3

National Contexts

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As stated in Chapter 1, the principal contextual question of interest in SITES 2006 concerned the system factors associated with different pedagogical approaches and ICT-use within the respective participating education systems. This chapter therefore focuses on the education systems that participated in SITES 2006 and their attributes. The contexts of each of the 22 education systems are characterized in order to aid interpretation of the findings reported in later chapters in general and to evaluate the extent to which system characteristics help us understand trends in school ICT-policy and in teaching pedagogy in particular.

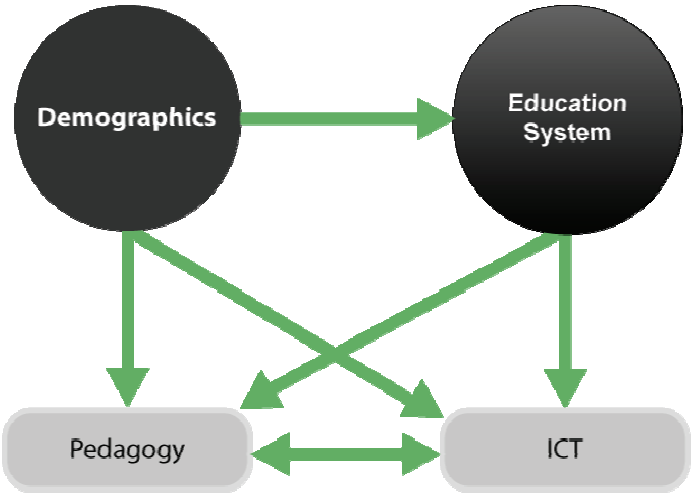
The chapter utilizes a conceptual structure that divides the system-level contextual questions and variables considered in this chapter into four clusters or spheres: demographics, education system, pedagogical trends, and ICT-related policies (see Figure 3.1 and refer also to Section 2.2 in Chapter 2). Each of these spheres is discussed below. The data for these spheres derive primarily from the national context questionnaire (NCQ) (answered by the SITES national research coordinator [NRC] for each country or education system). However, we also used several demographic and technology indicators from the *Human Development Report 2006* (United Nations Development Program, 2006).

All four contextual spheres are conceived in this chapter as attributes of education systems. Pedagogy and ICT in learning are, of course, processes that occur primarily at the levels of the classroom and school, but the general trends or patterns that emerge in relation to these processes can be considered characteristics of the overall system of education. This assertion aligns with the perspective given in Plomp,

N. Law et al. (eds.), Pedagogy and ICT Use in Schools around the World, 37–66.

Anderson, Law, and Quale (2003).

Figure 3.1 Four spheres of contextual factors



3.1 Research questions relating to the four spheres

3.1.1 Demographics

The system-wide demographic and education cultural indicators obtained from the UNDP *Human Development Report 2006* included population, urbanization, income, income inequality, education level, and investment in education. Our aim here was to explore the extent to which these indicators predicted ICT-related structure and pedagogy in education. The research question we posed in regard to this sphere was: *Among the education systems studied, what are the distributions of indicators (and how do they differ) in terms of population, GDP, income inequality, cell phone users per 1,000 of population, and internet users per 1,000 of population?*

The analysis is limited to only a few demographic indicators selected on the basis of prior research that suggested they might relate strongly to patterns of diffusion of ICT within education. ICT tends to be costly; as such, financial indicators were also of interest. Finally, we considered that concentrations of internet use and cell phone use might indicate the capabilities of individuals to deal with such technology easily.

3.1.2 Structure of the education systems

We identified four sets of indicators for this sphere: (i) education system investment and output; (ii) centralization in terms of funding sources and curricular components; (iii) professional development requirements for teachers; and (iv) mathematics and science curriculum components. Kozma's (2003) case study data support the importance of these forces. In exploring the role of these factors, we were guided by this broad research question: *What are the distributional patterns across education systems in terms of general education level, investment in education, professional development of teachers, centralization of curricula and funding, and mathematics curriculum and science curriculum components?*

3.1.3 Pedagogy

The NCQ instrument contained a number of questions relating to trends in pedagogical practice within each education system as a whole. Some of these focused on instructional reform or change. Indicators of teacher preparation were also included under pedagogy. For these questions or indicators, we were primarily interested in the distribution of pedagogical indicators across education systems.

3.1.4 ICT-related policy and activities

As with the sphere of pedagogy, ICT was a major dimension of interest, primarily in terms of its interaction with pedagogy. We decided to explore the following general question: *To what extent do education systems implement ICT and also combine it with pedagogical reform*? The relevant indicators included ICT-related policy and practice within education.

3.2 Methods overview

As noted, the principal instrument used to gather the information needed to answer these questions was the NCQ, which was administered to the SITES NRCs. The questionnaire was administered online by the IEA Data Processing Center in the last quarter of 2006. The NRCs were asked to consult with policymakers in their respective ministries of education and with other experts when answering the questions. The questionnaire included both open-ended and closed-ended questions; the analysis in this chapter integrates both types of

information. More methodological details related to indicators and the analysis can be found in Chapter 2 of the SITES 2006 technical report (Carstens and Pelgrum, in press).

Our analysis here is constrained to a single level in which the education system is the unit of analysis. While we have some rudimentary indicators of pedagogical orientation and ICT-use at the system level, these are drawn from answers to the NCQ questions and so do not have the benefit of the more extensively measured indicators based on the principal or teacher surveys and utilized in later chapters. Further, the analysis is necessarily limited by the inclusion of only 22 education systems, 16 of which are nations and six of which are within-country regions or distinct administrative units. While we refer to them all occasionally as "countries," generally we follow the IEA convention of referring to them as "education systems." The systems were not randomly sampled, so our utilization of statistical inference is of necessity informal, with only descriptive statistics and qualitative results reported in this chapter.

The reporting of this analysis and its findings is divided into two overall sections: within-sphere and between-sphere. The former focuses on descriptive distributions and qualitative data while the latter consists primarily of explanatory or predictive analyses. These sections are followed by a final, integrative section labeled "Conclusions". The findings in the within-sphere section are reported for each sphere one at a time: demographics, structure, pedagogy, and ICT.

3.3 Within-sphere (univariate) findings

3.3.1 Pedagogy

Considerable demographic diversity is evident across the 22 education systems (see Table 3.1). At the time of the SITES 2006 survey, the populations of these countries ranged from 1.3 million (Estonia) to 144 million (Russia). Urbanization ranged from 32% for Thailand to 100% for Hong Kong SAR and Singapore. Per person GDP started at about US$8,000 in Thailand and ranged through to about US$38,000 for Norway. We measured income inequality by subtracting the average per capita income of the lowest-earning 10% or poorest members of the population from the average per capita income of the top-earning or richest 10%. That calculation produced a gap of US$4,500 for Japan (the

lowest of the 22 education systems) and a gap of US$40,600 for Chile (the highest difference). Most of the participating systems had an inequality gap within the range of US$7,005 to US$12,500.

