

Comparative Analysis of Policies for ICT in Education

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International Significance of ICT Policy

As we enter the 21st century, there has been considerable international attention given to the role that ICT can play in economic, social, and educational change. This role has been most pronounced in the world's developed countries where technology has permeated businesses, schools, and homes and changed the way people work, learn, and play. The impact that ICT has had to date in the developed world, and the potential yet for further dramatic changes, is reflected in a range of multinational policy documents. For example, the leaders of the world's eight major industrialized democracies (G8 Heads of State, 2000) have noted that ICT has become an engine of growth for the global economy and has the potential to contribute significantly to sustainable economic development, to enhance public welfare, to strengthen democracy, to increase transparency in governance, to nourish cultural diversity, and to foster international peace and stability. At the same time, the group emphasizes the need to develop human resources capable of responding to the demands of the information age and to nurture ICT literacy and skills through education, training, and lifelong learning. The OECD (2001, 2006) also emphasizes the economic importance and impact of ICT in developed countries and points out the need for these countries to develop a workforce with the skills to use ICT to increase productivity, as well as the need for young people to develop ICT skills in preparation for adult life.

But it is not only the leaders of developed nations that stress the importance of ICT. The United Nations and the World Bank both advocate the use of ICT to support the development of the world's poorest countries. A World Bank (2003) report cites the potential that ICT has to improve efficient delivery of resources to the poor, to bring markets within reach of rural communities, to improve government services, and to transfer knowledge needed to meet the Millennium Development Goals. The African Heads of State (African Union, 2004) concur citing the potential for ICT to promote trade, improve health care, enhance good governance, and make education more available. In this regard, the World Bank report notes that ICT can increase access to education through distance learning, enable a knowledge network for students, train teachers, and broaden the availability of quality education materials. At the World Summit on the Information Society, the United Nations (2005) notes the potential of ICT to expand access to quality education, to boost literacy, and to provide universal primary education in developing countries.

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Much has been promised by multinational organizations for ICT to address the world's economic and social needs, especially in the area of education. But it is left to individual nations to deliver on these promises. National policies and programs can be an important tool for the realization of ICT's promise in education and that is the focus of this chapter.

The chapter presents a framework of alternative rationales and program components that can be used by researchers and policymakers to analyze, formulate, revise, and compare national ICT efforts. The framework consists of four alternative policy rationales—or “strategic” policy positions—and five components of ICT programs, or “operational” policies. Strategic and operational policies of various countries are used to illustrate these rationales and components. The chapter concludes with recommendations that countries can use when formulating or updating their educational ICT plans.

The Rationale for Strategic Policy for Educational ICT

National ICT policies can serve several important functions (Jones, 2003; Kozma, 2003a). Strategic policies can provide a rationale, a set of goals, and a vision for how education systems might be with the introduction of ICT and how students, teachers, parents, and the general population might benefit from its use in schools. These strategic policies can motivate change and coordinate disparate efforts so as to advance the nation's overall educational goals. Companion operational policies can set up programs and provide resources that enable these changes.

This is not to say that important things can not happen without nation policy. ICT-based innovation can and does occur in classrooms and schools without there being a close linkage to national policy (Jones, 2003; Kozma, 2003a). Also, there are often many ICT programs and projects sponsored by NGOs and corporations, apart from national policies and programs. But without the guidance of national policies and the resources of corollary programs, it is less likely that individual school and classroom innovations will be sustained. Nor is it likely individual effects will accrue across the country to have an overall impact on the educational system. Similarly, without the shared vision of a national policy the efforts of NGOs and corporations may very well go in divergent directions or work at cross-purposes and their contributions to the nation's education effort are more likely to be marginalized or even neutralized. In brief, without a strategic rationale to guide the national the use of technology in education, ICT policy is only operational. Policy becomes techno-centric, promoting the purchase of equipment or the training of teachers without providing a strong educational purpose or goal for the use of technology.

Strategic Educational ICT Policy Rationales



An analysis of national ICT policy statements identifies four alternative, somewhat-related rationales that are used to justify the investment of funds on educational ICT. These high-level statements can be thought of as “strategic policies”. Some strategic policies promote the use of educational ICT to support economic growth or promote social development. Some policies focus more specifically on the impact of ICT on the education system, either to advance education reform or support education management.

