ICT and the Emerging Paradigm for Life-long Learning

An IEA Educational Assessment of Infrastructure, Goals, and Practices in Twenty-six Countries

SITES

International Association
for the Evaluation of
Educational Achievement

University of Twente
OCTO

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The IEA Second Information Technology in Education Study (SITES) is an international comparative research project. It is intended to provide policy-makers and educational practitioners with information about ICT infusion in their educational systems and about the extent to which ICT contributes to bringing about in those systems reforms that will satisfy the needs of the Information Society.

The SITES project consists of three modules:

1. Module-1: a survey in 26 countries employing national samples of at least 200 computer-using schools from at least one of the following educational levels: primary, lower secondary, and upper secondary.
2. Module-2: case studies of schools that have implemented innovations as a result of ICT.
3. Module-3: a statistical survey of schools, teachers, and students.

The basic goal of SITES Module-1 was to describe the status of ICT in schools. Data therefore were collected at the school level (late 1998) with regard to curriculum, ICT-infrastructure, staff development, and management/organization.

This book contains comparative quantitative information from SITES Module-1 about the current state of ICT implementation in schools around the world.

PREFACE

Two and a half years have elapsed since the surveys reported in this volume were conducted. While this time is but a moment in human history, it is a generation in digital history. As Y2K came and went, millions logged onto the Internet for the first time and thousands of new digital products were invented. But have these changes outdated the implications of this study? Our contention is that the results of this research are as important now as they were two years ago, and to back up this claim, we consider how the technology has changed, how education has changed, and what we can learn from the study.

ICT is cheaper and faster, but most new technology consists of small refinements to technology in place three years ago. Many more people use wireless phones, personal data assistants (PDAs), global positioning systems (GPSs), digital video, and digital photography. Meta-search engines and other search advances have become so efficient that they have replaced a huge amount of paper filing.

Has this changed education? Yes, in that probably more teachers encourage their students to use digital photos and videos for their presentations. Yes, in that instructional material utilizing mobiles and PDAs has been designed and used in some places. But the most dramatic change in schools seems to be the rate at which schools and classrooms are being connected to the Internet. This phenomenon was documented by our 1998 survey, and the momentum appears to be steadily ongoing. It is not just the diffusion of the technology that is significant, but the fact that, once schools are connected to Internet, most of their teachers and many of their students actually use it.

Perhaps the most significant changes in educational ICT have been in the policy arena. In the past three years, many top-level international and national policy-makers have committed their governments to taking bold, new steps to utilize ICT more extensively in education. During the first year of the century, the European Commission (EC) issued a report on 'Promoting Innovation with New Technologies', and the Group of Eight (G8) issued a major statement called the 'Okinawa Charter on Global Information Society'.

The research reported in this study documents the remarkable role that ICT is playing in the emergence of new instructional practices across many educational systems. These emerging practices stem from the attempts of education to satisfy the needs of 'information societies' to provide life-long learning and to improve, in other ways, educational processes. The 1998 research also found how very important it is to develop effective staff development and organizational systems related to ICT. These and other findings remain fundamental to both research and practice during the early years of the 21st century.

This second edition differs from the first in terms of corrections to a few errata in the first edition, some slight modifications to the text of the early chapters, and a rewrite of Chapter 8 so as to better reflect some of the major policy issues on which SITES Module-1 was focused.

Ronald E. Anderson, *Co-Chair SITES*
Willem J. Pelgrum, *International Coordinator SITES Module-1*
April 2001

FOREWORD

Undertaking an international comparative assessment in education is a complex process, which usually takes a long time with regard to design development, data collection, data processing, and reporting. Therefore, it was quite a challenge to coordinate Module-1 of the IEA Second Information Technology in Education Study (abbreviated as SITES Module-1), given plans to run it within a time-frame of roughly one and a half years. This time-frame was deliberately chosen in order to provide interested audiences with a quick update about the current state of art regarding ICT after the last ICT assessment that was conducted by IEA in 1992 (see Pelgrum, Janssen, Reinen, & Plomp, 1993).

From the start of the study it was clear that SITES Module-1 should not be a study focusing on 'counting computers'. The participating group of researchers was convinced that the goals of the study should reflect the current widely held belief that ICT is a potentially strong facilitator for realizing school reforms aimed at preparing citizens for the Information Society.

The results that are described in this book are intended to provide a first picture resulting from the assessment data that were collected relatively recently. As such, the picture offers a view on the current landscape of ICT in education around the world. However, the picture is still quite vague. It shows rough contours that either need to be zoomed in on or to be projected from different angles in order to get a better view and understanding of what is happening. The intention was to produce this book as quickly as possible after the data collection, because it seemed that there was a high interest among different audiences to get immediate access to that data.

The International Coordinating Center (ICC) gratefully acknowledges the contribution of all persons who made it possible to design and run this study in a relatively short period of time. The national research coordinators and their teams, who very constructively cooperated with the ICC, have played an essential role in this study. However, the authors of this book take full responsibility for statistics and interpretations. The International Steering Committee, the team members at the ICC, and the staff at the IEA Data Processing Center in Hamburg provided invaluable contributions to the project (see Appendix A for a listing of names and addresses of all who were involved in this operation). The ICC also thanks Dick Wolf (the chair of the IEA Publications and Editorial Committee) for the review that was done in an extremely short period of time.

Finally, the ICC gratefully acknowledges the contributions to the international overhead costs of the study from the following sources:

- The Japanese National Institute for Educational Research (NIER), and the Ministry of Education, Science, Sports, and Culture.
- The Norwegian Ministry of Church, Education, and Research.
- The Dutch Science Foundation.
- Participation fees from countries.

Willem J. Pelgrum
International Coordinator SITES Module-1

CONTENTS

LIST OF TABLES AND FIGURES

Cha ter

STUD BAC GROUND AND DESIGN

W. J. Pelgrum (University of Twente) and R. E. Anderson (University of Minnesota)

Information on the rationale behind and the background to the Second Information Technology in Education Study (SITES) is followed by a description of the development of the first module of SITES, which is the main focus of this book. An overview of the conceptual framework of Module-1 and the main indicators used are then presented. Descriptions of the study design (including population definitions, samples and instruments) and database construction complete the chapter.

BAC GROUND

In the early 1980s many schools worldwide began to acquire computer technology for student learning. By the late 1980s schools were able to start linking this information technology to networks and other communication technology. But it was not until the 1990s that both information and communication technologies (ICT) became an established component of the educational systems of many countries. This very rapid entry of ICT into education coincided not only with advances in technology and their declining costs, but also with the diffusion of this technology in societies at large.

This ongoing, unprecedented growth of technology[1] has created a huge challenge for education and has raised questions about the effectiveness and impact of technological applications that can only be answered by research. The emergence of ICT in education has been so rapid that there exists a serious information gap regarding the actual infusion of technology in education. The International Association for the Evaluation of Educational Achievement (IEA) has contributed significantly to reducing this gap with its study of Computers in Education in 1989 and 1992 (Pelgrum & Plomp, 1993; Pelgrum, Janssen Reinen, & Plomp, 1993; Plomp, Anderson, & Kontogiannopoulou-Polydorides, 1996), as well as by including ICT indicators in some of its other studies. However, the extremely rapid growth in technology and technological applications in education requires regular updates on the actual situation in educational practice.

Compared to the 1980s, when many countries were introducing an early generation of microcomputers in their schools, current times see policy debates regarding technology dealing with a much broader range of societal issues. These debates coincide with the widespread adoption of Internet, the World Wide Web (WWW), and multimedia

1 In the past 10 years, educational communities increasingly have used the term 'technology' to refer to 'information technology' (IT) or to 'computers'. This trend stems from the growing integration of computers with communications, video, and audio technologies. Audio and video communications are rapidly becoming digital in form, which gives the computer a new, expanded role as a controller and manipulator of audio and video, as well as text and numeric data. Although many people refer to information technology (IT) as 'technology', many European countries refer to it as 'information and communication technology' (ICT). This report uses the terms 'technology', 'information technology', and 'information and communication technology' interchangeably.

(combining audio, video, and graphic) technologies in the home, workplace, and the school. These technological changes within all societal institutions reinforce the concept of the Information Society. Thus, the recent and ongoing ICT evolution makes it even more compelling that educational policy-makers recognize the broadening role of technology in schools.

Several influential policy reports recently have argued that our societies are changing from industrial societies into 'information societies', in which the creation and dissemination of knowledge is of paramount importance (European Round Table of Industrialists/ERT, 1997). They contend that, in order to combat social exclusion and to maintain competitiveness in a global economy, education must go beyond the framework of initial schooling in order to prepare and support citizens for life-long learning (European Commission, 1995; ERT, 1997; Panel on Educational Technology/PCACT/PET, 1997). Accompanying this argument is the belief that ICT can play an important role in reshaping education to respond to contemporary information needs. Furthermore, it is believed that ICT in education will yield a decreasing gap between socioeconomic realities and the output of the education system (ERT, 1997).

Such assumptions about the Information Society tend to underlie policies using the rhetoric of the 'school of tomorrow' or 'schools of the future'. Action plans to move toward the 'school of tomorrow' and/or for improving the ICT infrastructure have been launched at national and international levels. For example:

- Denmark started in 1994 an educational network (Sektornet) that will involve an expenditure of approximately 500 million DKK until the year 2000. Denmark also is developing a basic in-service program that will provide pedagogical 'ICT-driving licenses' for teachers.
- The European Commission (1995) produced 'Learning in the Information Society', an action plan for a European education initiative in 1996 to 1998.
- President Clinton in 1996 announced a plan to connect all United States schools to the 'information highway' by the year 2000, a policy objective that has also been adopted by Denmark, Finland, Japan, the Netherlands, Portugal, and Spain (Pelgrum, 1997).
- The Dutch government in 1997 established experimental teacher training institutes for the 'school of the future' in which ICT would play an important role.
- Singapore launched in April 1997 a bold, ambitious plan to incorporate ICT into the school curriculum. Called the 'Masterplan for IT in Education', the US$1.2B project provides a national blueprint for the use of ICT in all schools and seeks to create an ICT-enriched school environment for every child.

One force generating attention to the use of ICT in education is the growing need for life-long learning. The two main rationales behind the life-long learning concept are the rapid rise in the amount of information and the need for more frequent career changes. ICT can help implement life-long learning by such activities as 'on-demand learning' and project-based learning. It can also facilitate it by making learning 'anytime and anywhere', not just in classrooms, more feasible.

Meanwhile, several reports have been promoting this thrust at a global level. For example, in 1998, The World Bank (1998) Consultative Group on International Agricultural Research issued a report on technology and life-long learning. In 1999, the Learning Without Frontiers study group released a UNESCO report (Blurton, 1999) on new information and communication technologies and their implications for education. Both reports advocate policies that stimulate innovations in network-based technology, both inside and outside the classroom, thereby facilitating international socioeconomic progress.

On the basis of these developments, it seems reasonable to assume that in forthcoming years education systems in many countries will continue to be confronted with pressures to adopt and implement educational programs that reflect new ways of learning in order to prepare citizens for the Information Society. A major question confronting most actors (national policy-makers, school administrators, teachers, parents, teacher trainers, and educational developers) involved in the planning and implementation stage of this endeavor will be the extent to which progress is made in realizing these reforms. From the point of view of global economical competitiveness, this concern can be articulated in terms of several questions. Is our education measuring up with regard to its innovative potential? Are there gaps between objectives and educational reality? Which innovations exist and what evidence is there of their effectiveness?

More concretely, questions for which empirically based answers are sought, include:

1. To what extent have education systems adopted and implemented objectives that are considered important cornerstones of education in the Information Society? How does this process develop over time?
2. To what extent is ICT facilitating implementation of objectives that schools intend to achieve?
3. How, by whom, and to what extent is ICT used in education systems, and how does this develop over time?
4. What differences in ICT-related practices exist within and between systems and how can these differences be explained?
5. What is the impact of ICT on educational organizations, processes, and outcomes in different education systems?
6. Which innovative practices exist that may offer educational practitioners new targets within their reach?

DE ELOP ENT OF T E STUD

The above questions furnished the basis for IEA to initiate the planning of an ICT study consisting of three modules (Anderson, Haider, Pelgrum, & Watanabe, 1997) with slightly overlapping time schedules:

1. *Module-1:* a survey of principals and technology coordinators in primary, lower secondary, and upper secondary schools (1997–1999).
2. *Module-2:* case studies of innovative pedagogical practices using ICT (1999–2001).
3. *Module-3:* a survey at school, teacher, and student levels (2000–2005).

In 1997 the IEA General Assembly approved the start of Module-1, and the International Coordinating Center (ICC) began its activities. A first meeting of country representatives took place in December 1997 at the University of Twente, the Netherlands. That meeting (and follow-up meetings in February 1998 and August 1998) saw decisions made about the design of Module-1, in terms of conceptual framework, specification of sampling procedures, instrumentation, and time schedule.

The pilot study of SITES Module-1, which used drafts of instruments, was completed by June 1998. The final questionnaires were completed by September 1998, allowing collection of the survey data before December 1998. Entry, cleaning, and processing of the data were conducted during the first quarter of 1999, leading to the completion of the first draft report in April 1999. After extensive checking for accuracy at both the national and international levels, a second draft of the report was completed in June 1999.

ORGANI ATION AND FUNDING OF T E STUD

The International Coordinating Center of SITES Module-1 was located at the University of Twente, Center for Applied Educational Research (OCTO) in the Netherlands. The international coordinator was Dr W. J. Pelgrum, who also coordinated earlier IEA assessments on computers in schools in 1989 and 1992. Other staff involved at the ICC were Mr K. T. Bos (responsible for operational matters), Dr J. M. Voogt (consultant curriculum matters), Dr A. J. Visscher (consultant management and organization), Mr R. Steen (data manager), Mr C. M. Roozemond (data processor), and Mrs M. Kole (secretary). The ICC cooperated (via subcontracts) with the IEA Data Processing Center in Hamburg (contact persons Dr K. Schwippert and Mrs U. Itzlinger) and the University of Salzburg (Dr G. Haider and his team).

The International Steering Committee of the study consisted of Dr R. E. Anderson (chair, United States), Dr C. Dede (United States), Dr N. Law (China Hong Kong), Dr F. A. Oedegaard (Norway), Dr W. J. Pelgrum (ICC–the Netherlands), Dr J. Strakova (Czech Republic), and Mr R. Watanabe (Japan). The sampling coordinator for the study was Dr C. A. O'Muircheartaigh from the University of Chicago.

The communication infrastructure for the project consisted of a web site, containing files of all important project documents, which could be downloaded by the participants. This method of document transfer worked very well, although, in rare cases and for unknown reasons, transfer interruptions occurred. The other main way of communication was via email. This communication infrastructure contributed considerably to the efficacy of project operations.

The funding for the international overhead of Module-1 was provided by:

- The Japanese National Institute for Educational Research (NIER), and the Ministry of Education, Science, Sports, and Culture.
- The Norwegian Ministry of Church, Education, and Research.
- The Dutch Science Foundation.

A further contribution to funding came from the participation fees provided by the participating countries.

Each of these countries was represented by a national research coordinator (abbreviated as NRC in the remainder of this book). Appendix A gives the names of these persons and their institutional affiliations. The NRCs and their national research teams played a crucial role in the process of defining the study design and instrumentation. Moreover, these people were responsible for collecting (according to guidelines that had been agreed upon by all participants) the survey data in their countries.

Partici ating Countries

The following educational systems participated in the data collection for SITES Module-1:

Belgium-French	France	Norway
Bulgaria	Hungary	New Zealand
Canada	Iceland	Russian Federation
China Hong Kong	Israel	Singapore
Chinese Taipei	Italy	Slovenia
Cyprus	Japan	Slovak Republic
Czech Republic	Latvia	South Africa
Denmark	Lithuania	Thailand
Finland	Luxembourg	

At the beginning of the SITES Module-1 study, the Netherlands, the United Kingdom, and the United States had already begun their own surveys on ICT in schools. While these countries did not participate in the data collection for SITES Module-1, comparative statistics have been extracted from their national reports and included in this report wherever the indicators were truly comparable with SITES Module-1.

CONCEPTUAL FRA EWOR

The major aim of SITES Module-1 was to assess and analyze, by means of international comparative statistical surveys, the status of information and communication technologies (ICT) in schools for instructional activities by teachers and/or students at three stages in the school system (primary, lower secondary, and upper secondary education). SITES Module-1 was intended to result in a picture of ICT in education at one point in time (late 1998) that would allow for examination of developmental trends on the basis of earlier worldwide assessments (1989 and 1992) and provide a baseline for future assessments.

As indicated in the section above on the background of SITES, ICT is currently seen as having the potential to facilitate changes in education that will allow future citizens to be better prepared for the Information Society than is currently the case. Many policy documents contain common speculations about the directions that such change might take in creating the 'school of tomorrow'. Table 1.1 contains an overview of some of these common expectations, which were extracted from a literature review.

One may argue that the changes mentioned in Table 1.1 do not necessarily imply the use of ICT. However, ICT tends to play a facilitating role in managing the increased flows of information associated with more autonomous learning environments. Such information flows support subject-matter content (that can be located outside schools), the monitoring of progress (particularly individual student learning progress, with increased feedback to parents), individualized self-assessment options, and individualized educational career planning.

Table 1.1 Expected changes from education in the Industrial Society to education in the Information Society

Actor	Education in the Industrial Society (the traditionally important paradigm)	Education in the Information Society (the emerging paradigm)
School	• Isolated from society • Most information on school functioning confidential	• Integrated in society • Information openly available
Teacher	• Initiator of instruction • Whole class teaching • Evaluates students • Places low emphasis on communication skills	• Helps students find appropriate instructional path • Guides students' independent learning • Helps students to evaluate own progress • Places high emphasis on communication skills
Student	• Mostly passive • Learns mostly at school • Hardly any teamwork • Takes questions from books or teachers • Learns answers to questions • Low interest in learning	• More active • Learns at school and outside school • Much teamwork • Asks questions • Finds answers to questions • High interest
Parent	• Hardly actively involved in learning process • No steering of instruction • No life-long learning model	• Very active in learning process • Co-steering • Parents provide model

Source: Pelgrum, W.J., ten Brummelhuis, A.C.A., Collis, B.A., Plomp, Tj., and Janssen Reinen, I.A.M. (1997) *The Application of Multimedia Technologies in Schools: technology assessment of multimedia systems for pre-primary and primary schools.* Luxembourg: European Parliament, Directorate General for Research.