Cell phone penetration or use also showed considerable spread, with Thailand and South Africa at the bottom end of the range (about 430 cell phones per 1,000 adults). Hong Kong SAR, Israel, and Italy had just over 1,000 cell phones per 1,000 adults—a figure that implies some people had more than one mobile phone. Internet penetration was lower. The system with the fewest internet users was South Africa (78 internet users per 1,000). The system with the most was Denmark (696 per 1,000).

3.3.2 Structure of the education systems

Table 3.2 lists variables that describe the education systems as a whole. The first two variables were obtained from the UNDP data, as was the demographic information. The education level index (column u7) is the average of two percentages: adults who are literate and school-age children in school. As can be seen, most education systems in the study had quite high percentages for both factors. The highest were Denmark and Norway with 99%; the lowest were Chinese Taipei, South Africa, Thailand, and Hong Kong in the 80s. The remaining indicators presented in this section are based on data from the NCQ. Some are simply the answers to one or more questions; others are an aggregation (usually summation) of items from the NCQ.

1. Central versus local control (q1–7)

The first two indicators measured centralization of control and funding. When the NRCs were asked at what level (central government, provincial and/or regional government, district and/or local government, non-statutory and/or professional body, "schools are free to decide," and "other") various functions were set (e.g., system structure [q1], examinations [q2], and certification requirements [q3]), almost all of the them specified the central level. The only major exceptions to this pattern were the Canadian provinces and Catalonia-Spain.

More differentiation became evident with regard to control of curriculum and funding. According to the NRCs' reports, more than half of the education systems give primary control of funding for schooling to the central or provincial governments (entered as a "yes" in Table 3.2). Although the education systems were classified as either central or local, many of them provide some funding at both levels. For example, the

Table 3.1 Demographic factors by country (education system)*

Education system	(u1) Pop. in millions	(u2) % Urbani-zation	(u3) GDP per capita (in US$)	(u4) Income inequality (in US$)	(u5) Cell phone users per 1K	(u6) Internet users per 1K
Alberta Province, Canada	3.3	70	29,263	9,400	469	646
Catalonia, Spain	7.2	82	29,645	10,300	905	336
Chile	16.1	87	10,874	40,600	593	267
Chinese Taipei	23.0	60	12,941	18,400	677	273
Denmark	5.4	86	31,914	8,100	956	696
Estonia	1.3	69	14,555	6,500	931	497
Finland	5.2	61	29,951	5,600	954	629
France	60.3	77	29,300	9,100	738	414
Hong Kong SAR	7.0	100	30,822	17,800	1,184	506
Israel	6.6	92	24,382	13,400	1,057	471
Italy	58.0	68	28,180	11,600	1,090	501
Japan	127.9	66	29,251	4,500	716	587
Lithuania	3.4	67	13,107	10,400	996	282
Moscow, Russian Federation	10.9	79	9,902	13,700	617	211
Norway	4.6	77	38,454	6,100	861	390
Ontario Province, Canada	12.5	82	32,663	9,400	489	689
Russian Federation	143.9	73	9,902	6,440	517	111
Singapore	4.3	100	28,077	17,700	910	571
Slovak Republic	5.4	56	14,623	6,700	794	423
Slovenia	2.0	51	20,939	5,900	951	476
South Africa	47.2	59	11,192	33,100	428	78
Thailand	63.7	32	8,090	12,600	430	109

Notes:

* Primary source of all "u" indicators was the *UNDP Human Development Report, 2006*
Except where otherwise noted, the statistics were based upon 2004

(u1) Total population in millions

(u2) Percent of population in urban areas

(u3) Gross Domestic Product per person in US$

(u4) Income inequality is measured by subtracting the average per capita income of the lowest-earning 10% of the population from the top-earning 10% (figures in US$)

(u5) Cell phone users are the number of users per 1,000 population in 2003

(u6) Internet users are the number of user per 1,000 of population in 2003.

primary funding source in Lithuania is the local authority, which funds school infrastructure (buildings, non-teaching staff, heating, communications, etc.), but the central government provides the secondary source by funding the "student's basket" (teacher salaries, teaching materials, and teacher training). France has these sources of funding as well as funding from companies and families. In Estonia, funds are given to the municipalities, which have considerable autonomy in allocating them within the educational budget. In the Canadian provinces, funds are given to school boards. Danish schools funds are given to the municipalities, which have considerable

autonomy (both public and private) and are mainly financed by municipalities, but the municipalities receive a block grant from the central government. The grant is not earmarked for a specific purpose. Eight of the 22 education systems reported central control of funding but decentralized determination of the curriculum.

With regard to central or provincial control of curriculum components (e.g., attainment targets, textbook lists, and teaching methods), the education systems were again evenly divided, with slightly fewer than half indicating little control of curriculum elements. In Norway, the new reform, "Knowledge Promotion," implemented in schools in the fall of 2006, grants a higher degree of freedom at the local level with respect to teaching materials and the methods of classroom instruction. Compared to the old compulsory curriculum, the reform places a stronger emphasis on attainment targets and skill preparation. In Spain, the central government establishes around two thirds (65%) of the curriculum content for compulsory education. However, in Catalonia, as well as in other regions of Spain with their own official language, this percentage drops to 55.

2. Promotion of students in the target grade (q10, Table 3.2)

Another question (q10) asked the NRCs to specify the criteria their respective education system used to promote students in the target grade to the next grade level. The answer alternatives were (a) national examination, (b) school internal examination, (c) oral and/or written examinations throughout the school year, (d) portfolio of student work, and (e) other.

The q10 column in Table 3.2 contains the letters of all the answers selected. A maximum of three options could be selected, so one to three letters appear in that column. The most common answer was "c", for oral and/or written examinations throughout the school year. However, "b" for internal examination was also quite often selected, as was "bcd," for all three of those answers.

In Chinese Taipei, the NRC reported that every student is promoted to the next grade level after finishing his or her present grade, unless under some special conditions, such as a request from parents. Chinese Taipei's compulsory education system (Grades 1 to 9) does not fail students. Remedial activities are carried out to help students who

Table 3.2 Structural factors by education system

Education system	(u7) Index of education level	(u8) Educ. $ divided by GDP	(q4) Centralized funding
Alberta Province, Canada	0.97	5.3	yes
Catalonia, Spain	0.98	4.5	yes
Chile	0.91	3.7	yes
Chinese Taipei	0.88	4.7	no
Denmark	0.99	8.4	no
Estonia	0.97	5.7	no
Finland	0.99	6.5	no
France	0.97	6.0	no
Hong Kong SAR	0.88	4.7	yes
Israel	0.95	7.3	yes
Italy	0.96	4.9	.
Japan	0.94	3.7	no
Lithuania	0.97	5.2	no
Moscow, Russian Federation	0.95	3.9	yes
Norway	0.99	7.7	no
Ontario Province, Canada	0.97	5.6	yes
Russian Federation	0.95	3.7	yes
Singapore	0.91	5.7	yes
Slovak Republic	0.92	4.4	yes
Slovenia	0.98	6.0	yes
South Africa	0.80	5.4	yes
Thailand	0.86	4.2	yes