Support economic growth. A particularly common rationale for investment in educational ICT is the role it can play in preparing a future workforce and supporting economic development. The key to this policy approach is an articulation of specific ways that the educational deployment of ICT can support these broad economic goals, lest the connections between the two be hollow platitudes. For example, a major economic goal for most countries is sustainable economic growth. Economists attribute such growth to increases in productivity, which can include the absorption of more productive equipment, more skilled and productive workforce, and the creation of new knowledge (Stiglitz & Walsh, 2002). Corresponding education policies can connect the use of ICT to the development of students’ ICT skills which can be applied in the workforce, to develop their capacity to use technology to solve complex real-world problems that can contribute to productivity, and to their development of new kinds of “21st century” and lifelong learning skills which support knowledge creation, innovation, and entrepreneurialism in a “knowledge economy” (Kozma, 2005).

An example of this approach is Singapore where education policy has always been strongly linked to the development of human capital (Ashton, Green, Sung, & James, 2002). The most recent economic development plan in Singapore challenges businesses and workers to move beyond productivity gains resulting from the pervasive use of technology to the development of a knowledge economy, which relies on the development of new businesses based on research, innovation, and knowledge creation (Economic Review Committee, Singapore, 2003). In coordination with this economic plan, the Education Ministry instituted a number of reforms under the title “Learning to Think, Thinking to Learn: Towards Thinking Schools, Learning Nation” (Ministry of Education, Singapore, 2000). The country’s second ICT Master Plan, launched in 2002 (Mui, Kan, & Chun, 2004) and updated in 2006 (Ministry of Education Singapore, 2006) integrates ICT with changes in curriculum, assessment, instruction, professional development, and school culture to provide students with and prepare them to participate in the country’s knowledge economy.

Another example of economic-based education ICT policy is that of Jordan. Faced with persistently high unemployment and poverty, the Government of Jordan created a program of economic and social transformation in 2001 to develop high value-added sectors and to establish a knowledge economy (Ministry of Planning and International

Cooperation, Jordan, 2004). The top priority in this program has been the development of the nation's human resource. The Educational Reform for the Knowledge Economy (ERfKE) was a program launched in 2003 in support of these human development priorities. In this regard, "The ability of the educational system to develop and nurture creativity and innovation among learners [is] a cornerstone of an educational system that contributes to the development of a knowledge economy in Jordan. To do this, the educational system must itself be capable of nurturing an environment that encourages individuals to think in creative ways, innovate to solve problems, and capture what is learned and apply this within the wider system" (Ministry of Education, Jordan, 2005, p. 18). To accomplish this, Jordanian education policy commits the ministry to reform curriculum so as to balance traditional subject matter with learning process outcomes that make effective use of ICT and that engender knowledge creation and management.

Promote social development. Other countries have focused more on the potential social impact of ICT and governments have justified ICT investments with policies that promote their use to share knowledge, foster cultural creativity, increase democratic participation, make government services more widely available, and enhance social cohesion and the integration of different cultural groups and individuals with different abilities. Within education, socially-oriented policies offer the prospect of connections between classrooms across cultures, increased parental participation, student access to specialized educational services, and the delivery of educational services to remote populations. As with the economic rationale, the key is to articulate specific ways that educational ICT can support these broad social goals.

The education policy of the European Commission is of this sort. The Commission's policy of "information society for all" (European Commission, 2000, 2004) emphasizes the need to bring every business, school, home, and citizen into the digital age. One goal of the policy is to promote digital literacy that would provide students with new skills and knowledge that they will need for personal and professional development and for active participation in an information-driven society. The policy also addresses ICT's contribution to learning, especially for those who, due to their geographical location, socio-economic situation or special needs, do not have easy access to traditional education and training. Through networking among schools, the policy promotes collaborative projects between countries and cultures that can contribute to improving intercultural dialogue, mutual understanding, and social integration across the Union.

Within the European Union, Finland illustrates a national policy that focuses on the social impact of ICT. In its economic, social, and educational policies the Government of Finland places a very high importance on collaboration and knowledge sharing. The Finnish Information Society Program envisions a society "in which knowledge and expertise form part of the culture and also the key factor in production" (Information Science Advisory Board, 2000, p. 5). The country's education policy is coordinated with

this vision. As part of this the Information Society Program, the Ministry of Education in Finland (1995, 1999, 2004; Kankaanranta & Linnakyla, 2004) developed the Information Strategy for Research and Education. The goals of this policy emphasize the need to develop information society skills among all students, the building of open education and research networks, and the development of educational information products and services.