T E E ERGING PARADIG

SITES participants labeled the distinction in Table 1.1 between education in the Industrial Society and education in the Information Society as the traditionally important paradigm versus the emerging paradigm. Alternative labels for the emerging paradigm, such as 'life-long learning' and 'constructivism', were considered but avoided because of their more narrow connotations. The concept of the emerging paradigm (versus the traditionally important paradigm) provided a useful overarching structure for the conceptualization and execution of the study.

On the basis of previous educational research, the following four elements appeared to be those most essential to describing and comparing ICT-related activities in education. These four elements also helped to structure policy concerns and guide research.

- *Curriculum:* What are the ICT-related objectives and pedagogical practices that schools have adopted? Which ICT-related opportunities are schools offering to students?
- *Infrastructure:* What ICT facilities are available in schools?
- *Staff development:* How do schools help staff become more able at applying ICT? What incentives are offered to teachers to acquire ICT-related skills, and which training facilities are available for teachers?
- *Management and organization:* What policies and other actions are taken by the school management so as to facilitate ICT use? Which support facilities are made available in schools? To what extent are school principals in favor of ICT? What financial arrangements are in place?

Figure 1.1 shows the curriculum as the focal point of the study and the other perspectives as the potential facilitating conditions.

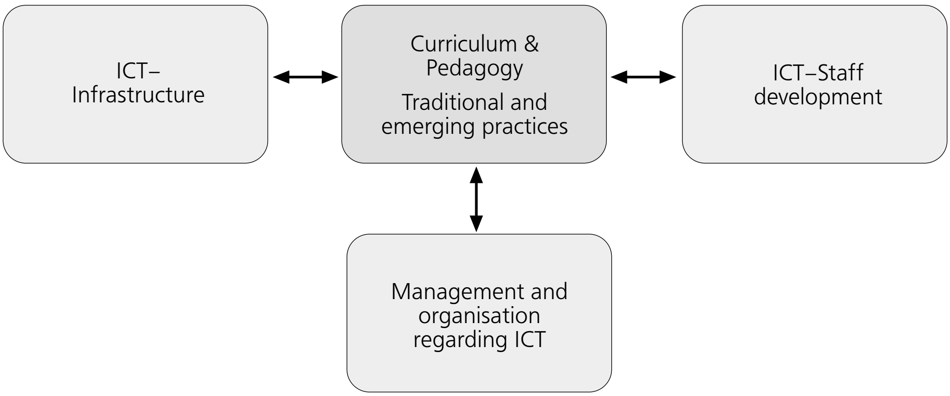

Figure 1.1 Main conceptual framework for SITES Module-1.

INDICATORS

Each of the elements in the framework were elaborated further in order to derive sets of measures that could serve as indicators for assessing the current status of ICT in education. The sections below describe these elaborations.

Curriculum and Pedagogy

'Curriculum' for present purposes is what schools are supposed to teach and why. It also refers to what they do teach and how (Plomp, Nieveen, & Pelgrum, 1996). In this broad sense, curriculum encompasses pedagogy and the instructional practices of teachers. A commonly used elaboration of this concept in international studies is the distinction between the intended, the implemented, and the realized or attained curriculum.

- *Intended curriculum:* This is the curriculum schools intend to implement and realize. It can be described in terms of achievement targets and planned educational processes (instructional processes, role of teachers, evaluation procedures, and the like). It is often defined at a national level.
- *Implemented curriculum:* This refers to the educational processes that actually are taking place inside schools. It can be described in terms of learning opportunities offered to students.
- *Realized (attained) curriculum:* This refers to the student outcomes from the learning experiences acquired at school.

While some countries have an informatics curriculum, many do not. Instead, they attempt to integrate ICT into other subjects in order to support or enhance learning in general. The SITES Module-1 study asked school principals for information about both the intended and the implemented curriculums of the school. Chapter 3 contains the questionnaire items that were ultimately included in the questionnaires for schools in order to assess this domain.

One question of special interest related to whether or not school principals who try to implement objectives related to the emerging paradigm are likely to place greater value on ICT learning practices. To explore this and related questions, school principals were asked about the extent to which ICT had contributed to realization of the traditionally important as well as the emerging objectives of their schools.

The research literature suggests that perceptions of the relevance and practicality of ICT are very important in predicting the extent to which educational innovations are adopted and implemented. Therefore, indicators of these dimensions were included as well. In order to assess the implemented curriculum, indicators were developed and included to measure opportunities for learning about ICT in general. In addition, indicators were designed to assess opportunities for ICT activities associated with the emerging paradigm as well as those associated with the traditionally important paradigm.

ICT Infrastructure

The ICT infrastructure was conceived in terms of two main areas, hardware and software.

Hardware

A general basic indicator of hardware availability in schools is the number of PCs (or workstations) available in each school that students and/or teachers can readily access for teaching and/or learning purposes. Appraising accessibility therefore requires qualifying these absolute numbers in terms of the number of students who need to share this equipment. The 'students per computer ratio' was used as a major indicator of accessibility. However, this ratio can be defined in different ways, as will be further explained in Chapter 4.

It was considered important to develop, alongside the quantity indicators, indicators of the quality and functionality of the available equipment. Aspects of quality and functionality were processor power, operating systems, peripherals, and access to the Internet/WWW.

It was expected that a substantial number of schools that had first introduced computers in the 1980s would suffer from outdated or malfunctioning equipment. An indicator regarding the number of computers not in use was therefore included, and reasons were gathered as to why these computers were unavailable.

Another expectation concerned national policy-making with regard to the ICT infrastructure in education. Specifically, it was thought that the international comparisons of the indicators described above might provide fuel for a debate on policy priorities. For instance, low values on these measures might induce some political pressure for change. As such, it seemed important also to include indicators on perceptions held by school officials of hardware needs.

Software

The second important aspect of ICT infrastructure in schools is the availability of software. Two main categories of software were distinguished, namely, *general purpose software* and *school subject-specific software.*

Pelgrum and Schipper (1993) showed the importance of this distinction in a 1993 study. They concluded that the integration of computers in the school curriculum is associated with the availability of subject-specific educational tool software: the more educational tool software that is available in schools, the greater the integration of ICT in the curriculum. However, the extent to which general-purpose programs were available was shown to be associated with an emphasis on teaching informatics as part of the curriculum. Although these indicators are rather crude indicators, they were found to be important for describing trends in the assessments that were conducted in 1989 and 1992 by IEA.

Staff De elo ment

Teachers play a key role in any educational innovation. If teachers are not able to apply new methods (perhaps because they do not see the relevance and/or practicality of these methods or because they lack relevant teaching qualifications), an innovation will fail. Therefore, for the SITES project as a whole, it seemed important to collect data from teachers about their ICT-related qualifications; their perceptions regarding the need for ICT, relevance and practicality; the pedagogical models they had adopted; and the ICT applications they had used to implement these models. For SITES Module-1 it was deemed feasible to collect information about staff development at the school level.

In terms of operationalizing the questionnaire items, the following underlying research questions were identified:

- What staff development requirements have schools adopted?
- What training and learning facilities for teachers are available in the schools and outside them?
- What are the financial investments of schools with regard to staff development?
- What professional development needs do school officials identify?

Chapter 5 provides a more detailed description of indicators regarding the professional development of staff.

anagement and Organi ation

Enthusiastic teachers who are prepared to invest a considerable amount of free time in effecting changes in their own instructional practices can do much to bring about educational innovations such as ICT. However, such teacher-initiated innovations will, in general, not reach a stage of large-scale institutionalization without the structural backing of the school as an organizational entity. The school management can stimulate and steer ICT-related educational developments. This may take the form of adopting explicit policies, such as:

- The stimulation of an ICT infrastructure.
- The creation of a supportive climate in the form of internal support for ICT.
- The implementation of policies designed to ensure the integration of ICT into instructional activities.
- The organization of computer facilities. This policy might, for example, determine that computers should spread throughout classrooms rather than being kept in separate computer rooms.

It was hypothesized that measures such as these would contribute to the infusion of ICT in the school curriculum. It was also hypothesized that the attitudes of school principals toward ICT would play a role in the extent to which the ICT-related school management climate favorably influenced or potentially inhibited the infusion of ICT.

Chapter 6 describes operationalizations of indicators and results.

Additional Indicators

It was decided that, in addition to gathering information on the areas described above, the questionnaires should include items designed to provide information on the following:

- School characteristics, especially school size, gender distribution, and school location.
- The role of school leaders (including information about gender, age, and experience).
- Principals' reports of innovative, pedagogical practices.

With regard to the last point, principals were asked to describe the 'most satisfying' pedagogical practice using technology in their school. The answers to this question made it possible to describe a wide variety of activities consistent with the emerging paradigm. Chapter 7 contains information about the details of this question and the ensuing results.

DESIGN AND SA PLING OF SITES ODULE-1

This section contains a summary of the design of Module-1 in terms of population definitions, sampling, instrument construction, and database construction. More details can be found in Appendix B and on the SITES web site (address: http://www.mscp.edte.utwente.nl/sitesm1).

Target Grades and Grade Ranges

When designing Module-1 of SITES, it was necessary to make assumptions about the likely definitions of student populations that would be used in Module-3. It was expected that Module-3 would focus on three student populations that would be defined in terms of particular target grade levels (defined below in the sections on population definitions).

The definition of target grades had implications for the instrument development. This was because the instruments were meant to collect information about the school context that might affect students at the target grade. For example, in school systems containing schools with grades extending from the lower to the upper secondary levels, the ICT infrastructure might be different for each of these levels, with the upper level perhaps having better access than the lower levels to more sophisticated machines and particular software.

Also, in regard to collecting data about intended instructional objectives in the schools, it was considered important to specify to the respondents the particular target groups that the researchers had in mind. However, that said, participants in SITES Module-1 had to solve the dilemma of relevant school context characteristics not necessarily being restricted to students at particular grade levels. For instance, it was realized that whereas some schools might restrict the use of the available ICT infrastructure to particular grade levels, others might make no distinction at all. It therefore was decided to distinguish three types of questionnaire items:

1. Those referring to a single target grade.
2. Those referring to a grade range that included the target grade.
3. Those referring to the entire school.

Decisions about the allocation of particular questionnaire items to each of these categories were made on the basis of consensus between the participating researchers. Moreover, NRCs were allowed to include an instruction to respondents that whenever particular questionnaire items referred to a grade or grade range, answers might be provided as if they were posed in terms of 'the entire school'.

Po ulations

Even though the school was the unit of analysis for SITES Module-1, the school populations were defined in terms of the characteristics of students attending schools.[2] As explained in the previous section, it was necessary to anticipate a student survey for SITES Module-3 and to define the populations in terms of schools with one of three types of student population. Countries had to be able to collect data in at least one of these populations in order to participate in the study. Population 2 was considered as the core population. Those countries participating in only one population were urged to select Population 2.

A target age was defined for each population so as to provide a best comparative basis for Module-1 and Module-3 data. The target age was then used (see points 1 and 2 under Population 2 below) to define the grade range and hence the schools constituting the population. The population definitions were as follows.

Population 2: In order to provide a basis for context information and trend data in Module-3, and to provide a basis for comparison with other IEA and OECD studies, it was agreed that the target age for Population 2 would be '*14 in the eighth month of the school year*'. (An effort is being made to ensure that testing in Module-3 coincides as much as possible with whenever the eighth month occurs in each participating country.)

1. *The grade range* was defined as the three grades within a school containing the most students of the target age (those aged 14 in the eighth month of the school year).
2. The schools in Population 2 consequently were those schools containing all three grades. However, some schools, while falling within the grade range, did not have all three grades because they catered for students bounded by a particular level school (as is seen in 'middle schools'). In such instances, it was determined that the grade range would include the two grades within such schools that contained the most students of the target age.

Population 1: The definition corresponded exactly to that for Population 2, except the target age was 10 (in the eighth month of the school year) instead of age 14.

Population 3: Population 3 was defined as *the final grade of secondary education*, with the grade range being the penultimate and final grades.

In the remainder of this book, Populations 1, 2, and 3 respectively will be referred to as:

1. primary education;
2. lower secondary education;
3. upper secondary education.

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2 More specifically, SITES Module-1 focused on schools that used computers for instructional purposes.

It should be pointed out that for some countries (for example, Bulgaria and Slovenia), the labeling of Population 2 as lower secondary was formally not correct, because the grade levels of part of this population are defined (in the formal education system) within the primary level. Although other labels (such as middle school) were considered, it was ultimately decided to use *lower secondary education* because this terminology is consistent with the earlier IEA Computers in Education studies, and also because the OECD and the European Commission use this terminology. Furthermore, it should be noted that in Singapore 'upper secondary education' refers to Grades 9 and 10. Hence, for Singapore this level should be read as 'final school years'.

Sam ling Criteria and Reali ed National Sam les

The national centers participating in the study were required to submit national sampling plans that contained detailed proposals on defining the national populations and the procedures to be used for drawing the samples. The base criteria for national sampling were set as follows:

1. Schools using ICT to be selected on the basis of a probability proportional to the number of students from the desired target population.
2. The response rate to be at least 85% after one replacement, 70% in situations with no replacements for non-responding schools, and 70% for complete enumeration.
3. The minimum sample size to be 200 ICT-using schools per population level.

Table 1.2 presents summary information about the characteristics of the national samples for each population. Appendix B contains more detailed information about the sample characteristics of each country.

It can be seen from Table 1.2 that the following countries were unable to generate samples that satisfied the international criteria:

- *Primary education:* Canada, Finland, Israel, and France.
- *Lower secondary education:* Belgium-French, Canada, Israel, Italy, New Zealand, the Russian Federation, and South Africa.
- *Upper secondary education:* Belgium-French, Canada, Israel, Italy, Latvia, the Russian Federation, the Slovak Republic, Slovenia, and South Africa.

These countries are flagged throughout this book. However, this flagging does not necessarily imply that these samples are biased.

The small sample sizes of other countries (for example, Cyprus and Luxembourg) are acceptable because they resulted from a complete enumeration.

Im lications of the Sam ling Design

An important implication of the chosen sample design is that all statistics reported in this book are proportional to the distribution of students in each population. Even if the text refers to, for example, 'the percentage of school principals in ICT using schools that gave a particular answer', this should be read as 'the percentage of students in ICT using schools whose principal gave a particular answer'.

Table 1.2 Estimates of the percentage of students at ICT-using schools, definitions of target grades and grade ranges, sample sizes, and response rate per educational level

	Primary Education					Lower Secondary Education					Upper Secondary Education				
	% students at ICT-using schools	Definition target rate	Definition grade range	Realized sample size	Response rate	% students at ICT-using schools	Definition target rate	Definition grade range	Realized sample size	Response rate	% students at ICT-using schools	Definition target rate	Definition grade range	Realized sample size	Response rate
Belgium-French	~	~	~	~	~	73	8	7-8	137	29	74	12	12	140	30
Bulgaria	~	~	~	~	~	19	8	6-8	209	84	70	11	9-11	225	90
Canada	99	5	5	1397	61	100	9	9	860	56	100	12	12	786	62
China Hong Kong	100	5	3-5	218	70	100	8	7-9	317	74	100	11,13	10-13	317	74
Chinese Taipei	50	4	1-6	212	88	100	8	7-9	210	86	100	12	10-12	235	92
Cyprus	15	5	4-6	26	93	75	8	8-9	33	83	100	12	11-12	31	93
Czech Republic	~	~	~	~	~	72	8	6-9	255	85	90	11,12,13	10-13	235	83
Denmark	~	~	~	~	~	100	9	7-9	229	92	~	~	~	~	~
Finland	100	4	3-5	185	84	100	8	7-9	197	90	~	~	~	~	~
France	80	5	4-5	309	51	100	9	8-9	296	74	100	12,13	12,13	293	73
Hungary	~	~	~	~	~	100	8	7-8	257	86	~	~	~	~	~
Iceland	100	4	4	137	81	100	8	8	103	77	100	12	12	27	93
Israel	85	4	4	144	72	85	8	8	129	65	85	12	12	133	67
Italy	55	5	5	205	100	79	9	9	190	95	89	13	13	186	93
Japan	100	4	1-6	215	86	100	8	7-9	204	81	100	12	10-12	210	84
Latvia	~	~	~	~	~	~	~	~	~	~	100	11	10-12	122	34
Lithuania	~	~	~	~	~	77	8	7-9	239	85	90	12	11-12	546	79
Luxembourg	~	~	~	~	~	100	8	7-9	18	75	100	12,14	11-12,13-14	22	79
New Zealand	100	5	4-6	210	84	100	9	9-10	259	61	~	~	~	~	~
Norway	100	5	5-7	1298	75	100	9	8-10	809	75	100	12	11-12	406	79
Russian Federation	~	~	~	~	~	53	8	7-9	106	100	53	11	10-11	106	100
Singapore	100	4	4-5	192	100	100	8	8-9	145	100	100	12,13	11-13	30	100
Slovak Republic	~	~	~	~	~	~	~	~	~	~	100	12	9-12	157	35
Slovenia	100	4	3-4	132	70	100	8	7-8	132	70	100	11,12	9-12	120	x
South Africa	~	~	~	~	~	18	8	7-9	109	43	18	12	10-12	113	46
Thailand	~	~	~	~	~	50	8	7-9	426	85	~	~	~	~	~

Notes*:* 12,13 means: grade 12 or grade 13, depending on the school type at the upper secondary level. x: depending on course type. ~: country did not participate at this educational level.

INSTRU ENTS

The ICC and participating NRCs cooperated closely to develop the instruments for Module-1. Participants discussed the first rough drafts during a meeting held in December 1997, and the revised versions of these were pre-piloted in January 1998 in six countries. Pilot versions were created during a meeting of NRCs in February 1998.

The results of the pilot phase, which ran from April through May 1998, were used, following a decision-making session by participants (in August 1998) to form the final versions of the questionnaires.

The instrumentation for SITES Module-1 consisted of two questionnaires:

1. A questionnaire for school principals.
2. A questionnaire for a person in the school who was knowledgeable about the ICT facilities and their use.

Table 1.3 contains a synopsis of the content of the questionnaires. Appendix C contains the complete questionnaires.