Notes:

(u7) "Education level" averages the country's literacy rate (percent of adults literate) with the gross enrollment of primary through tertiary

(u8) Educ. $" is the total public spending in US$ for K-12 education divided by the GDP (Gross Domestic Product)

(q4) Central funding combines responses from three NCQ questions (4, 5 & 6) by coding "yes" if primary funding source is national or provincial; otherwise, it is coded "no". Non-responses were coded "."

perform poorly in the assessment process. Similarly, the Danish public school system is not examination oriented. The main regulation is that a student attends a class with students of the same age. The final decision concerning progress is taken by the parents, although they are guided by the teachers and the school. In Ontario Province, teachers use a wide range of assessment and evaluation strategies throughout the year; decisions related to promotion are determined at the local school level by principals and teachers in consultation with parents. The schools, using a standard provincial report card, give students' grades to parents three times a year.

Table 3.2 Structural factors by education system (Continued)

Education system	(q7) Centralized control of curriculum	(q10) Criteria for promotion	(q11) No. of subjects with standards
Alberta Province, Canada	yes	bc	none
Catalonia, Spain	yes	b	some
Chile	yes	ce	none
Chinese Taipei	yes	e	none
Denmark	yes	e	some
Estonia	no	cd	all
Finland	no	c	none *
France	yes	b	all
Hong Kong SAR	no	c	some
Israel	no	b	all
Italy	yes	ce	all
Japan	no	c	all
Lithuania	no	c	none
Moscow, Russian Federation	no	e	all
Norway	yes	e	none
Ontario Province, Canada	no	c	some
Russian Federation	no	bcd	all
Singapore	yes	bcd	some
Slovak Republic	yes	bcd	all
Slovenia	no	c	all
South Africa	no	bcd	some
Thailand	no	bcd	all

Notes:

(q7) Central control of curriculum components was based upon question NCQ7; coded "yes" if country has central or provincial control of three or four curriculum components, but coded no if control over only one or two components

(q10) Criteria for promotion of students in target grade to next grade: (a) "national examination"; (b) "school internal examination"; (c) "oral and/or written examinations throughout the school year"; (d) "portfolio of student work"; and (e) "other"

(q11) Number of subjects with attainment standards for target grade: (a) "none"; (b) "all school subjects"; and (c) "only some subjects"

* Finland has defined national aims for learning but does not consider them to be attainment standards.

In Catalonia-Spain, a student can be promoted to the next grade despite failing up to two subjects. In Finland, students can be promoted to the next grade level even if they fail some school subjects. Here, the students are evaluated to ensure they have the skills required to manage the program of study at the next grade level. In Singapore, students must pass English language to be promoted to the next grade level. The Israeli procedure for evaluating the progress of students before deciding on their promotion to the next grade level is determined by their grade average at each half or term of the school year. All students in the target

grade must attain pre-defined standards in all school subjects in order to be promoted to the next grade level. Fifty-five out of 100 is the threshold (i.e., the passing grade). However, higher thresholds for failure can be locally defined. In addition, some schools provide students with opportunity to study during the summer holidays and/or take a test, the passing of which enables their promotion to Grade 9.

3. Attainment standards (q11, Table 3.2)
The NCQ asked (q11) if the education system had attainment standards for subjects in the target grade in terms of one of three answer alternatives: (a) none, (b) all school subjects, and (c) only some subjects. As evident in Table 3.2, 10 education systems at the time of SITES 2006 had attainment standards for all subjects in the target grade, six had these standards for some of the subjects, and six did not apply standards to any subjects. Of the six education systems with "some" subject standards, two (Chinese Taipei and South Africa) applied attainment standards to mathematics, science, and mother tongue Ten of the 22 education system NRCs reported attainment standards for all three core subjects: mathematics, science, and mother tongue.

3.3.3 Pedagogy and curriculum

The NCQ included a number of questions on pedagogical aspects related to teacher preparation, changes in pedagogical practices over the previous five years, and new pedagogies using ICT. There were also a number of questions on aspects of the mathematics and science curricula.

1. Teacher preparation (q16–19)
Several of the pedagogy indicators dealt with teacher development; the results appear in Table 3.3. The first question relating to this indicator (q16) asked, "*What is the normal requirement for being certified as a teacher*?" The answer options for the question were (1) post-secondary diploma and/or certification in an education field, (2) any post-secondary degree, (3) any post-secondary degree plus certificate in education, (4) other, and (5) requirements defined at local or school level only. The count of answer options selected was 3, 1, 14, and 4 for answers 1, 2, 3, and 4 respectively. It is clear from Table 3.3 that the certification procedures in some education systems are more stringent than in others. Finland and the Slovak Republic require a master's-level university degree for anyone teaching Grade 7 and higher; all teachers in their compulsory schools have to take teachers' pedagogical studies and basic educational

or disciplinary studies as part of this degree. Israel requires a B.Ed. degree plus one to two years of "coaching" experience in teaching. Thailand requires a one-year internship beyond the four-year degree program for teachers of science or mathematics, a prerequisite that does not apply to teachers of other subjects.

With regard to specific ICT-requirements for teacher certification, q17 asked, "*Are there ICT-specific requirements for being certified as a teacher*?" The answer options were (a) none, (b) technical competence, (c) subject teaching with ICT, (d) ICT-based pedagogy, (e) others, and (f) requirements defined only at local level. Even though the question format required respondents to check all answer options that applied, the NRCs each checked only one option, with the exception of the NRC from Catalonia. Although the NRC for Catalonia stated that most schools in the system have no ICT-requirements for teachers, he noted that private schools can and do specify such requirements. Over half (15) of the education systems reported "none," two reported "technical competence," none reported "subject teaching with ICT," three reported "ICT-based pedagogy" (Japan, Lithuania, and Singapore), and only Israel chose "requirements defined at the local level". Thus, only five education systems had an ICT-specific requirement for certification. However, several other systems said that such preparation was encouraged but not required.

A third indicator of teacher preparation is professional development. Question 18 asked, "*Are qualified teachers in the target grade required to undertake regularly any in-service and/or professional development activities on any of the following [seven] aspects?*" The indicator was defined as the number of in-service or professional development (PD) components (out of seven) required for teachers. Three of the components dealt with ICT-skills, one was defined as a "major subject area of teaching," and the remaining three concerned pedagogical strategies. The majority of the education systems (13) reported that their teachers were not required to engage regularly in any of the seven PD activities listed. At the other extreme, two countries (Japan and Thailand) reported five or more requirements; the remainder reported one, two, or three requirements. Israel, Catalonia, Lithuania, and Ontario Province all said that while no components were required, many teachers did undertake this training. Thus, even though some of the systems had fairly demanding pre-service and certification requirements, centralized in-service requirements were generally absent at the central level.