The social impact of ICT is also, perhaps especially, a concern among less-developed countries. Chile, for example, has used its educational ICT policy to address the social inequities in the country. Beginning in the early 1990's, education policy in Chile began to address inequities caused by years of neglect and privatization under military rule (Cox & Lemaitre, 1999, Cox, 2006). These policies focused initially on education improvements and ultimately on reform which extended the school day and the required period of matriculation, improved teacher quality, and better resources, particularly for the poorest performing schools. A central part of this policy was the widespread introduction of ICT, the training of teachers in their use, and the development of an educational portal on the Web (Laval & Hinistroza, 2002; Hinistroza, Hepp, Cox, & Guzman, 2003; Hepp 2004). Particular attention was given to ICT access for rural schools, most of which are attended by the nation's significant indigenous population, who have been traditionally underserved by the education system. Rural schools account for a third of the Chile's schools, yet they are attended by only 10% of the country's students, often in one-room school houses, many without telephone access and some without electrical power. As of 2004, 80% of the nation's schools are equipped with digital resources and 55% have Internet access, as a result of the policy (Hepp, 2004). More specifically, nearly 2,000 (or more than 60%) of the rural schools have broadband Internet access; more than 90% of rural communities have Internet access through community Infocenters.

Advance education reform. Any major change in an education system can be, and often is, called *reform*. But here the term is used to refer to major curriculum revisions, shifts in pedagogy, or assessment changes. ICT can play a particularly important role in supporting education reform and transformation (Means & Olson, 1995; Means, et al., 2004).

The kinds of education reforms that have been associated with the introduction of ICT include curriculum reforms that emphasize high levels of understanding of key concepts within subject areas and the ability to apply these concepts to solve complex, real-world problems (Bransford, Brown, & Cocking, 2000). Other curriculum reforms emphasize what are sometimes called "21st century skills", qualities that prepare students for the knowledge economy, such as creativity, information management, communication, collaboration, and the ability to direct one's own work and learning (Resnick & Wirt, 1996; ISTE, 2000; Partnership for the 21st Century, 2003, 2005; National Center on

Education and the Economy, 2006). ICT-related pedagogical changes treat the students as active agents who are engaged in collaborative projects that solve complex, real world-like problems or in sustained investigations and interactions that generate new ideas by building on and extending the ideas of others. The pedagogical role of teachers is to structure and support these practices by providing resources and explicitly modeling cognitive and social processes and prompting students to take up these practices (Bransford, Brown, & Cocking, 2000; Blumenfeld, Kempner, & Krajcik, 2006; Krajcik & Blumenfeld, 2006). Assessment reform emphasizes the need for continuous assessment that is integrated into regular, ongoing instructional activity and involves new assessment methods that include performance tasks and portfolio assessments (Pellegrino, Chudowsky, & Glaser, 2001; Mislavy, et al., 2003).

International studies have reported the use of these technology-based reforms in schools and classrooms in many countries around the world (Pelgrum & Anderson, 1999; Kozma, 2003b). These ICT-based curricular and pedagogical approaches are beginning to appear in national educational around the world. For example, Australian schools and teachers are integrating ICT to support experiential, constructivist learning in schools and across learning sites; engage students in personalized, collaborative, connected and interactive learning; and broaden and use new pedagogies and assessment approaches (Ministerial Council on Education, Employment, Training and Youth Affairs, 2006). Similarly, the South African education ICT policy document (Department of Education, South Africa, 2003, p. 13), states, "Learning through the use of ICTs is arguably one of the most powerful means of supporting learners to achieve the nationally-stated curriculum goals. In particular, the use of ICTs for learning encourages:

- learner-centered learning;
- active, exploratory, inquiry-based learning;
- collaborative work among learners and teachers; and
- creativity, analytical skills, critical thinking and informed decision-making."

Support education management. Some countries advocate the use of ICT to improve the management efficiencies or accountability of schools or the education system, more generally. Consequently, these policies emphasize computer-based testing and the use of digital data and management systems. For example, the current educational ICT policy of the United States emphasizes the use of technology to efficiently deliver online content and assessments and to provide principals, teachers, and parents with student performance and attendance data that can be used to personalize instruction, support decision making and the allocation of resources, and promote accountability (Department of Education, United States, 2004). Similarly, the educational ICT policy of Malaysia stresses the use of ICT to increase productivity, efficiency, and effectiveness

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of education management through office automation and data analysis (Ministry of Education, Malaysia, 2003).