ET ODOLOGICAL ISSUES

This section is intended to point the reader to some methodological issues that are important to consider when drawing inferences about or making generalizations from the descriptive results that are reported in this book.

Relia ility and alidity of easures

This book contains the first descriptive results of SITES Module-1, which was meant to be a quick survey assessing, by means of school-level questionnaires only, the current situation with regard to ICT in education. The measures that were included in Module-1 were partially derived from well-tested instruments that were used during the Computer in Education surveys in 1989 and 1992. However, some measures were completely new, especially the ones addressing indicators of emerging pedagogical practices. Throughout this report the instrumental basis underlying the reported results is documented, and references are made to Appendix E, which contains reliability estimates for the composite indicators that were constructed on the basis of questionnaire items. The reader should be aware that reliability does not imply validity, that is, whether an indicator is really measuring what is intended to be measured. Although the authors of this book are reasonably confident that indicators of computer infrastructure (for example, student:computer ratios, etc.; see Chapter 4) are valid measures, more uncertainty exists at this stage regarding indicators of emerging or traditional pedagogical practices. The reason for this uncertainty is that it is the first time in the history of international comparative assessments that such measures have been used. Also, there is a lack of empirical evidence on the issue of the validity of the measures. Module-2 of SITES is intended to throw more light on this question. In the meantime, the reader should be cautious with regard to the indicators that are reported in Chapter 3 on curriculum and pedagogy.

Table 1.3 Study topics with summaries of questionnaire content

Topic	Principal questionnaire	Technical questionnaire	Chapter
Curriculum	• ICT-related objectives of the school • Presence of types of teaching and learning practices • ICT attainment targets • Realization of ICT-related objectives	• Use of email/WWW for instructional purposes • Percentage of students/teachers using WWW • Internet-related activities of students • Use of technology applications by students	3
Infrastructure	• Needs and priorities • Perceived obstacles • Expenditures – Hardware – Software – Maintenance	• Number and types of computers • Operating systems • Processor types • Access to email/WWW • Access to email/WWW • Existence and content of home page • Number of computers not in use • Availability of peripherals • Availability of software types • Availability of software for school subjects • Hard- and software-related obstacles	4
Staff development	• Prescriptions for teachers • Attendance by teachers • Expenditures on staff development	• Types of internal information exchange • Availability of in-house/external training courses • Self assessment of ICT skills	5
Management and organization	• Existence of written policies on ICT • ICT-related policy measures • Principal attitudes towards ICT • Use of ICT for administration/ monitoring • Technical support infrastructure	• Priorities for external support	6
Innovative practices	• Most satisfying ICT-related learning activities		7
Background information	• Gender, age, experience of principal • Own use and type of use of ICT • Enrollment figures • Area in which school is located • Years of experience with ICT	• Roles and tasks • Experience as computer coordinator • Gender • Age	NA

Sam ling

With regard to sampling, it should be noted that SITES Module-1 focused on schools using ICT for educational purposes. This means that schools not using ICT or using ICT only for administrative activities were excluded from the sampling frames that were created in the participating countries. The reader therefore should be aware that the country comparisons are not always based on all students who were attending the schools in the participating countries. For example (see Table 1.2), at the lower secondary level, countries such as Canada, where 100% of the students were attending ICT-using schools, are compared with countries (for example, Bulgaria and South Africa) where only a fraction of the student population was represented. The effect of such low representation may be the emergence of an upward biased estimate of the situation in a particular country. Therefore, those readers who wish to draw inferences or make statements on the basis of the presented statistics should look first at Table 1.2 for information about the percentages of schools that used ICT for instructional purposes.

Another issue that is worth addressing at this point is the distinction that was made in Module-1 with regard to target grade, grade range, and the whole school. This issue is explained in the section above on 'target grades and grade ranges'. The implication of the fact that countries choose different grade ranges is not yet well understood. It might be argued that questions regarding grade ranges or the target grade may be affected by these definitions and, hence, could result in flawed interpretations.

In principle, standard errors are reported for all statistics in this book. In order to save space, this reporting sometimes takes the form of rules of thumb (as shown in Appendix D). As explained in the footnotes for tables and figures, a standard error is used to determine within which interval the statistics are estimated to fall for the population (that is, all students in the country who belong to the target population). It should be noted that standard errors are calculated, in principle, by using the formula SD/SQRT(n), with SD being the standard deviation of the statistic, SQRT the square root and n the number of valid observations. For countries where a finite population correction could be applied (that is, countries with a complete or nearly complete enumeration of all schools), an adapted formula, which leads to smaller standard errors, was used. This formula does not take into account the fact that most countries used a stratified sample. In theory, stratification leads to somewhat more accurate population estimates. This means that the standard errors reported in this book may be slightly inflated.

Trend Analyses

In this book, trend analyses comparing data from the IEA Computers in Education studies (1998 and 1992) with SITES Module-1 data do not appear. The main reason for this is that the number of countries that participated in Computers in Education as well as SITES was quite small. The trend analyses that are reported deal with student:computer ratios, which were calculated on data collected in 1995 in the Third International Mathematics and Science Study (TIMSS). These trends are described in Chapter 4. Methodological questions regarding the comparability of TIMSS and SITES are also discussed in that chapter.

Scales

This book contains not only statistics based on individual variables (that is, single questionnaire items), but also means, medians, and dispersion measures of so-called composite variables, which consist of a linear combination of a set of individual variables. Whenever a composite is reported, the accompanying text contains a description of or a reference to the questionnaire items that were used for constructing the composite. Also, for each composite, the reliability coefficient is shown in Appendix E.

For most composites in this book, the mean of scores on the individual variables was transformed to a scale with values varying between 0 and 100% according to the following formula:

100*(mean-1)/(k-1) — (where the answer scales were coded from 1 to k)

The reason for performing this transformation was to help the reader interpret the relative magnitude of the composite values. Not performing such a transformation would require the reader to perform all kinds of mental calculations when interpreting the statistics in a table or figure. For instance, an average value of 1.75 for a scale consisting of no/yes-items (coded respectively as 1 and 2) is very high, but the same value for a scale consisting of three answer alternatives (coded as 1, 2, and 3) is relatively low.

According to the formula above, the transformation would result in a value of respectively 75% and 38%, which may be more helpful by allowing the reader to quickly grasp the relative value of the statistic.

DATABASE CONSTRUCTION[3]

The development and administration of questionnaires in large-scale international studies like SITES is not the sole responsibility of experts in the survey field. This work must also be conducted in accordance with standards set by data-processing specialists. Appendix I of this report gives a detailed account of how the SITES Module-1 data were cleaned and processed during the pilot and main survey stages of the study.

Traditionally, several questions are constructed to measure one concept. Pilot testing these questions is necessary to find out whether their psychometric properties are sufficient and whether their content will enable a valid measurement of the concept. SITES piloted its questionnaires in most of the participating countries. After the first draft of the questionnaires had been finalized, the staff of the IEA Data Processing Center (DPC) developed questionnaire code books. Once each country had completed data collection and data entry, it put its data through the 'within country cleaning program' supplied by the DPC. This program checked (mainly) violations of valid data and the consistency of responses between some basic variables. Countries were asked to correct all errors before sending their files to the DPC.

3 This summary is based on Schwippert, Itzlinger, and Bos's 'Data handling in SITES Module-1' (see Appendix I).

Generally, errors in data codes arose because of the necessity to make national adaptations. Occasionally, data entry errors also crept in. Cleaning the national data sets required cooperation between the national data managers, the ICC of SITES, and the DPC team. The general idea behind the cleaning process can be described as an 'international cleaning loop', whereby standard cleaning procedures applied by the DPC staff resulted in a cleaning report documenting problems and warnings. It was possible to solve some of the problems by referring to information set out by the NRCs on data management forms. A report detailing any remaining problems was sent to the NRC, who tried to solve the problems manually. A revised data file was then sent to the DPC, which ran the cleaning programs again to check if problems still existed. When this had been done, the DPC staff discussed the new cleaning report among themselves and, where necessary, conferred with the NRC. These steps were repeated until the data were clean.

The only obvious errors on information to be replaced by other values were those that could be reconstructed. Codes that were obviously wrong and that could not be corrected by original data were treated as missing values. These practices ensured that the data-processing process was one of maintaining data quality and not one of manipulating the data. Although the country representative (usually the NRC) made decisions about re-coding the national data, in very rare cases the DPC (in cooperation with the ICC) did not accept highly implausible values if the NRC was unable to give a convincing explanation for those values.

The final data-processing activity was that of building the international database in conjunction with the corresponding documentation provided by the NRCs (thereby taking into account special national needs).

Communication y the We

SITES was the first IEA study to rely completely on the World Wide Web for communication between participants. While this medium offered new possibilities, it also presented problems. The main advantage was the limited amount of time needed for sending and receiving materials, letters, programs, and data files. 'Shipping' became a matter of minutes. This advantage was even more marked when materials were problematic and had to be re-sent. Furthermore, the NRCs found it easy to send draft versions of the data files to the DPC. However, some countries stretched the possibilities of using the Web by sending materials step by step.

STRUCTURE OF T E BOO

In addition to giving the background and methodology of the study, the first chapter of this book summarizes the indicators used. In the second chapter, each country's national ICT-related policies are summarized, thereby providing a context for the statistics that are reported in the remainder of this book. Chapter 3 describes the curriculum indicators. The focus here is on distinguishing the emerging and traditionally important pedagogical paradigms and their implications. Chapter 4 describes the ICT infrastructure with regard to the hardware and software provisions existing at each educational level. Chapter 5 focuses on indicators of ICT-related staff development in the schools, while Chapter 6 deals with ICT-related management and organization issues. Chapter 7 looks at the school principals' perceptions of what they saw as the most satisfying experience with ICT in their schools. The final Chapter, 8, contains a summary and reflections on the implications of the study.

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Cha ter

NATIONAL ICT-RELATED POLICIES

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This chapter contains summaries of national ICT-related policies. The descriptions offer important information about main context characteristics that can be used to interpret some of the observations made on the basis of the statistical results presented in later chapters.

INTRODUCTION

As noted in Chapter 1, many governments, inspired by the metaphor of the Information Society, have, in recent years, launched quite ambitious plans with regard to ICT in education. These policy plans are often difficult to grasp in quantitative terms. Nevertheless, the policy context of ICT in education is of crucial importance for understanding the statistical information about what is happening with regard to the facilities and use of ICT in schools. The IEA Computers in Education studies conducted in 1989 and 1992 (refer Pelgrum, Janssen Reinen, & Plomp, 1993) resulted in publication of a book on national ICT policies (Plomp, Anderson, & Kontogiannopoulou-Polydorides, 1996). A similar book, containing articles about national ICT policies from countries that were participating in SITES will also be published in due time (Plomp, Anderson, Law, & Quale, in preparation).

This chapter presents summaries for all countries except the Slovak Republic that participated in SITES Module-1. NRCs were given a maximum of three pages to present their national ICT-policies. As a consequence, these summaries contain bird's-eye views on what the participating researchers saw as the most important developments.

BELGIU -FRENC

N Deltour

TARGETS AND STAGES OF T E WIN PRO ECT I PLE ENTATION

In June 1996 the Walloon government passed the Win Project (Wallonie Intra Net), initiated by the Ministry of National and Regional Development, Equipment, and Transport. The implementation agreement was signed in July 1997. This project incorporates a reactualized conception of public infrastructures, and of national and regional development, widened to address new social, economic, and industrial needs. The telecommunications chapter of the 'Complementary Regional Political Declaration', published by the Walloon government in November 1997, introduced a very precise program of action, which aims to develop the use of telecommunication services as well as the cultural integration of ICT into the social and economic life of Wallonia.

In the educational field, the Walloon Region signed in February 1998 an agreement of cooperation with the French Community and the German Community. (These different political authorities will be described in the section dedicated to the Belgian educational system structure.) This agreement is based on the following principles:

- Belgium is intent on boosting its economy.
- The development of telecommunications is a major objective of this policy.
- The effective implementation of this policy requires young people to be trained in the use of ICT.
- The use of ICT by students, within different schools, is a new resource for learning and a necessary condition for a policy of equity.

This agreement requires:

- active support to be given to providing computer equipment throughout schools, so allowing each student to be trained in the use of ICT;
- the training of personnel, including one resource-person for each school;
- the establishment of educational servers so that each school has access to Internet;
- the establishment of one organization to supervise the deployment of equipment, and to ensure (subject to budgets) the development of this equipment.

In regard to the last point, this work may also require re-evaluating and renewing materials intended for teaching and learning purposes.

T E C BER EDIA CENTER C C CONCEPT

The Win Project includes the creation, within each school, of a 'Cyber Media Center' (CMC), that is, a classroom (or rooms) fitted out and equipped for individual or collective use.

In addition to personal computers for students and teachers, the CMC will have a multimedia projector, a video conference camera with adapted computer, a TV set, an Internet decoder, and servers allowing access to the common internal network. It will also put at the disposal of everyone a bank of CD-ROMs, software (including a World Wide Web navigator and email access) and computerized tools for office work.

CONTRIBUTION OF SC OOLS

In return, schools are required to commit themselves to certain pedagogical and technical conditions.

- They must ensure that a few (at least) of their teachers are trained in the use of ICT (these resource persons will be required to attend a training program, lasting several days, so that they can efficiently carry out their technical responsibilities within the school).
- They (the schools) must undertake a pedagogical project that specifies the activities they intend to develop in the field of ICT.
- They must respect the intended function of the equipment with which they are entrusted.
- They must cooperate with the central managing committee of the Walloon Region.

PLAN OF I PLE ENTATION

The first step to address the equipment needs of secondary schools (in all the organizing ethnic communities) took place between September 1998 and September 1999. Four hundred and thirty-five schools were equipped during that time. The process of equipping primary schools began in September 1999 and was to be completed by September 2000.

In December 1998, three CMCs were implemented. January 1999 was an intensive test period for these experimental CMCs and for the centrally located managers of the equipment. The launching phase (February and March 1999) involved equipping around 40 schools and then validating this configuration choice (that is, the hardware package) on a larger scale. The display phase, allowing the remaining schools to be equipped over a period of about seven months, began in April 1999. It was expected that the 120 schools that produced a pedagogical project in July 1998 would receive their equipment by May 1999.

SC OOLS INTERNAL POLICIES

Prior to the introduction of the Win Project, an ICT policy or consistent program governing the whole school system did not exist. When analyzing the official curriculum, we can see that integrating ICT in the different disciplines was not a high priority. All that existed were timid (and quite vague) recommendations regarding the utility of this 'tool' for teaching. Moreover, the programs dealing specifically with 'computer science' were obsolete. For example, the computer science program for the third cycle of secondary education (Grades 11 and 12, general courses) was published in 1981. The only programs to have been updated were those for vocational education (such as typing and word-processing).

According to the SITES data, the percentages of the participating Belgium-French schools with an internal policy were relatively low (37% for Population 2 and 47% for Population 3). At these two levels, the policies mainly emphasized staff development, Internet-related matters and the current and future use of computers. While the ICT programs in these schools do care about equity of ICT access, this is a subsidiary concern. The situation seems unusual in this respect, given that both the implemented and the realized curriculum are wider and richer than the official one.

TRAINING TEAC ERS TO USE ICT

An official training program of computer science exists for primary school teachers, and for teachers of Grades 7 to 9, but this program dates back to 1985. Moreover, its implementation and its efficiency are doubtful. More than half of the principals interviewed for SITES (54% in Population 2 and 64% in Population 3) stated that many of their teachers had attended basic computer science courses. However, only a few of them said that these courses were compulsory and that a lot of teachers were regularly attending ICT-related updating courses. Many of the principals also stated that the lack of knowledge and competence with respect to computer use was one of the major obstacles to using ICT in the school. Data such as these indicate that the implementation of ICT programs in Belgium-French schools is of high priority.

BULGARIA

P inhe

ISTOR AND STAGES OF DE ELOP ENT

Computers entered the Bulgarian school system on a large scale during the 1986/1987 school year with the introduction of 'informatics' as a separate new subject in the curriculum. It was introduced at Grades 10 and 11 and comprised about 100 study hours. At that time, the curriculum included some basic knowledge about information and computers, basics of algorithms, programming in (mostly) BASIC or Logo (but Pascal in the mathematics- and science-profiled schools/classes), and some (mainly theoretically delivered) application of computers.

The (secondary) school system was, for several years, relatively saturated with 8-bits Bulgarian Apple II clones. Despite numerous attempts to integrate (or 'penetrate') ICT into other subjects, there were no significant and sustainable results. Informatics remained isolated from the other subjects, with its own body of specialised teachers. Moreover, the computers were located in computer laboratories with students being able to access them only for the subject classes in informatics or related specialised/optional subjects. At the pre-secondary level, the only ICT-related opportunities for students involved extra-curriculum optional classes for limited numbers of students. At the elementary level, with some exceptions, even these possibilities did not exist.

RECENT DE ELOP ENTS

Over the last several years, that is, from 1992 on, the infrastructure and the curriculum of the previous period generally have remained the same. Informatics has remained as a subject in Grades 11 and 12 (in those schools containing Grade 12). For the secondary school subject of technology, a curriculum was developed for the elective branch of the subject information technology (two classes per week in Grades 9 and 10). This curriculum was developed in 1994 on a modular basis, and included initially five, and nowadays nine, modules that deal with the acquisition of skills relating to general applications software—word-processing, spreadsheets, databases, and so on, up to Internet (as of 1998). There is a strong computer-related tradition as well in profiled schools and separate classes in mathematics and informatics, where the curriculum is more intensive with respect to informatics/IT and is based more heavily on acquisition of programming skills and high-level abilities in the wider use of ICT. This mathematics/informatics profile is allocated mainly to the approximately 30 mathematics and science gymnasiums in the country but exists also in a number of profiled mathematics classes in other general secondary schools.

The unfavourable economic situation in Bulgaria and the frequent changes of government until 1997 had much to do with the fact that little attention was paid on a national scale to the acquisition of hardware and software, and the corresponding changes in the curriculum. For the whole period after 1990, Bulgaria did not have a substantial national program regarding its education system's ICT-related needs and priorities. This situation heavily affected the levels of hardware and software in the school systems, which were left to rely on resources procured through funds raised by the respective maintaining municipalities. Opportunities to introduce new curriculum elements and approaches were restricted, as were teachers' opportunities to receive in-service training in ICT or to update these skills of their own volition. The economic restraints of this period meant that large differences occurred in the ways that the different municipalities managed to cope with these problems.