Table 3.3 Pedagogical factors by education system

Education system	(q16) Teacher cert. required	(q17) ICT-specific req. for certification	(q18) Sum of req. teacher PD
Alberta Province, Canada	3	e	0
Catalonia, Spain	3	a	0
Chile	1	a	0
Chinese Taipei	3	a	0
Denmark	1	a	0
Estonia	3	b	2
Finland	4	a	0
France	2	a	7
Hong Kong SAR	3	a	0
Israel	3	f	0
Italy	4	a	0
Japan	3	d	6
Lithuania	3	d	0
Moscow, Russian Federation	3	a	3
Norway	1	a	0
Ontario Province, Canada	3	a	0
Russian Federation	3	a	2
Singapore	4	d	3
Slovak Republic	4	a	0
Slovenia	3	a	.
South Africa	3	b	1
Thailand	3	a	5

Notes:

(q16) Selection of teacher-certification requirement options: (1) "postsecondary diploma and/or certification in education field"; (2) "any post-secondary degree"; (3) "any post-secondary degree plus certificate in education"; (4) "other"; and (5) "requirements defined at local level only"

(q17) ICT-specific requirements for certification: (a) "none"; (b) "technical competence"; (c) "subject teaching with ICT"; (d) "ICT-based pedagogy"; (e) "others"; and (f) "requirements defined only at local level"

(q18) Sum of required teacher PD (professional development) is the number of PD components (out of 7) required of teachers.

The fourth indicator of teacher preparation was represented by q19, which asked, "*Do any government agencies subsidize in-service training or professional development courses for teachers in any of the following areas?*" The areas listed were (a) ICT-skills, (b) use of ICT in subjects, (c) use of ICT in administration, and (d) use of ICT for new approaches in learning. The letter for each of the four options selected is evident in the q19 column of Table 3.3. As can be seen, a large majority of the systems (17) reported subsidies of all four types. In addition, all the systems, except for the two that did not answer the question at all, chose the

Table 3.3 Pedagogical factors by education system (Continued)

Education system	(q19) Subsidy for PD and in-service	(q20j) Index of increased new pedagogical practices	(q29) No. of new pedagogies using ICT
Alberta Province, Canada	abcd	19	5
Catalonia, Spain	abcd	19	0
Chile	abcd	12	4
Chinese Taipei	abcd	17	3
Denmark	abcd	15	4
Estonia	abcd	20	0
Finland	abcd	14	3
France	abcd	14	4
Hong Kong SAR	abcd	15	0
Israel	abcd	20	0
Italy	abcd	23	0
Japan	ab	14	0
Lithuania	acd	23	0
Moscow, Russian Federation	abcd	14	0
Norway	abcd	19	5
Ontario Province, Canada	.	20	0
Russian Federation	a	14	0
Singapore	abcd	23	4
Slovak Republic	abcd	14	1
Slovenia	abcd	.	0
South Africa	-	20	0
Thailand	abcd	19	5

Notes:

(q19) Government subsidy of in-service or professional development for teachers in: (a) "ICT-skills"; (b) "use of ICT in subjects"; (c) "use of ICT in administration"; and (d) "use of ICT for new approaches in learning"

(q20j) Increased new pedagogical practices are the sum of the series of six questions asking if each of six aspects of non-traditional practices had decreased or increased during the past five years (NCQ20, items j to o) scored on a scale of (1) decreased; (2) no change; (3) increased a little; and (4) increased a lot

(q29) The number of new (non-traditional) pedagogies using ICT was based upon NCQ29 (items b to f).

option, "ICT-skills". Hence, despite there being no centralized specification of ICT-skills for teachers, appropriate ICT-based training was being subsidized and was sometimes available for teachers in most of the participating systems. Several systems reported the ministry of education as the agency responsible for providing training. One exception was Singapore, whose NRC reported that the ministry gives funding to the individual schools, which can then use this money to contract for training as they see fit.

2. Change in pedagogical practices (q20 j–o)
The principal way that we attempted to measure change in the pedagogical practices within the past five years was with a six-item (items j through o) subset in question NCQ20 (indicator q20j). The measure is thus the sum of a series of six questions (NCQ20, items j to o) that together asked the respondents to state if each of six aspects of non-traditional practices had decreased or increased over the previous five years. The items in the scale (q20j in Table 3.3) included the following types of emerging pedagogies: individualized learning, inquiry-based tasks, collaboration for project-based learning, inter-classroom collaboration, inter-school collaboration, and international collaborative projects. The categories for each item were (1) "decreased," (2) "no change," (3) "increased slightly," and (4) "increased a lot." The sum score ranged from 12 for Chile to 23 for Lithuania, Singapore, and Italy. Increases over the past five years did not necessarily correlate with prior change; some of the education systems at the low end had already made substantial changes in early years. The median increase for the 22 education systems was 20, which implies that the majority of the systems had increased their use of non-standard pedagogical practices at least slightly during the previous five years.

3. New pedagogies using ICT (q29)
Question NCQ29 asked if the education system had a system-wide program at the target grade for each of several new pedagogies using ICT. A sum scale was formed by adding the number of new (non-traditional) pedagogies with ICT (q29). The five new pedagogies using ICT were (b) student-centered pedagogies, (c) online learning, (d) "connecting with other schools and cultures," (e) "collaborative team learning," and (f) "communication and presentation." As Table 3.3 shows, 12 education systems did not have a system-wide program in relation to any of these attributes. Alberta Province, Norway, and Thailand, however, reported programs with all five characteristics.

4. Mathematics and science curricula (q12, 14)
This topic is not represented in the tables because all the education systems reported having a system-wide curriculum in both mathematics and science at the target-grade level. Each relevant question (namely NPQ12 and NPQ14) was followed by a multi-part question that asked the respondents to assess each system's emphasis on each of the following pedagogical approaches: (a) mastering basic skills, (b)

applying mathematics in real-life contexts, (c) communicating about mathematics, and (d) integrating mathematics with ICT. The rating scale for each of the four parts was a four-point scale with the labels none, very little, some, and a lot.

Nearly all respondents indicated that their country placed some emphasis on each of the four pedagogical approaches for both mathematics and science. However, for both subjects, the highest emphasis rating was given differentially for the pedagogies. According to the responses, most education systems gave "a lot" of emphasis to "mastering basic skills," about half of the systems gave that emphasis to "applying (mathematics or science) in real-life contexts," and about a quarter gave high emphasis to "communicating about mathematics." Only two of the 22 systems gave high emphasis to "integrating (mathematics or science) with ICT." Remarkably, the response distributions for the mathematics and science emphases (q13 and q15) were nearly identical.

3.3.4 ICT

The NCQ included a number of questions relating to expenditure for ICT in education and to policies and practices on the use of ICT. These are discussed in this section. The next section reports on the programs designed to develop "21st-century skills" that the education systems had in place for the target grade.