Multiple rationales. These four policy rationales are not mutually exclusive. Indeed, a number of countries have used two or more of these rationales together in mutually reinforcing ways. For example, Singapore combines an economic rationale with an education reform one, arguing that by reforming the curriculum to provide students with learning skills, creative thinking skills, and communication skills they will prepare a workforce of excellence for the future. Similarly, Finland has combined the social and economic rationales by claiming that the collaboration and knowledge sharing of the information society are key factors that support a highly productive economy.

Operational Components of ICT Policies

While strategic policies provide a vision of a future enriched by ICT and justification for the often significant expenditures required to employ ICT, it is the operational policies that offer the hope that these visions can be realized. Operational policies—typically framed as action plans, programs, or projects—often consist of one or more of the following components and these components can be used to analyze, compare, and formulate national policies.

Infrastructure development. Operational policies often include a provision and budget allocation for technical resources that are needed to accomplish the nation's strategic goals. This is typically a policy emphasis in the early stages of a country's use of ICT in education. Such plans often include the amounts and type of computer and multimedia hardware that will be purchased but they may also refer to resources related to television and radio, especially in developing countries. Increasingly, the Internet and local networking resources are also included, along with a budget for educational software (Quale, 2003). One example of an infrastructure development policy is that of Malaysia which has set the goal of supplying computers to schools at the ratio of one to every ten students by 2005 and one to every five students by 2010. At the same time, the government plans on supplying teachers with one computer for every five teachers by 2005 and one computer for every teacher by 2010. Infrastructure policies and programs may also address inequities in the current distribution of these resources. For example, Chile began distributing computers with its *Enlaces* educational ICT effort by first addressing the inequities that existed in the urban centers and then those that existed in remote rural areas.

Teacher training. Teacher training is a key element to education reform, particularly training that focuses on classroom practices and engages teachers in a community of professional practice and development (McLaughlin & Talbert 2001; Bransford, Darling-Hammond, & Page, 2005; Fishman & Davis, 2006). Consequently, teacher professional development is an essential component of ICT operational policy,

particularly those that connect with education reform. ICT teacher training policies frequently spell out a specific set of skills that teachers are to acquire, as well as specify the duration of training. These skills are often operational skills. Especially in the early phases of ICT introduction, teachers need training in the operation of hardware, software, and, to some extent, networking. For example, the Enlaces program in Chile provided basic training to two-thirds of all the country's teachers by 2002 that consisted of email, Internet, productivity software, and administrative uses. However, as the use of ICT progresses, teachers need more advanced skills in how to integrate ICT into the curriculum and into everyday classroom practice. For example, the purpose of the in-service training program in Finland is to provide teachers with the knowledge and skills needed to reform the pedagogical practices in their schools, especially with regard to collaborative teaching and learning, networking, and team work. Singapore starts by providing teachers with 24 hours of workshops on basic ICT skills, such as text applications, spreadsheets, and interactive digital resources, but then offers advanced training and resources for teachers in the areas of media and digital resource development, technology planning and evaluation, action learning and research, and specialized ICT applications in humanities, mathematics, science, and languages.

Technical support. Another important operational component is ongoing technical assistance, which teachers need not only in early phases of ICT use but as hardware and networking technologies become more sophisticated and educational applications become more complex. As with teacher training, assistance is needed not only to support teachers' operation and connection of hardware and software, as well as help in integrating the use of ICT across the full range of curricular subjects. For example, Chile developed a collaboration between the Ministry of Education and institutions of higher education to provide both training and ongoing technical support to schools all across the country, including those in rural areas.

Pedagogical and curricular change. An especially important component of operational policies, particularly for strategic policies that promote education reform, is the articulation of changes ICT-related changes in curriculum, pedagogical practices, and assessment. For example, an important component of Singapore's reform was to create a better balance in the curriculum between the acquisition of factual knowledge and the mastery and applications of concepts, and the development of individual curiosity, creativity, and enterprise. Thus the curriculum was broadened beyond a set of cores skills and values to include information skills, thinking skills and creativity, communication skills, knowledge application skills, self-management skills, and character development. To develop these skills and attitudes, cross-discipline project work was introduced into the classrooms. Assessment was revised to measure students' skills in analyzing and applying information, thinking, and communicating. The plan also strengthened the connections between the school, the home, and the community, as

part of a larger social development plan that encouraged a more active participation of citizens in community life.