Today, many schools have managed to acquire newer equipment and software. In addition, Bulgaria now has in place legislative, curriculum, program, and methodological policies (introduced at the central level) aimed at equipping schools with adequate ICT resources. Despite these developments, the country's school system generally still suffers from a lack of ICT equipment, software, and trained teachers. The integration of ICT in other subjects is still rather sporadic, and there is a substantial skills shortage among teachers of these subjects.

In 1998 a centrally developed ICT curriculum was made available at the elementary school level. The curriculum consists of two programs of study, comprising the above-mentioned nine modules, which can easily and flexibly be adapted by the teachers themselves. Some of the modules are compulsory, while the rest are optional. The curriculum aims, through the use of ICT in a variety of day-to-day regular classroom activities, to stimulate students' creativity and self-expression. The focus is not on ICT as a subject and tool *per se*. Rather, the acquisition of ICT skills is seen mainly within the context of creating and doing interesting things. The only computers that can be used for this curriculum are those with a graphic interface, preferably a multimedia one. Schools also can use a Bulgarian version of the Commenius Logo environment when working within this curriculum.

As of 1998, elementary school students also have had access to another optional curriculum that uses the same approach as the curriculum just described. This second curriculum consists of a number of modules that can be embedded within the framework of the subject application skills.

The start of the school year 1999/2000 saw the adoption of a new, more de-centralized school curriculum. Available during its first year only to Grade 9 level, this curriculum will gradually spread to all school grades. The curriculum requires that about 55% of secondary school time is spent on the concrete school choice, with the remaining 45% spent on compulsory subjects and hours per subject so as to fulfill the required state educational minimum standards. The compulsory part of the secondary school curriculum contains two ICT-related subjects. These are informatics in Grade 9 (with 72 study hours each year) and IT (which has a more pragmatic/application orientation) in Grades 9 and 10 (36 study hours per year). Each school has the right to add, throughout the whole secondary level, more study hours to these subjects.

T E NATIONAL EDUCATIONAL STRATEG ON ICT[1]

In 1997 a survey of secondary schools and a comprehensive analysis were conducted on the use and integration of ICT in education. Based on the conclusions and recommendations resulting from this project, the Ministry of Education and Science formed a strategy group to design and develop a national educational strategy on ICT in school education. The group comprised representatives from the educational system and the fields of science, business, and industry, as well as different social partners. The strategy was developed and adopted by the ministry in the summer of 1998. It outlined the developments needed with respect to the infrastructure (hardware, software, networking, school infrastructure), curriculum, teacher training (pre- and in-service), organization and financing, social partner involvement, and legislation. During the 1998/1999 school year, a program to implement the national strategy was drafted, and different possibilities and sources of funding were explored.[2] In August 1999, the Minister of Education approved the program and fundraising began.

The program envisaged the provision of multimedia equipment and software to all schools in the country on a gradual basis, and ensuring that staff receive adequate training. The program will run for six years. Stage 1 (one year of duration) involves equipping all secondary schools and 10% of the elementary and the basic schools. Stage 2 involves equipping 40% of the elementary and 50% of the basic schools, while Stage 3 will see all remaining schools equipped. Corresponding changes in the legislation and the curriculum to facilitate these developments will also be made. The program also aims to provide all schools with network and Internet connections, a steady penetration of ICT into all subjects, and appropriate training for the different subject teachers in ICT usage and ways of integrating ICT in the teaching of their subjects. These aims all have to be accomplished in line with the changes undertaken in the whole school curriculum and as part of the school reform process.

One pleasing initial realisation of these aims occurred in August 1999 when the Bulgarian Ministry of Education and Science and the Microsoft Corporation signed a general agreement that allows the Bulgarian education system to license existing software and to acquire new MS-software on a preferential basis. Problems relating to generic-type software thus have been radically resolved on a national scale.

1 An abridged version in English of the National Educational Strategy on ICT can be found at: http://www.minedu.government.bg/ict_project.htm

2 The full text of this program is available in Bulgarian at: http://www.minedu.government.bg/ICT Programme1.htm

CANADA

R Lortie and R ones

INTRODUCTION

Canada includes 10 provinces and three territories in a federal political system. The administration of education is under provincial or territorial jurisdiction. Each province and territory has full power to determine the structure of its education system. Similarities exist between these different structures throughout Canada, but various distinctive features at the provincial level allow for better responses to regional differences in a country with many cultural and historical heritages.

A common feature of Canada's education system is that all provinces and territories have a ministry or department of education that is responsible for elementary and secondary schooling. Public schools are free and accessible to all Canadians until the end of secondary education, that is, until approximately 17 years of age. Theoretically, students are required to stay in school until age 16 in most jurisdictions. Private schools offer Canadian households an alternative, but must meet the general criteria set out by the provincial or territorial authority.

The provincial and territorial educational authorities in turn delegate considerable decision-making power to school boards (at the local level), whose members are elected. School boards generally have authority with respect to:

- applying curricula;
- managing the school system;
- acquisitions that require financial resources;
- initiatives and proposals for new construction;
- major expenditures;
- the assignment of responsibilities to staff.

PRO INCIAL POLICIES FOR T E INTEGRATION AND USE OF ICT

Each province has its own plan for the integration of ICT.

New Brunswick (http://www.gov/nb.ca/education) is pursuing its action plan entitled 'Strategy for the Integration of Technology in Public Education in New Brunswick' to give students and educators access to ICT and to strengthen competencies in applying ICT.

Prince Edward Island's (http://www.gov.pe.ca/educ) 'Education Communication Technology' project is part of a broader action plan that aims to provide teachers and students with access to email and the World Wide Web (WWW). It is focusing on integrating technologies into programs and services, forming partnerships with the private sector, and training teachers.

The Nova Scotia (http://www.ednet.ns.ca) Department of Education and Culture has also developed a vision for the use of the new information technologies. This vision is set out in the document *Vision and Learning Outcomes for the Integration of Information Technology within the Nova Scotia Public School Program.*

In the province of *Newfoundland and Labrador* (http://www.gov.nf.ca/edu/startedu.htm), the aim is to maintain and improve access to computers and the Internet in all elementary and secondary schools as a part of the Stem-Net project (based on a document entitled *A Curriculum Framework for Technology Education: living in a technology society.*)

In *Quebec* (http://www.meq.gouv.qc.ca), the integration and use of information and communication technologies is supported by a complete action plan[3] covering: (i) learning content for students and their instructors; (ii) computer equipment and instructional materials; (iii) communications and the information highway; and (iv) organisation, innovation, and research.

Since 1992, *Ontario* (http://www.edu.gov.on.ca) provincial policy has required school boards to prepare long-range plans for the integration of computers into the curriculum and to keep their plans up to date and available for inspection by the ministry as required. Provincial funding support for technology in education has been provided through initiatives such as an allocation to school boards based on the number of elementary and secondary students, the ongoing Ontario Software Acquisition Program through which the provincial government makes a single point software purchase on behalf of all schools, and special initiatives such as the Technology Incentive Partnership Program (TIPP), which provided seed funding during 1995–98 to encourage technological innovation and school board and private sector partnerships.

In *Manitoba* (http://www.mb.ca/educate/main/index.html), the Department of Education and Training in recent years has launched ambitious initiatives for renewal in its sector. The department targeted the use of learning technologies to improve access to education programs, facilitate co-operation, give students more choices, and provide exciting learning opportunities economically. Additional objectives included revitalising educational and training programs so that they better respond to changing markets and the impact of new technologies.

Saskatchewan's (http://www.gov.sk.ca/govt/educ) action framework shows the importance of providing fair, flexible support and the means for training those involved. In addition to being present, the support available must allow for the acquisition of the technological knowledge relevant to today's knowledge-based society.

The *Alberta* (http://ednet.edc.gov.ab.ca) government recognises the need to participate actively in the integration of ICT; its action plan calls for clear learning objectives and reviewing educational programs. By the year 2000, Alberta had spent important financial resources modernising computer equipment in the schools and promoting the use of technology.

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3 *Les technologies de l'information et de la communication, Plan d'intervention, Éducation préscolaire, enseignement primaire et secondaire: formation générales des jeunes et des adultes.*

In 1995, *British Columbia* (http://www.bced.gov.bc.ca) adopted a five-year plan[4] for integrating new technologies in education. The plan's aims have been to promote and/or develop (i) greater availability of technological resources and learning materials for both teachers and students; (ii) stronger partnerships between the provincial government and the private sector; (iii) improved electronic links between schools; and (iv) an improved basis for the integration of information technologies with overall learning throughout the province.

An electronic network, first set up in 1998, will link all the communities in the *Northwest Territories* (http://siksik.learnet.nt.ca/ece/default.html). The Department of Education, Culture, and Employment is one of the main partners helping to fund the operating costs of this communications network, from which the department will launch a series of applications to facilitate the delivery of education programs.

The *Yukon* (http://www.gov.yk.ca/depts/education) Department of Education is concentrating on several essential activities, including the support of new and ground-breaking education programs for people of all ages: socio-psychological assistance, early intervention, remedial reading, literacy, distance education, and Internet access. In both the Yukon and the Northwest Territories, there are task forces for establishing complete frameworks for the integration of new technologies, in active cooperation with other provinces and the federal government.

The territory of *Nunavut* is brand new, having acquired territorial status on 1 April 1999. Agreements between the Northwest Territories and Nunavut currently govern the details of Nunavut's education system.

FEDERAL AND NATIONAL POLICIES AND PRACTICES FOR T E INTEGRATION AND T E USE OF ICT[5]

The Canadian government also participates actively with the provinces and territories through federal initiatives and in cooperation with the Council of Ministers of Education, Canada (CMEC) (http://www.cmec.ca) in giving a common vision.[6]

Through the CMEC, Canada's various provinces and territories have adopted a grid of Canada-wide priorities in the sphere of information and communication technologies.[7] They are emphasising the following:

1. The development of a common vision of information technologies in Canada to complement vision statements of the provinces and territories.

4 *Technology in BC Schools 1995–2000: school technology plan.*

5 The following section reviews the main federal initiatives for the integration and use of new information and communication technologies, although it does not provide a complete list of all existing initiatives.

6 The ministers of education felt the need to have a common tool for cooperation, participation, and communication. The CMEC was therefore created in 1967 to speak on behalf of education in Canada.

7 Council of Ministers of Education, Canada (1997) *Developments in Information Technology in Education.* Document prepared for the Commonwealth Education Ministers, Botswana, 1997.

2. The development of a strategic plan that will identify the potential benefits of a collaborative approach and determine priorities for CMEC action (taking into consideration current and planned initiatives).
3. A review of teacher education, including a review of current pre-service and in-service training for teachers in the area of information technologies, and the development of a comprehensive overview of practices and policies in each jurisdiction.
4. A framework for learning outcomes for students, under the leadership of Alberta in the west and Nova Scotia in the east, that defines key learning outcomes related to information technologies for the end of Grades 3, 6, 9, and 12.
5. The provision of examples of learning activities that illustrate ways to achieve certain specific outcomes.
6. Consideration of the feasibility of establishing a consultative mechanism on information technologies for life-long learning (such a mechanism would be an ongoing venue to facilitate the resolution of policy issues pertaining to technologies and life-long learning).

There are also a number of Canada-wide initiatives designed to accelerate our transition to a knowledge-based society. *Canada On-Line, Canada's SchoolNet*, and the *Computers for Schools* program are Industry Canada projects that fit into a broader plan for renewal entitled 'Connecting Canadians'. Indeed, connecting Canadians is one of the five strategic objectives of Industry Canada under the Employment and Growth Program.

There are many details about provincial, national, and federal programs that are impossible to summarise in this restricted description. In order to obtain a better summary of these details, it is advisable to consult the web site of each province. These sites can be found at Industry Canada's SchoolNet web site, www.canadaschoolnet/ind/ca. They can also be found at the web site for the Canadian Education Association, www.acea.can.

C INA ONG ONG

N Law

ICT IN EDUCATION A RE IEW OF DE ELOP ENTS

Computers were first introduced (at the beginning of the 1980s) to Hong Kong schools as a distinct school subject, 'computer studies', at the secondary 4 and 5 levels. Since then, a variety of computer subjects have been developed for the junior secondary and the pre-university levels. Despite the early introduction, the use of information technology in the school curriculum was, until 1997, confined mainly to the secondary level. Here, the study of computer subjects covered three major areas: computer systems, information processing, and programming. This situation contrasts starkly with the relatively high home penetration rate of personal computers of 34%, a figure that is comparable to that of other advanced economies like Japan, Singapore, and the United States.

In his 1997 inaugural policy address, the chief executive of the HKSAR, the Hon. Tung Chee Hwa, pledged to make Hong Kong 'a leader, not a follower, in the information world of tomorrow'. Since then, the government has announced a series of initiatives to apply IT in teaching and learning across the curriculum in both secondary and primary schools. These initiatives include the provision of about 65,000 computers for primary and secondary schools, the provision of over 45,000 training places for teachers, the introduction of a pilot scheme in 10 primary and 10 secondary schools, and an examination of the feasibility of an education-specific Intranet. Expenditure on this program has amounted to US$370M in capital cost and US$33.3M in annual recurrent cost.

In his 1998 policy address, the chief executive announced a further set of initiatives that included providing IT coordinators for 250 schools, enhancing technical support for all schools, and providing a grant for schools to make available computer facilities for use by students after school hours. These measures will incur an additional capital cost of US$42.8M and an annual recurrent cost of US$37.8M.

In June 1998, the government issued a document titled *Information Technology for Quality Education: five-year strategy 1998/99 to 2002/03*, and it called for two months' public consultation on its content. A total of 85 written submissions were received; other submissions were made through the media. In the light of these inputs, the government published a final policy document in November 1998. *Information Technology for Learning in a New Era: five-year strategy 1998/99 to 2002/03* (hereafter referred to as the Strategy) details the government's vision regarding ICT and its strategies to implement these technologies.

POLIC GOALS, ISION, AND TARGETS

The main rationale behind the urgent need to promote IT use in teaching and learning is that students must be able to meet the changing needs of the Information Age, which has arisen because of the exponential growth in the use of ICT in everyday life and society at large. Schools therefore must address the following goals: ensure that students understand the pervasive impact of IT on society and their daily lives; provide students with opportunities to develop their higher order thinking skills; and equip students with the skills needed to seek, evaluate, organize, and present information.

If the vision of promoting IT in education is to be realized, then it will be necessary to induce fundamental changes in the role and functions of schools, teachers, and students. Technology is seen as an important catalyst for the following: (i) turning schools into dynamic and innovative institutions where students can become more motivated, inquisitive, and creative learners; (ii) linking students into the vast networked world of knowledge and information so that they can acquire a broad knowledge base and a global outlook; (iii) developing in students capabilities to process information effectively and efficiently; and (iv) developing in students the attitudes and capabilities needed to achieve independent life-long learning.

In 1997, the government set two specific targets: first, that within five years, at least 25% of the teaching and learning within the school curriculum would be supported through IT; and second, that within 10 years, all teachers and secondary 5 graduates would be competent in using IT tools.

ey Com onents of the Strategy

The government's five-year Strategy identifies four key components:

1. *Ensuring access and connectivity so as to provide students with adequate and equitable access to IT facilities and access to information worldwide.* In line with the aim of providing schools, teachers, and students with a sufficient level of hardware and network access, the Strategy envisaged that by the school year 1999/2000 all primary schools would have, on average, 40 computers for use in teaching and learning, and the library, staff rooms, and computer-assisted rooms would be linked up by a Local Area Network with Internet access. In regard to secondary schools, the Strategy envisaged that these would have, on average, 82 computers for the teaching of various subjects, and that the library, staff rooms, and computer-assisted rooms would be linked up by a Local Area Network with Internet access. It was also expected that about 100 schools (approximately 21% of secondary schools) would be further equipped with a multimedia learning center, and that measures would be taken to ensure that less privileged students would have access to computers outside of the normal school hours. In addition, funding has been allocated to extend Internet access and individual email accounts for the entire student population in 350 secondary and primary schools.
2. *Providing teachers with opportunities to learn how to make use of IT in their teaching.* The Strategy defines four levels of competence in educational use of IT for principals and teachers. The first level, termed a 'basic' level, includes basic skills in general computer operations, word-processing, Internet surfing, and operating general educational software. The second level, termed 'comfortable', includes capability to make use of resources available through facilities like the Internet and Intranet in classroom teaching and lesson preparation. The third level, known as a 'competent' level, includes capability to handle computer networking, resolve simple hardware/software problems, and make use of authorware tools for lesson preparation. The fourth level, called a 'creative' level, includes the capability to design IT-based instructional materials, evaluate educational software, choose appropriate IT equipment to meet the school's needs, advise colleagues on a wide range of matters related to the use of IT in teaching, promote an IT culture in the school, develop a school-based IT plan, and manage the school's IT system.
3. *Providing curriculum and resource support to reach the set target of having 25% of the school curriculum taught with the support of IT.* The Strategy interprets this target as focusing on 'how the delivery of the existing curriculum can be improved with the assistance of IT'. A comprehensive review of the school curriculum is currently being conducted. It is anticipated that IT will become a core competence for students and be comprehensively integrated into the new school curriculum. In addition, the Education Department has pledged to encourage and support teachers to develop innovative school-based IT curricula and to disseminate best practices emerging from the IT pilot scheme, which started in 1998. An Information Technology Resource Center has been set up to source and promote appropriate software to support teaching and learning in various subjects, and it also operates an education software preview library for access by teachers.

4. *Fostering the development of a community-wide culture of collaboration amongst all stakeholders within and outside the school sector.* The stakeholders include the heads of schools, teachers, students, parents, tertiary institutions, the business community, and community bodies, all working together to realize the vision for IT in education and to achieve the set targets.

C INESE TAIPEI

G F Chiou, C C Wu, and Lin

Two major forces have been driving the development of ICT in education in Chinese Taipei. These are: (i) the inclusion of 'computing' as an independent subject in K–12 curricula; and (ii) the launching of a series of full-scale projects funded by the government.