1. Increased spending on ICT

The NCQ used a subset of items in question NCQ20 (q20a in Table 3.4) to determine if education systems had increased their spending on ICT within the past five years. The measure was the sum of scores on a series of seven questions (NCQ20, items b to h) that asked if spending on each of seven aspects of non-traditional practices had decreased or increased during the past five years. The scale items included these ICT-related expenditures: internet connections and networking, classroom-based ICT, instructional technology support, professional development related to ICT in teaching, and school-leadership development for ICT in learning. The categories for each item were (1) decreased, (2) no change, (3) increased slightly, and (4) increased a lot. The sum score ranged from 9 for Chile to 28 for Italy. Also at the low end were Hong Kong and Singapore and at the high end Catalonia, Finland, and Norway.

Increases in spending for ICT during the previous five years did not necessarily correlate with prior increases; some of the education systems

at the low end had already spent a considerable amount on ICT in earlier years. The median increase for the 22 education systems was about 20, which implies that the majority of the systems had increased their expenditure on ICT at least slightly during the preceding five years.

2. System-wide ICT in education policy

When asked if a system-wide ICT in education policy existed, 20 of the 22 respondents said yes. Those who answered in the affirmative were then asked if the ICT policy included each of 11 specific policy components (items a to k of NCQ24). The sum of these components constitutes q24 in Table 3.4. These components were clear vision, support for curriculum innovation, desired mode of integrating ICT in teaching, desired minimum level of access to ICT, desired internet connectivity, goal to reduce digital divide, attempts to ensure ICT access outside of school, teachers' PD requirements on ICT, stimulation of teachers' professional development in ICT, evaluation policy for ICT implementations, and funding arrangements.

The education systems varied considerably with regard to the number and type of ICT-related policies they had in place. Estonia, the Russian Federation, the Slovak Republic, and Slovenia had no policy components whereas Israel and Singapore had all 11. Some systems mentioned other policy components in the "other" category. For example, the NRC for Norway pointed out that Norway now defines digital literacy as a core competency, with the same level of importance as reading, numeracy, and writing.

3. Provision of hardware and software

The questionnaire offered several options (under NCQ25) on how each education system managed hardware and software funding and acquisitions. Respondents were asked to check all options that applied. The options were (a) funds provided through a central facility, (b) funds provided to schools, (c) matching or partial funding provided by a government unit, (d) government funds for internet connectivity, (e) funding is an integral part of the school budget, and (f) no government funding provided. The responses are listed in q25 of Table 3.4. Response alternatives (a) (central facility) and (d) (funds given to schools) were the most commonly selected—nearly half of the respondents chose them. "No government funding" (option f) was chosen by only two systems: the Slovak Republic and South Africa. It seems that funding for hardware and software in the majority of education systems flows from several different government levels.

4. Language as an ICT obstacle

Yes/no answers were solicited in relation to NCQ26, *"Is language an obstacle for schools in ICT-implementation in teaching and learning?"* Eight of the 22 education systems indicated that language was an obstacle; the remainder said no. Not surprisingly, in those education systems where language was considered an obstacle, English is not the primary language spoken at home. Although English is an official language in South Africa, language is still an obstacle, as there are 10 other official languages. Also, because English is the most common language used on the World Wide Web, it is not surprising that the majority of the respondents saw language as a problem.

A comment from the Israeli respondent suggested how policies can address the language barrier:

> The extent to which language is an obstacle for schools in ICT implementation in learning and teaching is dependent on the age of the students: the younger the students—the higher is the obstacle. The main obstacle lies in Internet use, since most websites are in English, which is not a mother tongue in Israel. However, English as a foreign language is a compulsory subject in the middle of primary school (sometimes even from 2nd grade), therefore, by secondary education, students can cope with websites in English. Still, this is an issue that required attention . . . therefore, some steps have been taken to minimize the dependency on English materials, e.g. (1) translation and adaptation of software for Hebrew-speaking children and Arab-speaking children, (2) translation and adaptation of online teaching and learning materials for Hebrew-speaking children and Arab-speaking children, (3) development of a national database for learning objects, led by the ministry of education—sharing of teaching and learning materials via discussion groups and educational portals, (4) nation-wide ICT-based projects facilitated by non-profit organizations.

5. ICT skills at the target grade

The NRCs were asked if their systems had a system-wide program regarding student ICT-related skills at the target grade. The q28 column in Table 3.4 summarizes the answers to that question. Twelve of the respondents said "yes," nine said "no," and one did not respond. Those education systems that had implemented a system-wide program

Table 3.4 ICT factors by education system

Education system	(q20a) Index of increased spending for ICT	(q24) No. of ICT policy aspects	(q25) Provision of hardware, software
Alberta Province, Canada	18	5	de
Catalonia, Spain	24	6	abd
Chile	9	7	abcd
Chinese Taipei	21	6	bd
Denmark	.	3	ce
Estonia	23	11	cd
Finland	22	9	de
France	21	7	bd
Hong Kong SAR	12	6	bcd
Israel	17	11	abd
Italy	28	8	.
Japan	17	3	cd
Lithuania	20	6	a
Moscow, Russian Federation	23	6	a
Norway	25	5	e
Ontario Province, Canada	21	1	e
Russian Federation	21	0	a
Singapore	15	11	abcd
Slovak Republic	19	0	ef
Slovenia	.	0	.
South Africa	19	11	af
Thailand	21	8	a

Notes:

(q20a) Increase in spending for ICT is the sum of a series of seven questions asking if each of ICT-spending had decreased or increased during the past five years (NCQ20, items b to h); scored on 4-point scale of (1) decreased; (2) no change; (3) increased a little; and (4) increased a lot

(q24) No. of ICT policy aspects is the sum of 11 questions (NCQ24) on each of 11 components (items a to k) of ICT-policy.

(q25) Choices to question NCQ25 on how hardware and software are funded and acquired by schools (see main text for options)

involving one or more compulsory classes in ICT included Chinese Taipei, France, Japan, the Slovak Republic, and Thailand. Those that had implemented a program that infused ICT-based instruction throughout several or all other subjects included Alberta Province, Chile, Denmark, Finland, and Singapore.

6. 21st-century skills policy

The SITES 2006 conceptual framework document defined "21st-century skills" in terms of two components—"collaborative inquiry" and

Table 3.4 ICT factors by education system (Continued)

Education system	(q26) Language as an ICT obstacle	(q28) ICT skills at target grade	(q30) 21st-century skills policy
Alberta Province, Canada	no	yes	yes
Catalonia, Spain	no	yes	yes
Chile	no	yes	yes
Chinese Taipei	no	yes	yes
Denmark	no	yes	yes
Estonia	no	yes	no
Finland	no	yes	yes
France	no	yes	no
Hong Kong SAR	no	no	yes
Israel	yes	no	yes
Italy	no	no	no
Japan	no	yes	no
Lithuania	yes	no	no
Moscow, Russian Federation	yes	no	no
Norway	no	no	yes
Ontario Province, Canada	no	no	yes
Russian Federation	yes	no	no
Singapore	no	yes	yes
Slovak Republic	yes	yes	yes
Slovenia	yes	.	.
South Africa	yes	no	yes
Thailand	yes	yes	yes

Notes:

(q26) Yes/No are answer choices to question 26: "Is language an obstacle for schools in ICT-implementation in teaching and learning?"

