possible at a more generic and systemic level? It is important to allow the systems of education, in parallel to organizations in other sectors, to be more rapidly adaptive and more agile, not just this time but on an ongoing basis. Is this a desirable goal for education and, if so, how can it be achieved?

The technical infrastructure called Internet will stay, and it will evolve. It is recognized to be a valuable source of information and communication, a place for transaction. Though prudence is required, countries are acting proactively but are still far away from seeing network-supported innovative practices in teaching and learning being sustainable or adopted on a large scale.

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Appendix A

Descriptor	Countries	Sponsor(s)	Area(s) of Activity	Key Source
Computer-supported collaborative learning networks	Belgium, Finland, Greece, Italy, the Netherlands	European Commission	Investigation of the cognitive and pedagogical aspects of computer-supported Collaborative Learning Networks, in which educational technology is used to help create *a community of learners who build knowledge together*	http://improving-ser.sti.jrc.it/default/show.gx?Object.object_id=TSER----00000000000009E6&_app.page=show-TSR.html
Emile	France, Greece, Hungary, Norway, Italy, Scotland	European Union (Socrates Programme)	Intercultural analysis dealing with the role of cultural identities on the use ICT in national educational systems (based on case studies)	http://www.emile.eu.org
Enlaces	Chile	Chilean Ministry of Education	Providing computers to schools, professional development for teachers, creating web-based content and services, and educational software	http://www.enlaces.cl
ImpaCT2	UK	Department of education and skills National Grid for Learning (NGfL)	Evaluation of the impact of ICT on pupil achievement	http://www.becta.org.uk/impact2/
Innovative and Best Practice Project	Australia	Australian Commonwealth Department of Education, Science and Training	Study of 107 innovative schools.	http://www.dest.gov.au/schools/publications/2001/innovation/report.pdf http://www.dest.gov.au/schools/Publications/2001/innovation/index.htm

ITCOLE	Finland, Greece, Italy, the Netherlands	European Commission	Analysis of practices in using ICT and computer-supported collaborative learning in European education. Provide examples and models of pedagogical practices.	http://www.euro-cscl.org/site/itcole
Master Plan for IT in Education	Singapore	Singapore Ministry of Education	A blueprint for the integration of information technology (IT) in education as a strategy to meet the challenges of the 21st century.	http://www1.moe.edu.sg/iteducation/
Models of teacher professional development for the integration of ICTs	Australia	Australian Commonwealth Department of Education, Science and Training	Explore existing models of teacher professional development in ICT across all Australia and develop collaborative activities aimed at sharing these models.	http://www.teacherpd.org/
Norwegian National Network for IT Research and Competence (ITU)	Norway	Ministry of Education, Research and Church Affairs	Interdisciplinary co-operation, network building, research and development, systematic documentation. Primary, secondary, teacher education.	http://www.itu.no/english_html http://luna.itu.no/
School Portraits	the Netherlands, Sweden, Ireland	Dutch Inspectorate of Education	Reviews of innovative use of ICT in schools	http://www.onderwijsinspectie.nl/producten/ictschoolportretten/sitevoorwoord_portretten.html
SITES/OECD	28 countries	Int'l Assoc. for the Evaluation of Educational Achievement (IEA)	Case studies of innovative schools and classroom practices	http://www.sites-m2.org http://www.oecd.org
Virtual Heads	UK	National College of School Leadership (UK)	Online component of the National Professional Qualification for Headship (course materials, Discussion groups & "Hotseats")	http://www.ultralab.ac.uk/projects/npqh/ http://www.ncsl.org.uk/index.cfm?pageID=18