All K–12 schools in Chinese Taipei function with a centralized system and are required to offer computer courses and adhere to the guidelines established by the Ministry of Education (MOE) when implementing these courses. The courses are intended to provide equal access to computers by all students, especially for those in less economically developed rural areas. The courses also serve to prepare students with the necessary knowledge and skills to use computers in other subjects. The curriculum guidelines state clearly the objectives for the computer courses offered at each school level, descriptions of which follow.

Elementary schools (Grades K–6): The objectives are to foster students' interest in the use of computers and their understanding of the impacts of computers on their daily lives. At present 'computing' is not an independent subject in the elementary curriculum. Instead, preliminary computer knowledge and skills are introduced as one of the optional topics in a subject called 'group activities' that is offered to Grades 3–6 students.

Junior high schools (Grades 7–9): The objectives are to teach students basic skills in computer application and foster students' positive attitudes towards the use of computers.[8] Computing is currently an independent subject at the junior high school level. It is a one-credit, four-semester course that all eighth and ninth graders are required to take.

Senior high schools (Grades 10–12): The objectives are to cultivate students' abilities to use computers in problem solving and to provide a brief introduction to the discipline of computer science.[9] This two-credit, two-semester course is offered as an elective to Grades 10–11 students in ordinary high schools but is a required course for students in vocational high schools.

It is worth mentioning that the MOE is initiating a reform of K–9 curricula, which aims to cut down the total number of K–9 subjects. What is currently being proposed is to combine existing subjects into a total of seven major areas. For example, the subjects of history,

8 Chiou, G.-F. and Wu, C.-C. (1996) A computer curriculum guideline for junior high schools in Chinese Taipei: its impacts and issues. *Proceedings of National Educational Computing Conference 1996.* Minneapolis, MN, pp80–87. (Republished by *ACM SIGCUE Outlook, 25*(1,2), 1997, pp21–29. Eugene, OR: International Society for Technology in Education-ISTE.)

9 Wu, C.-C., Lin, J. M.-C., and Ho, R.-G. (1997) A new computer guideline for senior high schools in Chinese Taipei. *Proceedings of the Fourteenth International Conference on Technology and Education, Oslo, Norway* (Vol. 1) (pp25–27). Arlington, TX: International Conference on Technology and Education.

geography, and civics will be combined to form a new area called social studies. Integrating computers into the seven major subject areas is one of the main themes in the reform.

The MOE takes responsibility for providing the necessary resources to ensure successful implementation of the computer curriculum at K–12 public schools. Specifically, each school will be equipped with adequate hardware and software in their computer laboratories and will be offered a variety of in-service teacher-training programs. The MOE will continue to review and endorse well-written textbooks for use in computer courses. The newly purchased PCs for the computer labs must meet the hardware specifications set out by the MOE, and they must be networked and connected to the Internet. The government will continue to fund schools so as to achieve the goal of at least one computer laboratory for every 40 classes at the elementary school level and at least one laboratory for every 35 classes at the junior high school level.

The Chinese Taipei government has also organized committees to draw up special plans to promote ICT in education. A particularly important plan is the IT Education Infrastructure Plan (ITEIP) that was initiated in 1996. The MOE had, up until that year, funded several projects to foster broad participation in Chinese Taipei's National Information Infrastructure by K–12 school teachers and students. The projects included, among others, 'Email to K–9 Schools', 'Improving K–12 IT in Instruction', and 'Development and Diffusion of CAI Software'. With these projects integrated into it, the ITEIP established guidelines for all aspects of ICT in education for the 10-year period from July 1996 through June 2006, with the ultimate goals of improving ICT literacy among the Chinese Taipei people and maintaining a competitive edge for Chinese Taipei in the world.

ITEIP also has a number of sub-goals:

1. *Enriching ICT instructional resources:* A government-funded National Educational Resources Center (NERC) has been established to collect useful educational resources for teachers of all K–12 subjects.[10] In addition, incentives will be provided to publishers and software companies who actively participate in this effort.
2. *Improving instructional methods:* The MOE and the National Science Council (NSC) will grant more funds for research related to the integration of ICT into the instruction of all subjects. The aim is to increase the effectiveness of classroom instruction.
3. *Enhancing teacher training:* An increasing number of in-service training programs will be offered to K–12 teachers to ensure that all teachers are ICT literate.
4. *Adjusting the organizational structure:* The emphasis of ICT in school education demands some corresponding changes in the organizational structure of schools. The short-term approach will be to expand the functions of school libraries so that they can take on the role of instructional resource centers.
5. *Upgrading computer equipment:* Every school is to have at least one computer laboratory that meets the minimum hardware specifications set by the MOE.
6. *Extending accessibility of the Chinese Taipei Academic Network (TANet):* All levels of schools (including colleges and universities) are to have access to TANet.

7. *ICT literacy for all:* All junior high school students are to acquire basic ICT skills, and all elementary students are to be given opportunities to learn in an ICT-rich instructional environment.

During 1999 the government provided a special fund of US$200M to speed up the implementation of ITEIP. It was expected that by the end of 1999 all K–12 schools would have well-equipped computer laboratories, and that all computers in these laboratories would be connected to the Internet. Furthermore, it was anticipated that all teachers would have been offered training opportunities in the use of network communication tools, the operational skills of common application software, and the integration of computer-assisted instruction software into classroom teaching. It was also expected that an abundance of instructional resources would be available to allow teachers fast and free access, and that computer systems in all schools would be made accessible for students with disabilities.

C PRUS

C Pa anastasiou

The public educational system of Cyprus is highly centralized and has four levels—pre-primary, primary, secondary, and higher. The general philosophy underlying public education is two-fold: (i) the dissemination of knowledge with an emphasis on general education; and (ii) a gradual transition to specialization in order to prepare students for an academic, professional, or business career. The policy of the educational system regarding ICT varies in primary, secondary junior (gymnasium), and secondary higher (lyceum) schools. Children begin their primary education at the age of 5.8 years and leave when they have completed the prescribed six-year course. In gymnasia, entrance is open (there are no examinations) to all primary school-leavers. The gymnasium comprises three grades, 7–9, and the emphasis is on general subjects and the humanities. The lyceum comprises the last three grades of secondary education. Lyceum students can choose one of the five main fields of specialization—classical, science, economics, commercial/secretarial, and foreign languages.

In the year 1996/1997, there was, across all levels of education in Cyprus, a total of 1,207 schools, 162,498 students and 12,275 teachers, giving a student:teacher ratio of 13.2:1. The enrollment figures for students by level were as follows: pre-primary 25,996, primary 64,761, secondary 61,266, third (that is, university/college) 9,982, and special education 493. The cost per student for public schools in terms of current expenditure was 785 Cyprus pounds (1CYP=1.71Euro) for pre-primary, 881 pounds for primary, 1,514 pounds for secondary general, 2,541 pounds for technical/vocational, 2,398 pounds for third-level non-university education, and 4,135 pounds for university. Expenditures across all levels of education accounted for 12.9% of the country's budget and 4.5% of the Gross National Product.

PRI AR SC OOL

In September 1993 the Department of Primary Education launched a pilot program aimed at introducing ICT into primary education. The basic objective of this program is to investigate the possibility of using computers and other information technology media as teaching and learning aids in the primary school, as well as to discover the most appropriate ways of implementing ICT in the primary sector of education. Within the framework of this program, ICT is viewed not as a separate subject but as a dynamic means of teaching and learning, of reinforcing the curriculum, and of developing children's basic skills of concentration and processing and presenting information.

According to globally accepted views on ICT in education, the computer is introduced into the classroom for the following reasons:

- to upgrade the quality and efficiency of 'traditional' teaching;
- to help motivate students to participate in the learning process;
- to equip people with the skills necessary to ensure that computers are used to implement productive learning.

Throughout Cyprus, computers are available in 32 primary schools. The Ministry of Education and Culture has provided these schools with 128 computers, 36 color printers, and a number of educational software programs. At the time of writing, the budget provided for increasing the number of computers in these schools to 58. Some of these schools have a special computer room, while others have computers installed in their classrooms.

Over the next few years a new program will aim to provide one computer for every 15 primary school students. Moreover, the intention is for the program to cover all of the country's primary schools. The program for the introduction and use of computers in primary school involves teachers with relevant qualifications, as well as teachers who have attended or are currently attending in-service training seminars at the Pedagogical Institute.

The relevant budgeted expense allotted to primary education is about 45,000 Cyprus pounds annually.

G NASIA

ICT as a separate subject is not taught in any of the three gymnasium grades. However, for the subject of design and technology, one computer has been installed in every workshop. Also, the subject of home economics has seen one computer with a color printer installed in each of 10 gymnasia.

L CEU S

Systematic use of the computer as a tool in subjects like typing and physics is already commonplace in the lyceums. Furthermore, there is the possibility of using ICT for the other subjects of the curriculum, given suitable hardware and software support. However, the focus of official policy is not on the issue of software/hardware/in-service training in ICT. Rather, it is on changing the underlying philosophy and mentality regarding the role of education, particularly in terms of aims and, more generally, in relation to curricula and content.

For Grade 10, ICT is taught as a separate subject for one period per week, in a special computer room that usually houses about 16 computers, in a ratio of two students to one machine. For Grades 11 and 12, ICT is offered as an elective subject (except in commercial/ secretarial, where it is not available). It covers two periods per week, and the lessons take place in a special computer room, which usually contains about 16 computers, in a ratio of one student to one machine.

T E C EC REPUBLIC

I ri o a and Tomase

BEGINNINGS OF ICT EDUCATION IN T E C EC REPUBLIC

Until 1986 the subject 'informatics and computer sciences' (ICS) was taught only experimentally within mathematics in a small number of schools. In 1986 the ICS was officially established in all secondary schools as an independent subject with its own curriculum.

Secondary general schools and some technical schools (especially those focused on electro-technology) had been equipped with 8-bits computers of Czech production, connected to a tape-recorder. ICS was taught two hours per week within the first two years of secondary studies, and the curriculum covered especially two fields—*algorithms*, based on everyday life tasks, *and basic programming* (in Basic or Charles languages).

At the elementary school level, about 10 experimental schools with an extended curriculum in mathematics were chosen to provide ICT education in the same way as secondary schools. ICS became a part of their mathematics curriculum. In addition to receiving instruction in algorithms and programming, students also had access to some simple drill and practice software and games.

In 1988 new 16-bits computers were developed in the Czech Republic, and these replaced the older ones in secondary schools. Diskette mechanics replaced the tape-recorder memory. (The older 8-bits computers were assigned to the elementary schools.) The curriculum shifted towards an application principle, and the schools started to orient ICS toward the teaching of applications such as word-processing and spreadsheets. Educational software (generally very simple testing and examining software) was also developed.

ICT EDUCATION AFTER

After 1989 the Czech market opened up to international trade, which enabled a mass import of PCs from abroad and the subsequent widespread equipping of schools with computers. Despite this significant improvement, educational practice regarding ICT showed little change.

Any form of official policy regarding ICT did not exist before 1989. Today, there is still no overall concept on ICT education, and ICT is only marginally mentioned in the official school standard of the Ministry of Education.

Primary and Lower Secondary Education

The 'Standard for Elementary Education' (for basic schools), approved in 1995, shows that ICT does not exist as an independent subject at the level of primary and lower secondary education. Students at the primary level receive no ICT education.

ICT is included in one of the seven domains of the lower secondary standard, namely, the 'manual activities and technologies'. In this domain, ICT has a place next to subjects like floriculture, home economy, and craftwork. The aim of ICT education is, according to the standard, to teach students how to use the appropriate instruments and facilities for various activities, as well as enabling them to work with accessible technologies, including computer technologies, at a basic user level. In the lower secondary level of those basic schools equipped with an appropriate number of computers, students can choose ICT as an elective subject. In such instances, ICT is taught for one to two hours per week at Grades 7–9, with students learning mainly keyboarding and word-processing skills. Students also are allowed to make use of the computers outside these lessons.

Those elementary schools interested in expanding their ICT education meet serious problems connected with financing the acquisition of computer equipment. Although many of them replaced the earlier 8-bits computers with 16-bits ones, the possibility of further improving the equipment situation is very limited. Because the teaching of ICT has never become a compulsory subject, the Ministry of Education does not pressure schools to make improvements, nor does it help them do so. All initiatives in this area are therefore completely up to the heads of the schools.

U er Secondary Education

In the upper secondary schools, ICT is generally represented as an independent compulsory subject that is taught two hours per week for one school year (or one hour per week for two school years). In addition, ICT and some related subjects can also be taught as elective or non-compulsory subjects, depending on the possibilities available to the schools and on the level of student interest.

Usually, there is one computer classroom at each school. In most instances, these classrooms are utilized solely for ICT lessons, which means that usually there is no space for using computers in other school subjects. Computers in these classrooms are interconnected in a local network. Most of the secondary schools in the Czech Republic are also connected to Internet. However, computing lessons always focus on user software and informatics, and the external network is rarely used for obtaining information relevant to other subjects.

In the 'Standard for Secondary General Education', approved in 1996, ICT education in secondary general schools is included in 'mathematics and computer technologies', which is one of the six main educational domains in secondary general schools. The specific goals of ICT education focus on learning about informatics and its importance in general; learning to orient oneself in a world of information; working with ICT and applying it; and developing algorithmic thinking. The emphasis is on the practical in that students learn how to use the computer as a tool. They learn desktop publishing and how to establish a connection with information institutions. They learn about hardware, software, and operating systems, and they acquire the bases of both lower and upper programming languages. They also learn word-processing and spreadsheeting, setting up and using databases, and utilizing multimedia systems and computer networks.

The 'Standard for Secondary Technical Education', approved in 1997, determines the ICT-related knowledge and skills to be provided by the secondary technical schools. The skills concerning applications of information technologies belong to one of the five areas of a graduate's key skills. According to the standard, these skills focus on word-processor applications. They also focus on working with special software appropriate for a given profession and with common information sources, especially those used in a given profession. The ICT curriculum in some secondary technical schools (especially those focused on electrotechnology) is considerably more advanced than the curriculum in other such schools. Graduates from the schools are expected to meet far more demanding requirements, such as applying professional graphical systems like CAD and CAM.

E PECTATIONS FOR T E FUTURE

To date, the Ministry of Education has treated ICT education and ICT in education as part of the educational standards articles. A specific policy has yet to be formulated, and a vision on ICT in education has yet to be developed. Nevertheless, a new educational concept on this area is being prepared, and it is expected that this policy will be strongly oriented towards everyday applications.

DEN AR

D Pedersen

POLICIES ON ICT IN EDUCATION

The basis of the Danish ICT policy is that the Information Society is a society for everybody, and that citizens should not be divided in 'A-teams' and 'B-teams' on the basis of their ICT-related knowledge and skills. The vision for ICT in education is to ensure ICT qualifications for all during their education, and that these qualifications accord with their expected future needs as citizens and members of the workforce. The ambition of the government is that the Danish education system is among the five to 10 best in the world in terms of the teaching and learning of ICT.[11]

The Danish strategy for an ICT-policy in the education system began in 1994 when the Danish Ministry of Research and Information Technology issued the report, *Info-Society Year 2000*.[12] The report's recommendations initiated a range of memoranda and programs designed to realize the aims of this policy. The recommendations, with their focus on

11 Ministry of Education (1998) *ICT in the Education System: action programme 1998–2003* (Informations og kommunikationsteknologi i uddannelsessystemet: handlingsplan 1998–2003). Copenhagen: Ministry of Education.

12 Ministry of Research and Information Technology (1994) *Info-Society Year 2000: report from the 'nformation-Society Year 2000'* (Informationssamfundet år 2000. Rapport fra udvalget om 'informationssamfundet år 2000'). Copenhagen: Ministry of Research and Information Technology.

technological infrastructure, management and organization, staff development and curriculum, clearly resemble the theoretical framework for SITES Module-1.

ICT POLICIES REGARDING T E TEC NOLOGICAL INFRASTRUCTURE

The official intention is to integrate ICT as a fourth culture technique, on a level with reading, writing, and arithmetic in basic schools. Realization of this aim begins, in principle, in the first grade (six- to seven-year-olds) and requires policies that ensure students have access within their schools to hardware, software, and communication networks.

Hardware: The goal here is to achieve a ratio of one computer (of less than five years old) for every (maximum) 10 students by the year 2003.[13] To this end, the government gave the municipalities an extra grant of DKK89M in 1996–1997.[14] Since 1999, there have been annual surveys of the state of ICT equipment at all educational institutions (geographic ICT charts).

Software: Here, the initiatives have focused on:

1. The establishment (in 1988) of Orfeus, an organization that develops educational software and programs.
2. The development, as a priority, of ICT-based education and the materials needed to support teaching of ICT at all levels of the educational system. A special focus in this regard is to support the learning of weak groups of students by focusing on their individual needs.

Communication: The goal is to connect all educational institutions to the Danish network of educational institutions Sectornet (Sektornet). DKK180M was allocated to connect basic schools to Sectornet over a four-year period,[15] and it was expected that 75% of the basic schools would be connected by the end of 2000.[16]

To ensure admittance to cheap and quick net connections between the educational institutions and the workplace at home, the Ministry of Education will monitor this field.

ICT POLICIES REGARDING ORGANI ATION AND ANAGE ENT

Many efforts have been made to inform people within the educational system of the implementation program for ICT and to ease them into it. Some of the major ones are:

- *The Danish National Center for Technology-Supported Learning (Center for Teknologistøttet Uddannelse (CTU)):* The center plays a support role in helping educational institutions ready themselves for the introduction of ICT hardware and software. It also collects and circulates ICT-related information for adult education, youth education, and higher

13 Ministry of Research and Information Technology (1997) 'ICT in figures 1997: 19 pictures of the INFO-society' (enclosure to ICT political report) ('IT i tal 1997: 19 billeder af Infosamfundet' (Bilag til IT-politisk redegørelse)). Copenhagen: Ministry of Research and Information Technology.

14 Danish Board of Technology (1998) *Technology and Ground School: a challenge* (Informationsteknologi og folkeskolen - en udfordring), p12. Copenhagen: The Danish Board of Technology.

15 Ministry of Research and Information Technology (1997), op. cit.

16 Ibid.

education institutions. CTU was granted DKK10M over a four-year period.[17] Eventually, it will spend around DKK46.5M in its support of projects aimed at implementing ICT in the education system.