Content development. Some countries, because of the uniqueness of their curricula or special considerations of culture and language, find a need to emphasize the development of digital content as part of their operational policy. For example, the ICT program in Chile supported the development of *La Plaza*, a socially-oriented educational portal organized as a community square that includes a post office (email), information kiosk (digital content), and a cultural center (virtual collaborative workplace). The ICT program in Finland encourages the production of Finnish language instructional materials on the Web and this is now one of the business sectors that the Government is nurturing as part of its economic development program.

Policy Recommendations

The strategic and operational policy elements provided above can serve as a framework for the analysis and comparison of national policies. But there are particular substantive recommendations that can help policymakers use this framework to craft particularly effective educational ICT policies.

Policy alignment. National ICT policies will have the greatest impact if they are aligned with other strategic and operational policies. This alignment is of three sorts: strategic-operational alignment, horizontal alignment, and vertical alignment. Alignment between strategic and operational policies assures that ICT programs and projects are directly tied to the nation's goals and rationale. For example, strategic policies that emphasize economic development should be matched by operational programs that use ICT to develop of new workforce skills, not just purchase new equipment, and strategic policies that emphasize pedagogical reform should be aligned with ICT training that provides teachers with new pedagogical skills, not just new technology skills.

Horizontal alignment assures that ICT policies are consonant with other policies within the education system. For example, changes in ICT policies can both contribute to and benefit from corresponding changes in curriculum, pedagogy, assessment, and teacher training and it behooves ICT policymakers within the ministry of education to coordinate their policymaking efforts with those in other departments. More generally, policymaking efforts in the education ministry can benefit from coordination with those in the ministries of economic planning, telecommunications, labor, and rural development. Often policy coordination of this sort requires the guidance of the highest level policymaker, the minister of education in the first instance and the prime minister in the latter. Some countries constitute cross-ministry councils to guide and coordinate related policies with shared goals.

Vertical alignment refers to the coordination of policies up and down structural layers. That is, national policies should guide and be coordinated with those at the state, provincial, or local level. This will assure that resources allocated at the national level are appropriately applied at the state and local levels to have the maximum impact on schools and classrooms.

Distributed policies. In some countries, educational policies may be the sole prerogative of the central government. In these countries, ICT policy may be formulated as a discrete policy statement within the ministry of education, such as that in Singapore or the United States. In other countries, it may be integrated into the overall national education policy, such as that in Malaysia and Chile, or it may even be embedded in the national telecommunications policy, such as in Egypt where the Ministry of Communications and Information Technology lead the nation's ICT-based Egypt Education Initiative, in collaboration with the Ministries of Education and Higher Education (Ministry of Communications and Information Technology, Egypt, 2006). This sort of policy integration has the advantage of bringing more political weight and resources to bear on the effort. But to have maximum impact within the education system, the strategic and operational ICT policies need to be articulated in explicitly educational terms within the Education Ministry.

On the other hand, many countries have a federal political structure or a decentralized education system, where educational decision-making is vested in the states, provinces, or local districts or villages. In these situations, much of the discussion above applies to policymaking at the local levels. But the national ministry or department can still play an important role. One possibility in these cases is for national ICT policy to be strictly operational, providing resources that support the general use of ICT but make them available for use by local agencies according to their own strategic policies. Alternatively, national strategic policy can be formulated as a vision that guides local efforts or it can be articulated in general terms to advance important countrywide economic and social goals, while leaving the local agencies to craft operational policies that accomplish these goals.

Policy implementation. There are often huge gaps between policies and the changes in classroom practice that they are intended to affect (Cohen & Hill, 2001). Policies are articulated but teachers are often not aware of the specifics of these policies or their goals. In turn, policies are implemented as programs, but often these programs are not effective in achieving change at the classroom level. A study by Cohen and Hill (2001) found that policies were most effectively implemented in classrooms where teachers had extended opportunities to learn policy-related materials. Rather than general reviews of policy statements or discussions of their implications, the most effective teacher development experiences were concrete, content-specific, and instructionally useable practices directly connected to policy. Consequently, ICT policy implementation can

best be assured when teacher professional development includes specific skills and tasks that incorporated ICT into their everyday classroom practices and explicitly connect these practices to ICT and broader education policies.