(q28) ICT-skills at the target grade is the answer to NCQ28 about the presence of "a system-wide program on student ICT-related skills"

(q30) 21st-century skills are the answer to NCQ30 as to presence of any system policy documents that mention the promotion of "21st-century skills".

"connectedness". The last question in the NCQ questionnaire was "*Do any of your educational system's policy documents promote approaches that mention "21st Century skills"* (q30). In response to this question, 14 NRCs said "yes," seven said "no," and one did not respond. Those with policies mentioning 21st-century skills were asked to summarize the country's policy, and these are briefly described in the next sub-section.

3.4 National policies for ICT and pedagogical reform

The NRCs were asked to write a brief description of any 21st-century skills program/policy their country had for the target grade. They were also asked to describe any system-wide ICT-skills program for the target grade and any target-grade initiatives for new pedagogies. The descriptions for any such programs are summarized below in order to provide a profile of national reform trends related to these types of programs.

3.4.1 Alberta, Canada

In 2004, Alberta published its "Learning and Technology Policy Framework." Although the document does not reference 21st-century skills, it does emphasize learning in the knowledge economy and lifelong learning. And while it does not promote constructivism, it does emphasize individualized learning, learning communities, and optimal learning environments. Alberta's policy on ICT-skills is to infuse ICT in learning all subjects.

3.4.2 Catalonia, Spain

Integration of ICT in teaching, learning, and evaluation processes is a priority for Catalonia's school system. The Department of Education has established that schools must foster pedagogical strategies aimed at developing communication skills and building shared knowledge. Another departmental mandate is that secondary education students must develop, across all school subjects and through application of today's wide-ranging palette of digital resources and devices, the information-processing and management skills they need to create text, support oral and distance communication, and work with numbers and figures. Further, use of ICT should include visual-arts production and musical expression, as well as interaction with the physical environment. Catalonia's teachers are asked to play a decisive role in advising and supporting students as they search and evaluate internet content as part of their learning. A key principle is that learner autonomy, ICT-skills, and student values have to be developed in harmony.

3.4.3 Chile

ICT-skills are part of Chile's secondary curriculum. At the time of SITES 2006, the Ministry of Education had begun a pilot project that aimed to

provide students with ICT-skills and related course materials based on the International Center for Distance Learning standards. The national curriculum contains several references to 21st-century skills.

3.4.4 Chinese Taipei

Chinese Taipei's newly implemented nine-year joint curriculum (an integration of the previous elementary and junior high curricula) claims to cultivate 21st-century citizens, but the notion of 21st-century skills is not formally defined. The curriculum emphasizes that all learning subjects should integrate ICT into their instructions. It aims to develop students' skills in collecting, analyzing, and utilizing information, as well as their ability to problem-solve and collaborate, to be active learners, and to engage in lifelong learning.

3.4.5 Denmark

Since the late 1990s, the Danish Ministry of Education has published a couple of action plans for integrating ICT in the education system. The plans specify the need to increase student skills in ICT and the need to integrate new pedagogic opportunities into learning. While the plans do not mention 21st-century skills, they do emphasize learning goals and activities very consistent with that movement. In addition to requiring the purchase of computers, the action plans focus on better access to the internet, email, and virtual networks, increased use of ICT in relation to tests and examinations, and increased integration of ICT in the pre- and in-service training of teachers. For further information, see http://eng.uvm.dk/publications/10InformationCom/1.htm?menuid=1535

3.4.6 Estonia

Estonian schools use the national curriculum enacted as a government decree in 2002 and subject to amendments in 2008 or 2009. The curriculum includes four cross-curriculum topics that include ICT and media education. ICT-use and the development of ICT-literacy are together understood as one of the main instruments to enhance work efficiency and social mobility. To implement the program, the Tiger Leap Foundation (TLF) was established in 1997. The intention behind this decision was to separate ICT-based activities from the general functioning of the Ministry of Education, to bring a more dynamic and open process to decision-making, and to guarantee targeted financing for ICT-related needs. During the 10 years of the Tiger Leap program's

existence, three strategies were enacted, each with a specific focus developed out of previous achievements and each looking forward to the issues that remain. By 2009, the "Learning Management Systems with Learning Object Repository and Learning Object Brokerage Platform" will be in use. Also, e-learning has been targeted as an initiative to be seamlessly integrated into everyday school life, and with at least 90% of all teachers using ICT in the learning process. For further information, see (1) *Learning Tiger: Strategy 2006–2009* (available from http://www.tiigrihype.ee/?op=body&id=190), and (2) *Tiger Leap 1997–2007*, which covers the work of the Tiger Leap Foundation.

3.4.7 Finland

As is evident from various policy papers, Finland's strategy has been to develop ICT in education as part of the country's aim to build a Finnish information society. Efforts have therefore been put into creating ways of using ICT to meet the diverse needs of people of different ages. The latest strategy paper—*The National Knowledge Society Strategy 2007–2015* (available from http://www.tietoyhteiskuntaohjelma.fi/esittely/en_GB/introduction/)—emphasizes the creation of a culture of learning and working in association with a system of tight-knit collaboration networks that include decision-makers, developers, implementers, and users.

Finland's ICT-skills-related strategic intent for year 2015 is that ICT will be inseparably linked to the daily life of citizens and organizations, and also to the ability of individuals and work communities to renew and continue to develop knowledge and learning, a development that Finland sees as the foundation of its economic and social competitiveness and well-being. The Information Society Program for Education, Training, and Research (2004–2006; http://www.minedu.fi/OPM/Julkaisut/2004/koulutuksen_ja_tutkimuksen_tietoyhteiskuntaohjelma?lang=en&extra_locale=en) contains actions aimed at developing all citizens' information society knowledge and skills, and promoting social innovation through the use of ICT.

Finland's national core curriculum for basic education (2004; http://www.oph.fi/english/) emphasizes that the learning environment and its equipment should support students' development in a manner that recognizes students as members of a modern information society. The core curriculum includes two (out of seven) cross-curricular themes that

refer to students' understanding of technology, their ICT-related skills, and their ability to use ICT in a versatile and responsible way.

3.4.8 France

In 2002, the French prime minister presented a new set of goals for a policy on ICT-use at different levels of education. The "2004–2006 Action Plan" called for France to be in the top tier of education systems using ICT in education. In 2006, France established the "IT and Internet Proficiency Certificate." This qualification specifies the ICT-skills development required at all levels of the education system. The emphasis is on subject-specific ICT-related learning activities.