- *The Janus Project* (1995–1997): The project promoted knowledge of goal-oriented planning of ICT at school.
- *The Poseidon Program* (1997–1999): This program comprises 10 ICT vanguard institutions responsible for testing the tools and procedures needed for integrating ICT in schools.

Numerous publications, including strategic and action plans, have also been an important means of disseminating information. The most important ones are the Ministry of Education publications, *Information Technology and Education* (1997) and *Information and Communication Technology in the Education System: action program 1998–2003* (1998).

ICT POLICIES REGARDING STAFF DE ELOP ENT

The main goal here is that of turning teachers into ICT users, through teacher education and in-service training. A special aim until 2003 is the development of general and subject-specific ICT qualifications for teachers so that they can help students acquire ICT-related knowledge and skills.

Some of the teachers' in-service training is taking place through distance education. Since the beginning of 1999, teachers in basic schools have been able to undertake the basic ICT training program, 'School-ICT: the educational ICT-driving license'. Also, the CTU and the Danish government have granted about DKK10M for the implementation of *ICT and the Teachers: a strategy for ICT in teacher education and for further teacher and in-service education.*

POLICIES REGARDING T E CURRICULU

The Ministry of Education's five-year action program (1998–2003), 'Information and Communication Technology in the Education System', gives priority to defining, developing, and maintaining general ICT skills and competencies in the basic schools and in youth education. The program also provides guidelines regarding the general ICT skills and competencies to be implemented at the level of individual grades and in curriculum subjects.

One of the five high-priority areas in the report focuses on determining whether and to what extent ICT is important for the content, didactics, and methodology of these curriculum subjects. This area also seeks to determine the likely consequences that ICT integration will have for the organization of teaching and for the composition of subjects at different places in the education system. More specifically, a number of projects have been set up to look at the following:

- the importance of ICT for the kind and quality of education in Denmark;
- whether subjects as presently prescribed will continue to exist, or whether they will be incorporated into or replaced by new 'groups of knowledge, know-how and skills';

17 Ibid.

- whether it is possible to create a philosophical leitmotif regarding ICT that can be carried right through the Danish educational system.

In 1998, the government, recognizing the lack of knowledge regarding ICT-based educational and teaching methods, also agreed to undertake a national program of research so as to strengthen 'ICT-supported learning'. A related initiative involves developing methodologies to track the efficacy of ICT in education.

ISIONS FOR T E FUTURE

The government's 1998–2003 action plans also give priority to public distance education, so that all citizens can access a range of educational activities. The aim of the Danish education system is to be the main provider of new educational qualifications, which means that it will actively compete with the increasing number of private and foreign organizations presently offering educational qualifications. However, if students are to have equal and flexible access to life-long education, then priority must be given to allowing them to obtain grants to attend courses offered by other (not Danish) institutions, in situations where there is an insufficient number of courses in a subject area.

The Ministry of Education intends taking an increased role in coordinating research into and communicating knowledge about ICT in education in general and its implementation in education in particular. The establishment of one or more competence centers is under consideration. Finally, initiatives are being taken to ensure that ICT projects receive coordinated and systematic evaluation when they begin and end.

FINLAND

an aanranta and P Linna yl

T E SOCIET OF TO ORROW IS A NOWLEDGE SOCIET OF E UAL OPPORTUNITIES FOR ALL

During the 1990s the Finnish strategy was to develop ICT in education as part of its policy of building a Finnish information society. This has meant a nationwide effort to create possibilities for information and communication technologies to meet the diverse needs of people of different ages. Different sectors of government have carried out extensive preparatory work in this regard. In 1995, the government produced a position paper outlining its information society strategy, that of providing every citizen with opportunities to acquire the skills they will need to access the information mediated by new technology.[18] The paper challenged all administrative branches to prepare detailed action plans to implement the strategy.

The increasing importance of information and communication technologies is a consequence of the fact that processing information and constructing knowledge now play

18 In Finnish, the word *tieto* stands for both 'information' and 'knowledge'. This strategy addresses the more profound needs of the 'Knowledge Society' rather than the 'Information Society'. However, the latter is used in the strategy document because of its more universal usage.

a key role in developing different activities in society. The 1990s saw a transition from technological know-how toward the cultural application of 'contents'. In other words, the focus moved from issues related to hardware to the development of software and the content of information networks. The launching of the Finnish University Network (Funet) in the mid-1980s to secure links between universities and the international research community foreshadowed the exploding interest in the development and use of the Internet, and of mobile communication technologies, in the second half of this decade. Now we are seeing the emergence of such trends as the production of culturally adjusted content, user-orientation, and, above all, strategies to empower people and increase their quality of life.

T E INFOR ATION STRATEGIES OF T E INISTR OF EDUCATION

The Ministry of Education's information strategies focus on education, research, and culture. These strategies aim to provide institutions with modern information networks, and to provide schools at all levels with the opportunities to use these networks and the services offered by them. Libraries are also included in the development strategy, since they are crucial in providing services to everybody. The specific information strategies of the Ministry of Education are:

- The National Strategy on Education, Training, and Research (1995);
- Towards a Culture-Oriented Information Society (1996);
- The Information Strategy for Research and Education for the Years 2000–2004 (1999).

These strategies encourage citizens to face challenges arising in a changing society. The key elements are high-quality education and training, research, and culture, with opportunities for life-long learning.

The central goals of the 'National Strategy on Education, Training and Research' center on:

- moving from a 'once-and-for-all' training to life-long learning;
- providing basic Information Society skills for all;
- developing a high level of vocational skills among citizens;
- ensuring that teachers achieve a high level of professional skills;
- securing the development of information products and services;
- supporting multidisciplinary research on the Information Society;
- building education and research networks into an open global network.

The guiding principle of the strategy 'Towards a Culture-Oriented Information Society' (from the year 1996 on) has been to guarantee all citizens equal access to cultural services. The production of Finnish content in the new media is considered essential in realizing this aim, because it is a necessary part of developing user-centered technology. Furthermore, the production of new content and information services means increased employment opportunities in terms of both culture and technology. Another intention behind these measures is that of diminishing alienation and enhancing internationalization among the Finnish people. Encouraging the older generation and girls and women to use information technology is particularly important in this regard, and also points to the importance of developing learning-centered approaches that focus on collaboration, individual styles of learning, learning difficulties, alternative ways of learning, and multidisciplinary approaches to learning.

I PLE ENTATION OF NATIONAL INFOR ATION STRATEGIES

National information strategy goals have been implemented by helping educational establishments acquire the necessary infrastructure and develop technical networking between the schools. In addition to technological support, other concrete activities to achieve strategy goals have included further education for teachers, designing technologically enriched environments, and developing innovative learning and teaching materials.

At the beginning of 1996, the Ministry of Education launched a program called Information Finland. Implemented by the National Board of Education throughout 1996 through 1999, the program has helped schools and other educational institutes link in with international information networks, and it has promoted the introduction of information and communication technologies as tools for teaching and learning. It also has helped schools purchase computers and carry out in-service training for teachers in all types of schools in the Finnish education system. The program aimed to have all schools and other educational institutions connected to the networks by the year 2000, and for teachers to be using ICT-based tools in their teaching.

The aim of the in-service training program for teachers, called 'Finland as an Information Society', is to provide them 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. In order to promote this methodological development, various projects have been undertaken in 1999, relating particularly to sustained use of information technologies as a natural part of instruction. The program has also produced teaching and learning materials, and these are available on the Internet.

Access to information is one of the fundamental rights of all citizens. The public library system is therefore a core feature of Finnish cultural democracy. Every municipality has a public library, and these libraries form the basis of the right to information. The library system has been designed according to a networked model based on cooperation and shared responsibility. One of the main principles underpinning development of the public libraries is that of preventing citizens becoming alienated in the Information Society. Due to rapid adaptation of modern information technology, the country's public libraries are very up-to-date in telecommunications. In 1997, 90% of the public libraries had installed a computerized library system, and 60% of the main libraries now offer their clients Internet services.

FUTURE C ALLENGES

The ongoing, extraordinarily rapid development of ICT as well as of new media (for example, mobile communications, electronic books, and digital radio and TV broadcasts) provide novel means to serve Finland's diversifying educational needs. Even though the technological infrastructure in Finland is reasonably well developed, it still requires continuous building-up. In 1997, an assessment of the extent to which the strategy goals had been realized showed that they were still more or less on schedule. However, special emphasis is needed to develop the content and services of the information networks, and it is also crucial that even more attention is paid to teachers' basic training and continuing education.

The main aim of Finland's information strategies is for the country to develop an information society that enhances its citizens' quality of life. This essential shift from a formerly narrow (mechanistic) to a broader (qualitative) interpretation of the Information Society is necessary if education and schooling are to meet these challenges and opportunities (Lehtinen, 1998). The rapid construction of the Information Society, the genesis of a digital and global economy, and the development of media require substantial changes to the culture of work and professional competence. Thus, the Ministry of Education considers it essential to shift the emphasis of the implementation strategy to those factors that affect the lives of all citizens. In specific terms, the ministry wishes to:

- enhance the content and quality of the information available through the networks, with special attention being paid to the production of pedagogically useful materials;
- ensure that information services are readily available to all citizens, regardless of their qualifications;
- see a refocusing of teachers' basic and complementary education to meet the challenges of different teaching methods;
- promote extensive and multidisciplinary research in fields supporting the development of high-technology industries, in important issues in pedagogy and education (such as learning difficulties), and in social phenomena in a complex information society.

FRANCE

A Ser ant and C R gnier

ICT INITIATI ES

In 1985 and 1986, the Ministry of Education implemented two plans for stimulating the placement of information technology in the educational system. The results of this initiative were somewhat disappointing, because it seems that a number of conditional factors were insufficiently taken into account. For example, software could not be readily adapted to the needs of the schools and teachers lacked enough training. In 1989, a major education law was adopted requiring, as one of its major goals, that schools provide 'training adapted in its content and its methods to the economical, technological, social and cultural evolution of the country and to its European and international environment'. This law foresaw the placement of a 'teacher training university institute' in each académie.[19] One of the major tasks of these institutes would be training teachers to acquire competencies in the different techniques of communication and information. The law also called for 'reinforcing partnerships with enterprises' and improving the 'sharing of common technological means and equipment'.

19 The académie is an administrative educational unit. There are 30 of them in France.

Although these objectives were stated in the 1980s, they remain valid today. Current efforts are directed at realizing and using more appropriate ICT general conditions than existed 10 years ago. Certainly, official reports published in the early 1990s indicated that it would be important to focus on how to stimulate the use of computers, rather than to concentrate only on indicators like student:computer ratios. However, the reports also pointed to problems associated with the diversity of equipment that exists between schools, and the fact that teachers often perceive ICT as a time-consuming burden.

Insufficiencies were observed in terms of instructional use of ICT in 1996/1997, which led to the Ministry of Education seeking to effect improvements by 'constituting, together with local communities, a real pedagogical net of upper secondary, lower secondary and primary schools, open (through the possibilities of Internet) to the big international networks'. The ministry also acknowledged that schools would have to accept that knowledge can be acquired outside the school. Training courses for teachers are and will be organized at the national and regional levels. A number of policy measures have been put into place to develop the instructional use of ICT and to facilitate the production of high-quality pedagogical resources. The ministry furthermore stressed that the educational community would need to take into account the rapid developments within the multimedia market.

In November 1997, the government announced a set of policy goals and measures designed to address the concern of engaging France in the Information Society.

1. Each student, from pre-primary school up to the university, would have access, within a pedagogical framework, to digital and/or usual audiovisual resources.
2. Each student, each teacher, and each class would have an email address.
3. All necessary information (administrative and pedagogical) required by teachers would be available through a digital network.
4. A fund of about US$86M would be made available to support the efforts of local collectivities for improving the ICT infrastructure in schools.

The Ministry of Education subsequently incited software developers to 'propose specific and attractive offers for the schools'. (These offers are now public.) In regard to the development of the 'educational multimedia industry', the Ministry of Education financially supports the design and production of educational software (in 1998 this investment represented about one-quarter of private investments in educational multimedia). An agreement was signed in February 1998 with authors and production societies to waive royalty claims on pedagogically related products.

Teacher training concerns were addressed through two national initiatives in 1998. The first related to pre-service training. Here, an 'emergency plan' was implemented (with a budget of about US$10M) to support the teacher training university institutes. The second, relating to in-service training, saw implementation of specific training actions relating to ICT in education. The Minister of Education also signaled that distance education would, in the years to come, have a significant role in in-service training or as a complement to pre-service training.

These intentions are now firmly embedded in school programs, which are being reformed and modernized by a more systematic introduction of ICTs in the official texts. However, the Minister of Education has emphasized that the success in the field of ICT relies on them being truly integrated into the daily pedagogy, and that the educational community should not underestimate the difficulty of this process.

T E CURRENT SITUATION

Today, at the primary school level, ICT tools are not widespread, and the software that is available 'is often not well adapted to the learning methods of primary school pupils'. Moreover, teachers often are not sufficiently prepared to carry out their new role. At the lower secondary school level, it seems that the use of ICT is especially well-developed in the teaching of technology as a subject. Programs of other subjects are being progressively developed to incorporate ICT. At the upper secondary level, students in technological tracks are becoming practiced in the use of professional software. Students enrolled in vocational training are being given similar opportunities. Students in general upper secondary schooling have the option of studying 'computer science'.

In order to adapt more easily the use of pedagogical products to a use in the classroom, the Ministry of Education has launched calls for initiatives to identify projects involving teachers as well as enterprises liable to realize these projects. This program is provided with a little more than US$7M.

The number of computers per school and the number of computers per student are increasing. A comparison of the results of a national survey conducted in the fourth semester of 1998 with that of one conducted in 1997 provides the following ratios: in 1998, there was one computer for every 17.5 students in lower secondary schools, while in 1997 there was one computer for every 26 students. At the general and technological upper secondary schools, the ratios were one for every 7.3 students in 1998 and one for every 12 students in 1997. The vocational upper secondary schools had one computer for every five students in 1998 while the 1997 ratio was one for every eight. Similar comparisons are more difficult for primary schools, because the method that was used to calculate the ratios was not the same. In 1998, 79% of the primary schools were equipped with computers, but of these schools 29% had only one microcomputer, and this might not be used by students (1997 gave a ratio of 1.1 computer for every primary school). While it is possible from these figures to determine a ratio of one computer for 26 pupils in equipped primary schools, this figure is only theoretical. It should also be noted that only a small number of schools at this level have computers linked to an internal network.

The above ratios disguise the fact that the number of computers cited are not proportional to the size of the school, meaning that schools of bigger size are less well equipped, comparatively. It should also be pointed out that the quantity of equipment is not always related to its quality. The most recently equipped schools, for example, usually have more advanced computers. According to the survey, the location (rural, urban, and so on) of schools also plays a role regarding differences in the quantity and quality of equipment across schools.

In general, however, efforts to achieve connection to an internal network are noticeable. As of 1 May 1998, this aim had been achieved in 58% of lower secondary schools and 73% of general and technological upper secondary schools (compared to just under 33% for both types of schools in 1997) and 51% of vocational upper secondary schools (17% in 1997).

It is in terms of connection to the Internet that progress is most visible, at least for lower and upper secondary schools (connection appears to have been much slower in primary schools). According to the national survey conducted at the end of 1998, more than 85% of general and technological upper secondary schools, 61% of vocational upper secondary schools (68% of all upper secondary on 1 May 1998 and 30% in 1997), 53% of lower secondary schools (40% on 1 May 1998 and 10% in 1997), and 10.5% of primary schools (4.5% on 1 May 1998 and 1% in 1997) did have this connection available. However, this access appears limited to certain places or working spaces within the schools and to certain teachers or students. This situation highlights the need to ensure everyone in the schools has access to Internet, in parallel with the above-mentioned needs for connection to the internal network (which was the case in only 20% of the schools with access to Internet). It was expected that all secondary schools would have access to Internet by the end of 1999.

FUTURE PLANS

At the time of writing, it was envisaged that the next few years would be a process of consolidation. Ongoing efforts were being made to ensure that all students and teachers would have access, within a pedagogical framework, to ICT by the year 2000. It was thought likely that connection to Internet at the primary school level would be slower and more difficult to realize, but it was hoped that at least 50% of primary schools would have Internet connections by the end of 1999.

A considerable effort was being made at the national and regional levels to create web sites for information services that would allow all 'actors' involved in the educational process (including parents) to receive all necessary information regarding ICT-related tools (including the quality of those tools), projects, and official goals. This effort was also being made to allow as many contacts, collaboration projects, and innovations as possible. The decentralization of responsibilities in education that has been in process since 1982 in France has made this wide coordination between partners a necessity. Moreover, the French Ministry of Education has fully engaged itself in international cooperation in the field of new technologies in education.

UNGAR

I Banfi

EDUCATIONAL POLIC ISSUES

In Hungary, compulsory schooling begins at the age of six. Most primary schools (more than 90%) cover Grades 1 to 8, and most secondary schools cover Grades 9 to 12.

As early as 1984 a government program required every secondary school (and later the primary schools, as well) to have a microcomputer. One result of this was that the school principals together decided to begin teaching information technology. In 1998, information technology became an individual school subject, with every student in Grades 6 to 10 required to take at least one lesson in this area a week, so that he or she could acquire the basic knowledge needed to use information technology. The revision (from the beginning of the 1990s) of the curriculum for public education had already pointed to this development and suggested that schools would need to link into worldwide telecommunications networks. These measures were again highlighted in Hungary's National Information Strategy 1995 (which was based on the new education law of 1993).

In 1996, the Ministry of Culture and Education launched a large-scale information technology development program called 'School-net'. This program has given, from September 1998 onwards, every secondary school and secondary school student, along with about 250 primary schools, complete and free access to the Internet. The program has also, depending on the number of students, provided all schools with a multimedia computer room containing seven to 16 PCs (the number of PCs depends on the number of students in each school), each with the necessary software. The implementation of this program has been slower in primary than in secondary schools, and priority is being given to rural schools with modest financial resources.[20]

CURRICULU

Under the new educational law (1993, and the modified version of 1996), all schools (teachers) were required to develop a new school development plan based on the National Core Curriculum (NCC), which was issued by the government at the end of 1995. In September 1998, schools had to start teaching according to the new curriculum. The NCC describes only the minimum to be taught for every age group (a core curriculum); schools may add their own components to this. In order to support local curriculum development, the National Institute of Public Education created a curriculum databank comprising nearly 1,000 model curricula containing ideas, frameworks, and main considerations. The databank, available on the Internet, in the country's pedagogical institutes, and in 31 schools around the country, contains several types of curricula related to information technology.