Private public partnerships. The introduction and widespread use of ICT is an expensive proposition for any country. An important resource in this effort can be private-public partnerships. These partnerships can involve the Ministry of Education, along with universities, private NGOs, or private corporations. For example, the Ministry of Education in South Korea entered into an agreement with Intel to train a majority of the country's 400,000 teachers, principals, and professors in coordination with its ICT master plan (Intel, 2005). The World Economic Forum and its sponsors support ICT-based education reform in Jordan, Egypt, India, and Palestine (<http://www.weforum.org/en/initiatives/gei/index.htm>). Related to this effort, both Intel and World Links Arab Region (an NGO) are training teachers in Jordan, as part of that country's master plan. These partnerships can be particularly important in developing countries, where the demands for resources are significant and the available funds scarce. For example, the *Telefonica OCT Chile* supported the *Enlaces* program by donating telephone lines and unlimited Internet connections to schools, along with free email accounts for teachers and students (Hinistroza, et al., 2003).

Outcome-oriented policies, programs, and evaluations. The use of ICT in education constitutes a significant investment and this requires a significant return in terms of learners served and the number that become productive workers and citizens. Strategic policies should not only offer sweeping visions and specific goals for how technology can advance economic, social, and educational development, and operational policies should not only provide programs and resources but they should also describe how these visions and resources will impact the educational system with measurable outcomes. Policies and programs should call for indicators and monitoring and evaluation plans by which these outcomes can be tracked (Wagner, et al., 2005). Both process and outcome measures should be used to monitor the progress of policies and programs and provide information to policy makers that can be used to revise and refine policies and programs. The implementation of monitoring and evaluation component will increase the likelihood that national ICT education policies and programs will indeed be implemented and benefit students, teachers, schools, the economy, and society, more generally.

Resources. Policymakers can benefit not only from these recommendations but large collection of resources that can aid them in policy formulation and implementation. Among these are works that list the current ICT policies of other countries, such as *Cross-national information and communication technology policies and practices in education* (Plomp, Anderson, Law, Quale, 2003; and its update currently in progress) and the *Meta-survey on the use of technologies in education in Asia and the Pacific*

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(UNESCO, 2003). UNESCO also has a policymakers toolkit for ICT in education (<http://www.infodev.org/en/Project.11.html>). And the infoDev program at the World Bank has a variety of knowledge maps, guides, and handbooks (<http://www.infodev.org/en/Topic.4d.html>) that can be most helpful. With these resources, policymakers can begin to craft and refine policies that can help ICT deliver on its promises.

References

- African Union (2004). *Strategic plan of the Commission of the African Union: 2004-2007*. Addis Ababa: African Union.
- Ashton, D.; Green, F.; Sung, J.; & James, D. (2002). The evolution of education and training strategies in Singapore, Taiwan, and S. Korea: A development model of skill formation. *Journal of Education and Work*, 15(1), 5-30.
- Blumenfeld, P., Kempler, T. & Krajcik, J. (2006). Motivation and cognitive engagement in learning environments. In R. K. Sawyer (Ed.), *Cambridge Handbook of the Learning Sciences* (pp. 475-488). Cambridge: Cambridge University Press.
- Bransford, J., Brown, A., & Cocking, R. (2000). *How people learn: Brain, mind, experience, and school* (2nd ed.). Washington, DC: National Academic Press.
- Bransford, J., Darling-Hammond, L., & LePage, P. (2005). Introduction. In J. Bransford & L. Darling-Hammond (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 1-39). San Francisco: Jossey-Bass.
- Cohen, D. & Hill, H. (2001). *Learning policy: When state education reform works*. New Haven, CT: Yale University Press.
- Cox, C. (2006). *Policy formation and implementation in secondary education reform: The case of Chile at the turn of the century*. Washington: World Bank.
- Cox, C. & Lemaitre, M. J. (1999). Market and state principles of reform in Chilean education: Policies and results. In G. Perry & D. Leipziger (Eds.), *Recent policy lessons and emerging challenges*. Washington: World Bank.
- Department of Education, South Africa (2003). *Draft white paper on e-education: Transforming teaching and learning through information and communication technologies*. Pretoria: Department of Education.
- Department of Education, United States (2004). *Toward a new golden age in American education: How the Internet, the law, and today's students are revolutionizing expectations*. Washington: Department of Education.
- Economic Review Committee, Singapore (2003). *New challenges, fresh goals: Towards a dynamic global city*. Singapore: Ministry of Trade and Industry.
- European Commission (2000). *eEurope: An information society for all*. Brussels: European Commission.
- European Commission (n.d.). *A programme for the effective integration of Information and Communications Technologies (ICT) in education and training: 2004-2006*. Retrieved December 3, 2006 from: http://ec.europa.eu/education/programmes/elearning/programme_en.html.