3.4.9 Hong Kong SAR

One of Hong Kong's policy goals is to empower learners with IT: "Students will acquire the necessary skills, knowledge and attitudes for lifelong learning and creative problem solving in the information age" (http://www.edb.gov.hk/index.aspx?nodeid=72&langno=1). Students are to use IT for information retrieval, knowledge enquiry, communication, collaboration, and as an analytical and personal development tool. The 2004 document, *Information Technology in Education: The Way Forward* (see above link), which called for education to move to a learning-centered stance, argues that this approach, in association with internet project-based learning, is a paradigm shift that should be achieved within five years. Activities and resources specific to ICT in education can be found at http://www.edb.gov.hk/index.aspx?nodeid=72&langno=1, while http://www.edb.gov.hk/index.aspx?langno=1&nodeID=2497 provides information on general education matters.

3.4.10 Israel

The fourth and current stage of the Israeli "National Computerization Program" focuses on 21st-century skills and emphasizes ICT as a lever for system-wide change and "ICT as a way of life." This stage includes broad implementation of ICT-based literacy and information skills in learning processes, facilitation of novel concepts and teaching-learning processes in knowledge-saturated learning environments, and spreading ICT-culture typical of the digital age. Current goals emphasize broadening online activities and implementing them in all teaching and learning processes; implementing *standards in information studies;* developing a *bank of learning objects;* fostering *collaborative* learning; and

advancing the use of ICT *by populations with special needs*. This national program also advances the implementation of focused programs of various kinds. Examples of these are "Learning without Boundaries" (for Grade 10 students), which encourages students to study literature reflecting local culture in collaboration with peer students abroad; "Ethics and Values on the Web," and "ICT Youth," a youth movement focusing on development of ICT-leadership.

3.4.11 Italy

In Italy, ICT is normally taught in technical and vocational schools (*Istituti tecnici e professionali*). In the mid-1990s, the government of Italy decided to introduce ICT in all schools through a national scheme. This large-scale program, called the "Program for the Development of Educational Technologies 1997–2000" (*Programma di sviluppo delle tecnologie didattiche*) (PSTD), was launched in 1997 by the Ministry of Education and was designed to implement ICT throughout the whole Italian school system. The program was extended to all Italian schools in 1997 and completed in 2000. In 2006, Italy established a national teacher training program on ICT. This initiative, which is a continuation of the so-called "ForTic" program, involves implementation of a national web portal for technological training through a blended-learning modality. The program has three main goals: improving teaching and learning processes; enabling students to master multimedia; and enhancing teachers' professional capabilities by providing them with training in the use and application of ICT. Another aim for the program is to implement new organizational and institutional models across Italy's education system. For further information, go to http://www.pubblica.istruzione.it/innovazione/index.shtml

3.4.12 Japan

Having recognized the necessity of having in place a forward-looking national strategy in regard to the IT revolution, Japan implemented its "e-Japan Strategy" in 2001. The strategy is endeavoring to create a "knowledge-emergent society" that fosters diverse creativity through the exchange of knowledge among citizens. The strategy's vision statement sets education as the main means of realizing the ideal IT society. Accordingly, the strategy calls for all citizens to receive the most advanced level of education regardless of geographical, physical, economic, and other conditions.

Japan maintains that all its citizens need to acquire IT knowledge and skills to enjoy the benefits of these tools, especially in terms of enhancing their intellectual creativity and ability to think logically. Students utilize ICT in all subject lessons taught in school. They are encouraged to bring a proactive approach to learning how to use ICT and to making it part of their learning of subject material. More particularly, their proactive use of ICT is seen as a means of developing high-level communication skills that include ability to collect information, to organize that information, and to express their ideas. Emphasis is also paid to ensuring students learn to adopt moral and appropriate behavior in the virtual world. At the lower secondary school level, students use computers and the internet to learn to communicate with others proactively.

3.4.13 Lithuania

Lithuania has seen a shift in its pedagogical approach from one that emphasizes teaching to one that emphasizes learning. Teacher in-service training programs now stress topics related to collaborative learning, active learning, and the like. The assessment system has not yet adjusted to this shift, so there is some conflict between the new learning goals (e.g., creativity, problem-solving skills) and national standards for assessment. ICT remains largely a separate subject rather than a generalized tool for learning.

3.4.14 Moscow City, Russian Federation

The situation in Moscow reflects the general situation in the country (see 3.4.17 Russian Federation below) However, the city is much more advanced than the rest of the country in the consistency of its regional ICT-policy for education as well as in its financing implementation for this policy. The aim here is to ensure ICT in learning is supported by adequate hardware, software, and connectivity. The regulatory aspect associated with the introduction of ICT into general schools is covered by the concept of the ICT-school. An example of the Moscow approach in this regard is the distance-learning general school for children who cannot visit schools because of their physical conditions (see http://www.home-edu.ru and http://www.liveschool.ru). For further information, visit http://www.school.edu.ru and http://www.intmedia.ru

3.4.15 Norway

The aim of Norway's multi-year "Program for Digital Literacy (2004–2008)" is to smooth out the digital divide (and consequently the social divide) by promoting a vision of digital skills for all. More specifically, the program, which is the government's main effort on ICT in education, addresses the entire education sector. Digital literacy consists of basic ICT-skills, deemed equivalent to reading, writing, and numeracy, and more advanced skills that ensure creative and critical use of digital tools and media, including tasks such as locating and controlling information from different digital sources. In terms of Norway's specific goals for infrastructure, competence, and quality development, the strategy focuses on the use and accessibility of digital learning resources. In the field of research and development, the strategy promotes innovative and pedagogical use of ICT at all levels of the education system.

ICT has also begun to play a major role in assessment in Norway. ICT has been gradually introduced into final examinations in primary and secondary education since 2005, and as of 2008, formative assessment using digital portfolios is being used at all levels of education. More information on these initiatives can be obtained by accessing http://insight.eun.org/ww/en/pub/insight/policy/policy_briefings/countryreport_norway.htm

3.4.16 Ontario, Canada

In Ontario-Canada, students can develop their ICT-skills through an optional course called Information and Communication Technology and Business that is offered in Grade 9. Grade 10 students have access to a course in communications technology. However, ICT-skill development tends to be largely absent from Grade 8.

3.4.17 Russian Federation

Twenty-five years ago, the Soviet Union began its country-wide course titled "Computer Science and Technology," offered during the last two years of high school (i.e., for students ages 16 to 17). The course had two versions—with and without computer support. Today, learning about and with ICT is assumed in primary school, in Grades 8 to 9 (secondary school), and in different profiles of high school.