INFRASTRUCTURE

In terms of hardware, Hungary's secondary schools are, thanks to the *School-net* program and previous ICT programs, tenders, and support agencies, adequately equipped for both teaching and using information technology and for access to the Internet. The Ministry of Culture and Education has also developed a few dozen multimedia packages for various subject areas, and provided these to schools free of charge. Schools also are able, through the Internet, to download free educational software developed in Hungary.

The situation is not so favorable in primary schools (attended by most of the 14-year-old students, the target population for SITES Module-1). Many schools possess only a few and

20 In Hungary there is a wide variety of educational institutions. The majority of the 14-year-old population assessed in SITES lies in the last grade of the eight-grade primary school while roughly 7–8% of them are in the six- or eight-grade secondary schools.

outdated PCs, a situation that makes information technology education difficult and the use of modern applications (for example, CD-ROMs and Internet) impossible. There are a few primary schools in villages where PCs are not available at all.

TEAC ER TRAINING

At present, there is a shortage of trained information technology teachers, especially in primary schools. Furthermore, most other teachers do not have sufficient skills to use PCs and the Internet in their own subjects. The government has given substantial support to the development and implementation of intensive teacher in-service programs, encompassing basic level user courses through to tertiary level degree courses in ICT in education. All such courses (in case accredited institutions or organizations offer them) are free for teachers. (Those who have already taken such a course can organize training for their teacher colleagues.) Those teachers who undertake tertiary level training (known as educational informatics teacher training) and then use the new technologies in their lessons receive an obligatory 30–50% supplement to their salaries. This supplement is offered as motivation to acquire new knowledge and skills, and to participate actively in in-service training. Over the period 1997/98, some 11,000 teachers enrolled in an information technology course. Unfortunately, it appears that, once trained, some teachers give up their jobs and use their newly acquired knowledge to leave teaching for better paid jobs.

FUTURE PLANS

Preparing students for the Information Society is at present a strong educational aim. In the coming years, the Ministry of Education intends to focus more on effective applications of new technologies than on the development of infrastructure. Considerable financial support will be assigned for content development, the improvement of the interactive network system, and teacher (in-service) training.

ICELAND

F nsson and A R Þr insd ttir

POLICIES ON ICT IN EDUCATION

The official policy of the Ministry of Education, Science and Culture is that Iceland should aim to be amongst the leaders in the usage of ICT.[21] The main policies for ICT regarding compulsory and upper secondary schools in Iceland are set out in the National Curriculum Guidelines for Compulsory Schools and the National Curriculum Guidelines for Upper Secondary Schools, which are issued by the Ministry of Education, Science, and Culture. A new set of guidelines for both primary and secondary schools was published in 1999.

21 Menntamálaráðuneytið (Ministry of Education) (1996) *Í krafti upplýsinga: Tillögur menntamálaráðuneytisins um menntun, menningu og upplýsingatækni 1996–1999* (The power of information). Reykjavík: Author.

Com ulsory Schools

Until 1999, compulsory schools in Iceland based their ICT development on policies laid out in the National Curriculum Guidelines of 1989[22] as well as on a general policy document issued by the Ministry of Education in 1996.[23] The policies from 1989 were stated in general terms and contained the following main points: all software and teaching aids should be in Icelandic; there should be at least one computer in every classroom; computers should be used regularly in classrooms; and every school should be able to access databanks in Iceland and abroad.

In 1999, the Ministry of Education published new National Curriculum Guidelines.[24] These place considerable weight on ICT. For example, the policies for ICT in the old guidelines comprised only one page but now the policies are over 30 pages long with a quite detailed set of educational goals for the fourth, seventh, and tenth grades.

The basic idea at the core of these new policies for ICT in compulsory schools is that the computer is an integral part of modern society. Schools have to prepare students to live in a world that is permeated with computers at every level.

At the compulsory educational level, ICT should focus on three areas. First, students should be made familiar with the basic skills and technology necessary for computer use. Second, they should be taught to use information in a critical and creative manner. Finally, the outcome should be that, at the end of compulsory education, students are able to enjoy and participate in culture in a creative and moral manner. Essentially, ICT and computer usage is not to be taught as a separate subject in schools but should be a part of students' everyday learning. The Internet should be an integral part of the educational environment and its use should be encouraged. Students should be able to work independently in gathering information on the Internet and utilising it in their studies.

U er Secondary Schools

The national curriculum guidelines for the upper secondary schools do not spell out ICT policies in the same detail as is done in the guidelines for compulsory schools. Until 1999, upper secondary schools operated on the basis of guidelines published in 1990, where no mention is made of ICT policies.[25] However, a number of courses in computer usage are described that are an integral part of many educational programs. The 1999 guidelines contain descriptions of several computer courses and a discussion of the role of ICT in

21 Menntamálaráðuneytið (Ministry of Education) (1996) *Í krafti upplýsinga: Tillögur menntamálaráðuneytisins um menntun, menningu og upplýsingatækni 1996-1999* (The power of information). Reykjavík: Author.

22 Menntamálaráðuneytið (Ministry of Education) (1989) *Aðalnámskrá grunnskóla* (National Curriculum Guidelines for Compulsory Schools). Reykjavík: Author.

23 Menntamálaráðuneytið (1996), op. cit.

24 Menntamálaráðuneytið (Ministry of Education) (1999a) *Aðalnámskrá grunnskóla* (National Curriculum Guidelines for Compulsory Schools). Reykjavík: Author.

25 Menntamálaráðuneytið (Ministry of Education) (1990) *Aðalnámskrá framhaldsskóla* (National Curriculum Guidelines for Upper Secondary Schools). Reykjavík: Author.

general terms.[26] For further policy guidance, schools have to refer to the general policies for ICT that the Ministry of Education had published elsewhere.[27]

The emphasis on ICT for upper secondary schools is similar to policies for compulsory education. ICT is described as an exciting opportunity to enrich learning at all levels. Schools should endeavor to make ICT an integral part of all subjects and prepare students to become life-long users of ICT. Instructional methods should ensure that students are active, not passive, users of ICT.

The system is financed by the state and by local governments. In 1997, about 5.4% of GDP was spent on education. The Althing, the Icelandic parliament, is legally responsible for the educational system. The governing body that administers the system is the Ministry of Education, Science, and Culture.

T E I PLE ENTATION OF ICT IN ICELAND

To a great extent, the implementation of ICT is left to individual schools and teachers. In the last 10 years, there has been considerable movement toward decentralization in the Icelandic educational system. For example, it is no longer specified down to the last krona how individual schools are to spend their budgets. A school receives its budget depending upon its size. If a school can save money in one area, it is allowed to use that money as it sees fit. Many schools spend more money on computers than their budgets specify. This is achieved by saving in other areas and by donations from parents, organizations, and private companies. Schools also can obtain funds for ICT development by applying for grants at national and local levels.

In Iceland, there are different policies in operation for the purchase of computer hardware. Many local governments have specified policies in this area, but some schools have also formed independent policies. The most influential policy statement on the purchase of hardware was issued by the Ministry of Education in 1993. From that date onward, the ministry has supported software for DOS and Windows operating systems only. As a result, Apple computers have lost most of their support in schools.

It is the policy to buy multimedia computers with an Internet connection for primary, lower secondary, and the upper secondary schools. In all schools, the exact number of computers needed is left to the school principal to determine. Most schools buy their computers, but recently there has been a movement toward leasing computers from computer firms or financial companies. It is believed that this will be cheaper in the long run and will enable schools to offer recent rather than outdated computers to their students.

In 1988, the Ministry of Education and the Computer Center at the University of Iceland started to cooperate on acquiring and developing computer software for Icelandic schools. The operation moved to the National Center for Educational Materials in 1992. This project has led to the publication of over 100 educational computer programs in Icelandic. Most were translated from other languages, but 11 were written in Icelandic.

26 Menntamálaráðuneytið (Ministry of Education) (1999b) Aðalnámskrá framhaldsskóla (National Curriculum Guidelines for Upper Secondary Schools). Reykjavík: Author.

27 Menntamálaráðuneytið (1996), op. cit.

There has not been a comprehensive policy for the implementation of educational software in schools. Several studies have shown that educational software is already widely used in schools, both in specific subjects and remedial teaching. However, its use depends on the interest of individual teachers or schools.

It is the policy of the Ministry of Education that all teachers be well versed in the utilization of computers and ICT. All recently graduated teachers, both at the compulsory and upper secondary levels, are well versed in ICT, because the subject is now part of the curriculum for teachers. In recent years, older teachers have also had the opportunity to train in this field. Computer courses are now part of the in-service training that is offered to teachers. Many teachers have also attended computer courses that are available to the general public, and there have been a number of instances where all the teachers in a school have attended a computer course together.

ISRAEL

D ioduser, R Nachmias, and A Baruch

INTRODUCTION

Israel, acknowledging the importance of ICT in education, as well as in the industrial world, has allocated a significant amount of educational and financial resources to the application of ICT in the educational system over the past 20 years.

Computers were first introduced into the Israeli educational system at the high school level as early as the 1970s. The main focus at this time was on 'computer science studies'. In the late 1970s, computers were introduced at the elementary level as well, and throughout the entire educational system, in the form of computer-assisted instruction (CAI), involving mostly tutorial drill and practice systems, and serving teachers and students in several curriculum subjects. In the 1980s the introduction of computers into the educational system was still not systematic, remaining unorganized and local in concept (in terms of policies and projects). Although computer usage at this time was perceived basically as a complement to former activities, CAI use broadened to include data organization and manipulation activities.

The National Com uteri ation Program Turning Point

During the 1990s the introduction of computers was a high priority for the Israeli education system. In 1990 the Israeli Minister of Education appointed a committee to examine the promotion of science and technology in the Israeli education system. The agenda also included the development of a national policy for the implementation of computers in Israeli schools. On the basis of the resulting report, a national five-year plan (1994–1998), known as The National Computerization Program, was established. The program aimed at promoting the teaching and implementation of computers in Israeli schools, with the ultimate intention of improving the educational system altogether. It included goals and guidelines for the implementation process, as well as focuses and emphases according to age levels.

OB ECTI ES

The implementation of the schools computerization program has been one of the central initiatives of the educational system during the second half of the 1990s. The principal objective of this initiative is to ensure that all teachers and students in Israeli schools can operate computers, with a ratio of one computer for every 10 students.

The two central *educational* objectives of the program are:

1. to expose students to information and communication technologies, and impart basic capabilities for their functioning in the ICT-rich society in which we live;
2. to assimilate information technologies in the school as leverage for pedagogic changes and as a tool for improving teaching in various domains.

The *operational* objectives of the program include:

- improving teaching processes, moving from the concept of the teacher as someone who conveys material to a passive learner, to that of someone who fosters the active participation of the learner;
- reorganizing the learning environment to enable a variety of teaching methods;
- encouraging the independent, creative, investigative, and experiential learner;
- providing solutions for students with different learning styles;
- augmenting cooperation among students, among students and teachers, and between the school and the community.

I PLE ENTATION PRINCIPLES

The central components of the plan involved: (i) implementing the necessary *infrastructure* throughout Israeli schools within a five-year period; (ii) ensuring that *students* acquired computer literacy; (iii) assimilating computers in different *subject matters*; (iv) advancing *teachers'* knowledge of ICT and intensifying their routine training; and (v) implementing national *programs and initiatives.*

The focus of the program at first was to computerize junior high schools because of changes in the structure of the Israeli educational system. Also, it was thought that placing computers at this level would ensure optimal benefit from the use of computers. Moreover, it was considered politic to place them here because these schools had been discriminated against in the past in terms of resourcing.

The main application principles of the program were as follows.

- *Integration of systems—computerization package:* The program included the appointment of integrators (companies) for executing the facets of the plan. The school 'computer packages' offered by the integrators were financed by the Ministry of Education, the local municipalities, and a non-profit national organization allocating funds for educational and social issues.
- *Standardization of configurations:* Standard configurations for hardware were defined by the Ministry of Education. The ministry also set standards for software, which were

obligatory for all companies involved in developing educational software. As for communication standards, these were established only after the first years of the implementation of the program, and became operational in its last two years. A yearly databank of authorized software for educational purposes was published and distributed to schools and educational centers. All standards were upgraded and updated on a yearly basis in accordance with technological developments.

- *Supervision and control:* The National Computerization Program plan included an evaluation component in the form of a control and assessment department. The department evaluated the computerization process as a whole and throughout all its stages, from planning through to implementation. It also evaluated the acquisition of target computing skills at each age level and in accordance with subject matter, the improvement of teaching skills as a result of training, and the process of purchasing hardware and software.
- *Teachers as a vital component:* Special attention was given to training both students and in-service teachers in the use of modern technology. The policy intended to instill in teachers the view that computer technology is a vital component of teaching practice and future curricula.
- *Demonstration schools:* Ten schools throughout the country, mostly six-year combined junior and high schools, were chosen as demonstration schools. These schools received additional professional and academic support and coaching. They functioned as real-life laboratories, where the aims were to develop novel means of assimilating advanced technologies into teaching and learning, to apply recent and modern teaching-learning methods, and to examine and test new theories in the field of computer applications as well as working patterns applicable to all schools.
- *'Computer for every child':* 1997 saw the implementation of a project designed to complement the National Computerization Program. The project, under the patronage of the Israeli Prime Minister, sponsors computers for underprivileged Israeli children, for their use at home. The hope is that the project will help shatter the cycle of poverty and lack of opportunities that these children experience. In addition to receiving hardware, software, and technical support, the children and other members of their families are trained in how to use the technology.

INITIAL ABRIDG ENT AND OUTCO ES

During the first stage of the National Computerization Program (1994–1998), about half of the schools in Israel were computerized, averaging 300 schools per annum. The program administrators set the student:computer ratio for the distribution of computers at 1:10. By the year 2000, it was expected that an additional 15,000 'computing packages' would have been distributed to families throughout the country through the Computer for Each Child Project.

By the end of 1998, the National Computerization Program, with the help of funding from some other sources (municipal, local, private), had brought 30,000 computers (along with their required peripheral equipment, software, and courseware) into Israeli schools. These schools, in accordance with the goals and aims of the program, all received guidance from skilled computer trainers. Each school also received group training over a period of two years.

The annual sum expended on the National Computerization Program approached 1% of the total national expenditure on education. Over 90% of secondary schools, 40% of elementary schools, and 125 special education schools were computerized. At the time of writing, the program had just come to the end of its five-year period. However, some initial assessment data relating to the program's implementation were already available.

These data show that most of the resources have, in practice, been invested in establishing the hardware infrastructure. In many schools the program has produced only minor changes in the teaching and learning processes. Achievement of the required changes doubtless will necessitate innovative educational thinking and a greater assimilation of ICT in teaching and learning. Some special schools (amongst them a few of the demonstrative schools) are starting to show the beginnings of innovative thinking and practices, but many schools are continuing to use computers in a way that makes little use of their potential for advancing education.

During its five years, the program established teacher-training routines in most computerized schools. Some of these schools even produced local leaders and officeholders who are leading the assimilation process. Nonetheless, some teachers still lack sufficient training to generate a substantial change in ways of teaching various subjects.

ISIONS AND DIRECTIONS

In 1997, the Ministry of Education and Culture established a committee to plan the implementation of the Second Five-Year Program. The aim of this stage has been to expand and intensify the computerization process based on the lessons and conclusions drawn from the first stage. This second program is focusing a great deal of its efforts on integrating the new technologies within the schools. A particular emphasis is that of using the technology to foster individual learning (thereby enhancing knowledge and communication possibilities) and to promote the acquisition of life-long learning skills. Better and more powerful control and assessment procedures also are being brought into play.

ITAL

R elchiori

INTRODUCTION

Over the last few years, an accountability drive has characterized many aspects of the Italian public sector, including education. Since 1993 the successive governments have made educational reform a frontline policy and, in the process, have radically changed Italian schools. A cornerstone of the reform has been that of stressing and promoting each school's *autonomy* to carry out its teaching programs as it sees fit. In 1997, as part of the reform process, the government brought in a series of national legislative measures that have steered schools toward a phase of great changes; a phase that is still underway.

POLICIES ON ICT IN EDUCATION

The policies on ICT education can be described according to three time periods that followed on from the founding of special sections for software programmers in the technical and commercial schools.

First Period

ICT technologies were developed at the upper secondary school level following the introduction of experimental curricula for the above-mentioned software programmers. At the same time, experimental activities were promoted in the upper schools of the *licei classici* and *licei scientifici* (where computer science was included in mathematics), and in the vocational schools (where an experimental project called 'computing' was being carried out). The 1982–1985 period saw hundreds of technical schools involved in the promotion of experimental national activities, such as the projects 'Ambra', 'Ergon', 'Orione', and 'Igea'.

Second Period

During this period the ministry issued a national plan for introducing computer science in all upper secondary schools. The plan aimed to:

- introduce basic concepts of communication, for example, signal and code;
- use a systems approach;
- accustom students to models of reality, given that computer science languages are based on symbols language;
- help students acquire an awareness of the instrumental and indirect features of computer science;
- give students opportunities to reflect on aspects of change that ICT has brought to work and society.

To realize these targets, schools would be required to:

- use computers as pedagogical tools;
- teach students the basics of computers and computer science (algorithmic, data structures, functional structures);
- teach students how to use didactical and application software (word-processing, spreadsheets, databases, graphics).

The plan was first fully realized in the curricula of mathematics and physics in the first and second years of upper schools, and was extended to include certain other subjects in the final three years of the 1985–1992 period. It encompassed 90% of the upper secondary schools and offered approximately 3,000 teacher training courses (over 700 teachers received training). During this period, some experiments were carried out with regard to the use of information technologies in the pedagogical and didactical activities of primary and lower secondary schools.

Third Period

This period has seen the Ministry of Public Education launching a large-scale program for spreading ICT throughout Italy's entire school system. The program, named 'Programma di Sviluppo delle Tecnologie Didattiche 1997–2000 (PSTD)' and involving a vast public investment, has the following objectives:

- helping students master multimedia so that they understand and can use the different tools;
- supporting new styles of learning, communication, and planning;
- improving teaching/learning processes and didactical organization within single subjects and across subjects;
- developing the professionalism of teachers by offering training and providing them with the tools and services they need for their daily work.