To appear in the *International Handbook on Information Technology in Education*

- Fishman, B. & Davis, E. (2006). Teacher learning research and the learning sciences. In R. K. Sawyer (Ed.), *Cambridge Handbook of the Learning Sciences* (pp. 535-550). Cambridge: Cambridge University Press.
- G8 Heads of State (2000). *G8 Okinawa Communiqué*. Retrieved on December 30, 2006 from: <http://en.g8russia.ru/g8/history/okinawa2000/4/>
- International Society for Technology in Education [ISTE] (2000). *National Educational Technology Standards for Students: Connecting Curriculum and Technology*. Eugene, OR: ISTE.
- Hepp, P. (2004). *Enlaces: The Chilean ICT in education program*. Presentation made at the APEC Education Ministerial Meeting, Santiago, Chile.
- Hinestroza, J. E., Hepp, P., Cox, C. & Guzman, A. (2003). National policies and practices on ICT in education: Chile. In T. Plomp, R. Anderson, N. Law, & A. Quale (Eds.), *Cross-national information and communication technology policies and practices in education* (pp 97-114). Greenwich, Connecticut: IPA.
- Information Society Advisory Board, Finland (2000). *Finland as an Information Society: The report of the Information Society Advisory Board*. Helsinki: Information Society Advisory Board.
- Intel (2005). *3 million teachers help students learn to develop 21st century skills*. Retrieved on January 2, 2006 from: <http://www.intel.com/pressroom/archive/releases/20051116edu.htm>.
- International Society for Technology in Education [ISTE] (2000). *National Educational Technology Standards for Students: Connecting Curriculum and Technology*. Eugene, OR: ISTE.
- Jones, R. (2003). Local and national ICT policies. In R. Kozma (Ed.) *Technology, innovation, and educational change: A global perspective* (pp. 163-194). Eugene, OR: International Society for Technology in Education.
- Kankaanranta, M. & Linnakyla, P., 2004. National policies and practices on ICT in education: Finland. In T. Plomp, R. Anderson, N. Law, & A. Quale (Eds.), *Cross-national information and communication technology policies and practices in education* (pp 213-232). Greenwich, Connecticut: IPA.
- Kozma, R. (2003a). Summary and implications for ICT-based educational change. In R. Kozma (Ed.), *Technology, innovation, and educational change: A global perspective*. Eugene, OR: International Society for Technology in Education.
- Kozma, R. (2003b). Technology and classroom practices: An international study. *Journal of Research on Computers in Education*, 36(1), 1-14.
- Kozma, R. (2005). National policies that connect ICT-based education reform to economic and social development. *Human Technology*, 1(2), 117-156.
- Krajcik, J. & Blumenfeld, P. (2006). Project-based learning. In R. K. Sawyer (Ed.), *Cambridge Handbook of the Learning Sciences* (pp. 317-334). Cambridge: Cambridge University Press.
- Laval, E. & Hinestroza, J. E. (2002). Chilean schools: The Enlaces Network. *Technologia*, July-September, 14-18.
- McLaughlin, M., & Talbert, J. (2001). *Professional communities and the work of high school teaching*. Chicago: University of Chicago Press.