The Russian Federation's national standards of 2004 require learning with ICT in most school subjects. This learning covers general applications (e.g., text, graphics, and video editing), basic professional

and subject-oriented applications (e.g., GIS, CAD, graphical pads, virtual labs, digital sensors, computer control—LEGO-style), and musical keyboards, etc. The practical implementation of the Federation's ICT standards has generally evolved slowly. However, major progress has been made since 2003 via the "E-learning Support Project" (made possible by a World Bank loan to the Russian Federation). Although concentrated on seven regions in different parts of the country, the project is providing digital resources (depository, etc.) for the whole country.

The Federation's unified examinations (combining secondary graduation and university entrance examinations) provide examples of "total" ICT-use (as a communication media). Today, ICT in general schooling belongs to dimensions of the National Priority Projects. So, for example, by the end of 2007, all schools in Russia were expected to have 128K (at least) of connectivity. The new secondary school standards (in development) contain a section on conditions of learning. These include digital information sources and digital instruments (both hardware and software) for learning and teaching. For further information, see http://www.mon.gov.ru, http://www.school.edu.ru

3.4.18 Singapore

In 1997, Singapore launched its "Masterplan for IT in Education" (MPITE). The plan served as a blueprint for integrating information technology in the education system in order to ensure Singaporeans could meet the challenges of the 21st century. The key objective was to use IT to help equip young people with learning skills, creative thinking skills, and communication skills. This was a key strategy for producing a workforce of excellence for the future. Building on MPITE, "Masterplan II for IT in Education" began in 2003.

The use of alternative assessment strategies and open tasks is one of Singapore's more recent efforts to enhance teaching and learning and to use assessment for learning. The mathematics curriculum now emphasizes problem-solving, communication, and making connections, while the science curriculum is moving toward more inquiry-based teaching, learning, and assessment. For further information on the Masterplans, refer to http://www.moe.gov.sg/edumall/mpite/overview/index.html

3.4.19 Slovak Republic

The republic published a policy of school reform called "Millennium" in the year 2000. This initiative was supported by the new government in 2001. Some of the reforms have already been undertaken (e.g., a new law for financing schools), while many steps still remain (e.g., a new school law for primary and secondary education). In the field of ICT in education, the Slovak Republic has, as its policy, supporting the eEurope+ policy.

3.4.20 Slovenia

Slovenia is undertaking a strategy designed to develop an information society in its republic. The strategy, which is based on the strategic frameworks of *i2010*, includes the "National Strategy of e-learning 2006–2010," the goal of which is to develop an efficient and ICT-supported national system of education at all grade levels. The advent of ICT has led to changes in learning processes and subject-matter content in schools; learning is becoming more efficient and attractive, and learning and teaching "whenever and wherever" are now possible, as are virtual classrooms. These plans also emphasize 21st-century skills by offering more self-evaluation and the means whereby students and teachers can develop research skills. For further information on these strategies, see (only in the Slovene language) http://www.mvzt.gov.si/fileadmin/mvzt.gov.si/pageuploads/pdf/informacijska_druzba/Strategija_ si2010.pdf

3.4.21 South Africa

According to South Africa's white paper on e-education,

> The ICT revolution has had an impact on curriculum development and delivery and continues to pose new challenges for education and training systems around the world, which can be summarized into three broad areas, namely: participation in the information society, impact of ICTs on access, cost effectiveness and quality of education, and integration of ICTs into the learning and teaching process. Two new optional school subjects have been introduced: Technology Education, replacing wood-metalwork, and Computer-Applications Technology replacing typing. (Republic of South Africa, 2004, p. 9)

3.4.22 Thailand

In Thailand, limited ICT-infrastructure prohibits the development of many ICT-skills. The learning and teaching of science and mathematics link with project-based learning though the use of ICT-tools, and the internet where applicable. The National Education Act B.E. 2542 (1999) clearly identified the general provisions for the development of 21st-century skills, as driven by technologies for education (Chapter 9). Thailand's ninth "National Economic and Social Development Plan" (2007–2011), focuses on developing the quality of life of the Thai people in the knowledge-based learning society through a "sufficiency economy" philosophy.

The issues associated with implementing and using ICT in education were brought to the fore by the Thai results for IEA's Third International Mathematics and Science Study (TIMSS), the OECD's Programme for International Student Assessment (PISA), and SITES-M1 and SITES-M2. As a consequence, mother language, English, mathematics, and science are now focal areas of improvement. Thailand sees thinking skills, learning process, and technology uses as the vehicles by which the country can improve its students' achievement in these areas in particular and their life skills in general.

3.5 Conclusions

The purpose of this chapter was to profile the education systems that participated in SITES 2006, especially with respect to each system's ICT-related policies and practices. We trust that these descriptive profiles will enrich interpretations of the SITES 2006 data in the remainder of this report, and that these interpretations, in turn, will inform the decisions that teachers and schools make from hereon with respect to ICT and learning pedagogies.

In this descriptive overview, we found a great deal of diversity and variation across the 22 systems. While the lessons to be learned are mainly at the system level and not so much in relation to "clusters" of education systems, it is important to note that many of the systems had, at the time of the study, no active, centralized policy to assure that education in their country is well prepared for teaching and learning in the 21st century. The following three findings illustrate this conclusion:

1. Fifteen of the 22 education systems did not have specific ICT-related requirements for teacher certification,
2. Thirteen of the systems reported no formal requirements for key types of teacher professional development, and
3. Twelve education systems did not have a system-wide program that stimulated new pedagogies.

These findings indicate that progress toward realizing the goals implicit in these statements since the SITES-M1 study conducted in 1998 (Pelgrum & Anderson, 1999) has been slow.

When we looked only at the education systems with both centralized funding and a centralized curriculum (Alberta Province, Catalonia, Chile, and Singapore), we found that these had either an official, system-wide policy or program on ICT-skills or a policy on the development of 21st-century skills, or both. This situation is consistent with the expectation that reform policies and programs are more easily established within a highly centralized system. The situation is a very interesting one because we also found that education systems with low income (GDP per capita) were not more likely than systems with higher incomes to be centralized. Nor were these lower-income systems any more likely than higher income systems to have policies on ICT-skills and 21st-century skills involving the use of ICT.

Other than the ICT-related considerations, the theme that emerges most from the analysis presented in this chapter is that of pedagogical reform. The majority of the NRCs reported that the five years preceding SITES 2006 had seen an increase in the following pedagogies in their education systems: inquiry-based learning, individualized learning, collaborative projects, inter-school collaboration, and international collaboration projects. The answers to both the fixed-choice questions and the open-ended questions revealed inquiry-based pedagogies in particular to have been the focus of reform.

In addition to explicitly naming the trends associated with pedagogical reform, official references to goals or programs related to 21st-century skills implicitly recognize movement toward pedagogical reform. Policy statements on 21st-century skills consistently mention the need for active learning and student-centered learning, as well as the need for training in decision-making and collaborative work. Thus, the outgrowth of trends toward curricula and classroom experiences designed for the learning of 21st-century skills inevitably leads toward even more pedagogical reform.