To appear in the *International Handbook on Information Technology in Education*

- Means, B. (2006). Prospects for transforming schools with technology-supported assessment. In R. K. Sawyer (Ed.), *Cambridge Handbook of the Learning Sciences* (pp. 505-520). Cambridge: Cambridge University Press.
- Means, B., Roschelle, R., Penuel, W., Sabelli, N., & Haertel, G. (2004). Technology's contribution to teaching and policy: Efficiency, standardization, or transformation? In R. E. Floden (Ed.), *Review of Research in Education* (Vol. 27). Washington, DC: American Educational Research Association.
- Means, B., & Olson, K. (1995). *Technology's role in education reform: Findings from a national study of innovating schools*. Washington, D.C.; Department of Education, Office of Educational Research and Improvement.
- Means, B., Penuel, W., & Padilla, C. (2001). *The connected school: Technology and learning in high school*. San Francisco: Jossey-Bass.
- Ministerial Council on Education, Employment, Training and Youth Affairs, Australia [MCEETYA] (2006). *Leadership strategy: Learning in an online world*. Carlton South, Australia: MCEETYA.
- Ministry of Communications and Information Technology, Egypt (2006). *Egypt Education Initiative*. Retrieved December 30, 2006 from: http://www.mcit.gov.eg/ICT_Learning_1.aspx.
- Ministry of Education, Finland (1995). *National strategy for education, training, and research in the information society*. Helsinki: Ministry of Education.
- Ministry of Education, Finland (1999). *Education, training and research in the information society: A national strategy for 2000-2004*. Helsinki: Ministry of Education.
- Ministry of Education, Finland (2004). *Information society programme for education, training, and research: 2004-2006*. Helsinki: Ministry of Education.
- Ministry of Education, Malaysia, (2003). *Education development plan: 2001-2010*. Kuala Lumpur: Ministry of Education.
- Ministry of Education, Singapore (2000). *Mission with a passion: Making a difference*. Singapore: Ministry of Education.
- Ministry of Education, Singapore (2006). *Overview of Masterplan II for ICT in education*. Retrieved on December 12, 2006 from: <http://www.moe.gov.sg/edumall/mp2/mp2.htm>.
- Ministry of Planning and International Cooperation, Jordan (2004). *National social and economic development plan: 2004-2006*. Amman, Jordan: Ministry of Planning and International Cooperation.
- Mislevy, R., Steinberg, L., Almond, R., Haertel, G., & Penuel, W. (2003). Improving educational assessment. In G. Haertel & B. Means (Eds.), *Evaluating Educational Technology: Effective Research Designs for Improving Learning* (pp. 149-180). New York: Teachers College Press.
- Mui, Y. H., Kan, E., & Chun, T. Y., 2004. National policies and practices on ICT in education: Singapore. In T. Plomp, R. Anderson, N. Law, & A. Quale (Eds.), *Cross-national information and communication technology policies and practices in education* (pp 495-508). Greenwich, Connecticut: IPA.

To appear in the *International Handbook on Information Technology in Education*

- National Center on Education and the Economy (2006). *Though choices or though times*. San Francisco: Jossey-Bass.
- Organization for Economic Co-operation and Development [OECD] (2001). *The well-being of nations: The role of human and social capital*. Paris: OECD.
- Organization of Economic Co-operation and Development [OECD] (2006). *Are Students Ready for a Technology-Rich World? What PISA Tells Us*. Paris: OECD.
- Partnership for the 21st Century. (2003). *Learning for the 21st Century*. Washington, DC: Partnership for the 21st Century.
- Partnership for the 21st Century. (2005). *A report on the landscape of 21st century assessment*. Washington, DC: Partnership for the 21st Century.
- Pelgrum, W. & Anderson, R. (1999). *ICT and the emerging paradigm for life long learning*. Amsterdam: International Association for the Advancement of Educational Achievement.
- Pellegrino, J.; Chudowski, N.; & Glaser, R. (2001). *Knowing what students know: The science and design of educational assessment*. Washington, DC: National Academy Press.
- Plomp, T. Anderson, R., Law, N., & Quale, A. (Eds.) (2003). *Cross-national information and communication technology policies and practices in education*. Greenwich, Connecticut: IPA.
- Quale, A. (2003). Trends in instructional ICT infrastructure. In T. Plomp, R. Anderson, N. Law, & A. Quale (Eds.), *Cross-national information and communication technology policies and practices in education* (pp 31-42). Greenwich, Connecticut: IPA.
- Resnick, L., & Wirt, J. (1996). Changing the workplace: New challenges for education policy and practice. In L. Resnick & J. Wirt (Eds.), *Linking school and work: Roles for standards and assessment* (pp.1-22). San Francisco: Jossey-Bass.
- Scaradmalia, M. & Bereiter, C. (2006). Knowledge building: Theory, pedagogy, and technology. In R. K. Sawyer (Ed.), *Cambridge Handbook of the Learning Sciences* (pp. 97-115). Cambridge: Cambridge University Press.
- Stiglitz, J. & Walsh, C. (2002). *Principals of macroeconomics* (3rd ed.). New York: Norton.
- UNESCO (2003). *Meta-survey on the use of technologies in education in Asia and the Pacific*. Paris: UNESCO.
- United Nations (2005). *World Summit on the Information Society: Tunis commitment*. New York: United Nations.
- Wagner, D., Day, R., James, T., Kozma, R., Miller, J., & Unnwin, T. (2005). *Monitoring and evaluation of ICT in education projects: A handbook for developing countries*. Washington: infoDev, World Bank.
- World Bank (2003). *ICT and MDGs: A World Bank perspective*. Washington: World Bank.