In order to systematize the intervention, while at the same time allowing it the flexibility to accommodate different requirements and realities, PSTD was broken down into several projects (each capable of absorbing sub-projects). These were:

1. General projects:
   A. refresher courses for teachers
   B. classroom multimedia;
2. Special directed project;
3. Pilot project.

The funds assigned to PSTD were as follows:

Years	*Lire (in billions)*	*Euro*
1997	159.9	82.985.386
1998	271.5	141.440.501
1999	367.5	191.544.885
2000	191.0	99.686.848
Total	989.9	516.179.541

ICT IN T E CURRICULU AND ICT USE

The inclusion of ICT in the primary and the secondary schools has always been carried out within existing curricula rather than through a specific subject. Many primary school teachers use the computer for educational purposes. In those primary schools with ICT, each student uses computers for about 10 hours during a school year.

In the lower secondary schools, most teachers of technical disciplines use the computer as a support when teaching word-processing and database applications and when carrying out Internet-related projects. On average, in those lower secondary schools with ICT, each student uses the computer about 30 hours across all three school years.

In the first and second years of upper secondary schools, the computer is used to teach mathematics and physics. The computer is therefore primarily used for 'drill and practice'. In the three-year period of upper secondary school, ICT is taught as a specialized subject in most technical, vocational, industrial, and commercial schools. In the other secondary schools, ICT is mainly used within subjects such as Italian language, science, mathematics, and physics. On average, a secondary non-specialist ICT student uses the computer about two hours every week, for five years, while the specialist student uses computers about two hours, for the first and the second years, and nine hours for the following three-year period.

ONITORING T E OUTCO ES OF T E PROGRA

The progress of PSTD is evaluated through a monitoring program that includes collection of data at the end of each school year. The first such collection was carried out in September 1998 using a school questionnaire that was completed by the school principals or their delegates of all the financed schools (5,320 schools for Project 1A and 1,898 for Project 1B) By 30 September 1998, 3,720 schools of the 1A group (70% of the total) and 1,242 of the 1B group (65% of the total) had completed the questionnaires (giving a total response of 4,962 questionnaires).

In addition to the school questionnaire, a questionnaire was sent to a sample of 18,750 teachers. The 1A and 1B projects involve teachers in different ways. The 1A project essentially provides teachers with updates on the main themes of the new technologies, while the 1B project expects that teachers will experience multimedia didactic activities alongside their students. The results of this survey showed that the level of participation of teachers in the projects is substantial. The 1A project involved 104,380 teachers, that is, 41% of the regular teachers working in the schools financed by the PSTD or, to put it another way, an average of 28 teachers per school. The 1B project involved 32,877 teachers, that is, 37% of regular teachers or an average of 26 teachers per school.

APAN

Shimi u

A OR DOCU ENTS INFLUENCING ICT POLICIES ON EDUCATION

In Japan, three major policy recommendations have influenced ICT-related developments. These are:

1. *The Second Report on Educational Reform (1986):* Released by The Temporal Council of Education, this report focused on the necessity to modernize Japanese education for the future and pointed out the importance of ICT and its impact on education. It recommended the following actions related to ICT: (i) develop ICT education to meet the needs of the Information Society; (ii) use the potential power of ICT to activate all educational institutions; and (iii) take into account the 'light and shadow' cast by ICT and its ability to humanize the educational environment.
2. *The First Report on Japanese Educational Policies towards the Twenty-first Century (July 1996):* This report, released by the Central Council of Education, played a crucial role in

determining the Ministry of Education's educational policies. It strengthened the actions recommended by the previous document and included several new, more concrete suggestions: (i) the systematic implementation of information education in the Japanese curriculum; (ii) a qualitative improvement in school education through the use of the information communication network; (iii) the creation of 'new schools' designed to meet the needs of the anticipated information- and communication-rich society; and (iv) the implementation of measures designed to overcome the 'shadow' of ICT (such as weakened human relations and a diminishing experience with nature) and to cultivate a moral and balanced mind for life in an information society.

3. *The Education Reform Program (1998):* Released by the Central Council of Education, this program built on previous recommendations, called for further advancement of ICT in education, and identified feasible programs to be implemented by the ministry. For example, this document called for Internet to be introduced into all secondary and special schools by 2001 and into all elementary schools by 2003.

The recommendations of these reports are presently being implemented by the Ministry of Education, local governments, and local boards of education.

E UIPPING SC OOLS WIT ARDWARE

The first program to equip schools with computers began in 1990. Carried out by the Ministry of Education, it aimed to provide all elementary schools with two computers, all junior secondary schools with 22 computers, all general senior secondary schools with 23 computers, and all special schools with five computers. The ministry makes subsidies to local governments for teachers' salaries to ensure that the number of students in each classroom is no more than 40 at all levels. On the basis of this class size standard, elementary schools had to have at least two computers for demonstration or teacher use, while junior and senior schools had to have at least one computer per two students in a computer laboratory.

The second program began in 1994 with the aim of equipping elementary, junior secondary, general senior secondary, and special schools with 22, 42, 42, and 8 computers respectively. Under this program, elementary schools should have one computer per two students in a computer laboratory, and junior and senior secondary schools should have one computer for each student in a computer laboratory.

Although the ministry set the policy, its implementation was left to local governments, which meant that the actual funding came from them and the boards of education. As a result, the actual number of computers in classrooms differed from school to school. Ministry of Education statistics for 1998 revealed that 95.1% of elementary, 99.8% of junior secondary, 100% of senior secondary, and 98.6% of special schools were equipped with computers, and that the average number of computers in the schools was 10.4, 28.1, 71.1, and 11.4 respectively for each school type. However, a new funding program aimed at the extensive implementation of ICT in schools from the year 2000 had already been proposed by the Task Force Commission in its 1988 report, *Realizing the Educational Environment for the Advancement of ICT* (1998). The commission took into consideration the implementation of ICT not only in schools but also in educational institutions outside schools.

INFOR ATION EDUCATION IN T E SC OOL CURRICULU

Information education as a part of general education (and not as a vocational subject) was first included in the 'Course of Study' released in 1989. The Course of Study is a legal document that provides guidelines on the content of the Japanese school curriculum from elementary to senior secondary levels. It is determined by the ministry and provides the basis for the selection of national textbooks. In the 1989 document, 'foundations of information' was introduced for selection in the subject technology and domestic science at the junior secondary level, while computer studies could be offered as a school option under the 'other subjects' curriculum at the senior secondary level. At the elementary level, the Course of Study recommended the use of computers as an effective educational tool in all subjects.

A drastic step was taken in the subsequent Course of Study, released in 1998. Here, the use of computers was spelt out for all subjects at the elementary through senior secondary levels. The document called for a new compulsory general subject, 'information', to be introduced into the senior secondary curriculum, and for all senior secondary students to learn 'information A, B, or C'. 'Information and computer' (formerly 'foundations of information') would become a compulsory area in the subject technology and domestic science in the junior secondary curriculum. Information would be included as a key area in the lessons called *sougouteki gakusyu no jikan* (integrated study hours), and these would be introduced into the school curriculum at all levels. The 1998 Course of Study therefore set a course whereby information education will be implemented extensively throughout the Japanese school curricula. This action corresponds to the systematic implementation stated in the First Report of the Central Council of Education.

INTERNET IN SC OOLS

The number of schools in Japan with access to Internet has grown rapidly in recent years. At the time of writing, and according to figures provided by the Ministry of Education, 13.6% of schools at the elementary level, 22.7% of schools at the junior secondary level, 37.4% of schools at the senior secondary level, and 21.9% of special schools had access to Internet. As stated in the *Educational Reform Program (1998)* report, Japan's aim has been to have facilities for Internet access to all its junior and senior secondary schools in place by 2001 and to distribute these facilities to all its elementary schools by 2003.

Another report, released in 1998 by The Task Force Commission on the Promotion of Internet in Education and backed by the Ministry of Education, sets out future actions regarding Internet use in schools. The key recommendations are as follows:

- enrichment of educational content on the World Wide Web;
- filtering illegal and harmful information on the Internet;
- setting up organizations for using Internet in schools and in districts;

- establishing support systems for Internet use in schools and in districts;
- easing schools' burden on ICT-related expenditure.

This proposal will serve as a very influential document when the ministry decides on the actual budget for ICT. Local governments also will take this document into account when they set out the actual funding.

ISCELLANEOUS

The Ministry of Education has led several experimental projects on the use of ICT in schools. Although backed by the ministry, these projects have been carried out by various public organizations. In 1994, the Computer Education Center (CEC) began the '100-schools Networking Project'. This project evolved into 'The New 100-schools Networking Project', which began in 1997. The 'Ko-Net Plan (Children's Network Plan)', a more extensive version of the '100-schools Project', has involved over 1,000 schools and, like its predecessor, developed innovative practices on Internet. The Ministry of Education has also, since 1994, provided research and development funding for educational software, an initiative that has produced almost 100 items of educational software.

Another important factor influencing ICT implementation is teacher training. The ministry has provided in-service teacher training courses on computer use for over 20 years as well as in-service computer coordinator training courses since 1993. In addition, it has required, from the year 2000 on, all pre-service teachers to take two units of ICT and at least one unit of 'method and technology of education'.

LAT IA

A Grinfelds

BAC GROUND ISTOR

In the period from 1940 to 1990 the Latvian education system was part of the closed and centralized education system of the former Soviet Union. It was not until 1990, after regaining its independence, that Latvia was able to start reforming its society and education system. Since 1985 the policy for computerization of the education system of Latvia has focused on all general education schools. However, the taking into account of existing limitations has seen priority being given to secondary schools.

A full-scale installation of computer laboratories in Latvia's secondary schools began in 1985 as part of the former Soviet Union's general program of 'informatization' of the education system. All secondary schools in Latvia were equipped with homemade personal BKs—computers with 16-bits processors. Unfortunately, these computers were totally incompatible with IBM personal computers, a fact that caused significant difficulties when the process of acquiring IBM-compatible personal computers started.

Within the framework of this program, the new subject of 'informatics' was introduced in the curriculum of secondary schools, and a set of textbooks was published to support this subject. Because BK computers had poor application software, relatively high attention was paid to programming.

After regaining its independence, Latvia faced many serious problems and tasks in almost all branches of life. One obvious example was the need to develop and improve the education system so that it could meet the needs of an upcoming open society. During this period, the development of information and communication technologies in education stagnated because nationwide initiatives to acquire modern computers were almost non-existent. For the schools, it was a matter of 'serve yourself', which some local school boards and schools managed to do by finding counterparts from Western countries, which supported their efforts to acquire new technologies.

One of the most important events during this time was Latvia's participation in the second phase of the IEA Computers in Education Study (1991–1994). This study saw an international comparative assessment of the Latvian education system's use of ICT carried out for the first time.

CURRENT ACTI ITIES

Taking into account the rapidly strengthening impact of ICT on society and the marked tendency for industrial societies to evolve into 'information societies', the Latvian government decided, at the end of 1997, to make a substantial investment, that of integrating ICT throughout its education system. Three main objectives were set for this program:

1. To develop a computer network for the education system of Latvia. This initiative included establishing a physical network for all levels of the education system as well as a broad set of databases for use by educational administrators.
2. To develop modern computer laboratories with access to the Internet in all of the more than 1,100 schools of general education in Latvia (elementary, primary, and secondary schools).
3. To develop in-service teacher training in ICT use in different subject areas.

During 1998, emphasis was put on developing information databases for the education system. At the same time, 39 regional computer centers containing 12 networked computers for students and one computer for teachers were developed across the country, and in-service teacher training programs began in the regional centers.

The local government of Riga (the capital of Latvia) announced another significant two-year (1998–1999) investment program. More than 25% of all secondary schools of Latvia are located in Riga, and the local government of that city decided to invest about US$2M per year to equip the schools there with modern computer laboratories and to connect them to the Internet.

The premise that most in-service teachers should be trained to use ICT required the development of a course system and methodological aids. Latvia therefore is now participating in the international Nordic-Baltic project, 'Establishment of the Nordic-Baltic Network of Research and Development Centers for use of ICT in Teacher Training'.

I PLE ENTATION STRATEGIES

Until now, implementation of ICT in schools has focused on the inclusion of 'informatics' as a separate school subject in the curriculum of secondary schools. This means that, in most cases, the computer has formed the object of study and the tool for acquiring ICT-related knowledge and skills. Over the last few years, this situation has changed slightly because more attention has been paid to innovative teaching practices (including the integration of ICT) in different subject areas. ICT is also being integrated into other activities performed in the schools.

The current trends have been reflected in the new National Compulsory Education Standard, which states that it is important for teachers and students to master information technology, the computer in particular.

SOFTWARE AND T E INTERNET

A set of standard software packages is installed on all computers acquired for use in schools: MS Windows '98, MS Office '97 Pro, and Lotus Notes for access to information databases. Additional software can be installed should teachers of informatics or of other subjects assume that it is necessary for improving instruction.

Specific subject-related software is not widespread in Latvian schools. The main reasons relate to problems with adapting software, teachers not knowing how to use ICT, and software designers lacking interest in producing domestic software for instructional purposes in different subject areas. During the last two years, only one instructional multimedia CD-ROM—on the history of Latvia—has been produced. A more specific CD-ROM, containing an overview of the results of the first year of the ICT investment program, was produced in 1999.

The use of the Internet is not yet part of everyday life in Latvian schools. This situation is mainly due to the lack of online connections. Other obstacles include an absence of clearly stated recommendations/requirements on Internet use in different subject areas and the low motivation of subject teachers to change their instructional methods.

TEAC ER TRAINING

As was mentioned above, in-service teacher training is one of the most urgent issues regarding the implementation of ICT in different subject areas. Three factors inhibiting in-service teacher training in ICT are:

- Low motivation, especially among older teachers, to acquire ICT-related knowledge and skills.

- Low motivation to change methods of teaching used in particular subject areas. This is especially true of older high-rated teachers, who have successfully used classic teaching methodology for decades.
- A moderate knowledge of English. This is a serious problem for most teachers in Latvia.

In an effort to overcome these barriers, a special sub-program designed to speed up the process of teacher training in ICT use both in general and subject-specific areas has been developed within the main 'informatization' program. Pre-service training of student teachers is encompassed in the requirement (compulsory) that all first-year university students use ICT.

SU AR

The ongoing integration of ICT in Latvia's education system reflects the growing interest of educational policy-makers and the government to proceed as quickly as possible with overall computerization of the education system at all levels from the smallest elementary school through to school boards and the Ministry of Education and Science. The launch of nationwide programs that are supported financially by the government allows us to anticipate with reasonable optimism that the wide and effective use of ICT in the education system of Latvia will become a reality in the near future.

LIT UANIA

L ar aus aite

INTRODUCTION

Secondary education in Lithuania involves three stages: primary (Grades 1–4), basic (5-10), and upper secondary (11–12). Education is compulsory for all residents between the ages of six or seven and 16. Most secondary schools are public and fully funded by the state. There are more than 700 upper secondary schools (Grades 1–12), with a total of about 440,000 students, as well as 575 basic schools (Grades 1–10), with more than 62,000 students. The education system in Lithuania is centralized: the Ministry of Education and Science controls most decisions and policy formulations. Nowadays, the education system is moving away from a state-controlled model to a state-supervised model.

CURRICULU

ICT presently forms a separate compulsory course in upper secondary schools (Grades 11–12). The course involves 68 hours of class time. During the school year 1999–2000, 'informatics' became part of the basic school (Grades 9–10) compulsory curricula. The course consists of the following parts: information (basic ICT concepts), algorithms (programming), computers (hardware, operating systems, software, etc.), and information technologies (word-processing, spreadsheets, etc.). The use of ICT for teaching and learning other subjects is optional.

Students learn most of their ICT-related knowledge and skills during the informatics course. However, the SITES results (see Chapter 3) indicate that the majority of students acquire their ICT-related skills in the upper grades of the school.

School administration boards decide how computers are to be used in schools, but it is usually teachers who take the initiative to use them in the first place. Although schools take a constructivist approach to learning, they presently are unlikely to use ICT in this manner for various reasons, including a lack of hardware and software and a lack of qualifications and experience among teachers.

INFRASTRUCTURE

The introduction of computers into secondary education began in the mid-1980s. In 1986 informatics became a compulsory subject in all secondary schools. Since then, the government has endeavored to provide secondary schools with computers as a tool for learning this subject. Until 1994 the purchase of computers for Lithuanian secondary schools was systematically financed from the state budget. Government-supported expenditures amounted to approximately US$250,000 annually. By the end of 1996, only 71% of secondary schools had one or more computers, and the student:computer ratio was 1:84. More than 30% of the computers were 8-bits.

In 1996, the Ministry of Education and Science implemented a two-year project known as 'Computers for Secondary, Vocational, and High Schools in Lithuania'. The budget for this project was approximately US$7M. The project focused on the following initiatives:

- providing each secondary school with at least one computer with a modem and necessary software;
- building up an educational computer network;
- establishing the necessary infrastructure for teacher training;
- undertaking preliminary teacher training.

In 1998, government expenditure on ICT projects was about US$500,000. Today, the purchase of equipment is usually supported by local authorities and various non-governmental funds, but it is the schools that do the actual buying. It is worth mentioning that the basic schools are still poorly equipped. Only about 15% of them have any computers at all.

As the SITES results set out in Chapter 4 show, the number of computers available varies from school to school. Less than 30% of the students have a chance to use computers at school. The small difference between student:computer ratios for the grade range versus the ratios for the entire school (Tables G.1.1–G.1.3) indicates that most school computers are used by students across school grades. However, a deeper analysis of results shows that it is students in the final grades of the lower secondary school and upper secondary school who make the greatest use of them. Younger students have fewer opportunities to access computers at school. These results reflect the national policy on ICT in education; namely, that computers are to be used mainly by upper grade students studying the compulsory subject informatics.

In regard to the quality of the computer equipment available, a substantial number of outdated and obsolete computers remain in the schools, with less than 20% of them suited for multimedia. This situation is not surprising given that the national government, local authorities, and the schools lack funding to buy up-to-date equipment. However, the older, less powerful equipment is adequate for learning programming.

Most of the equipment consists of stand-alone computers. It should also be noted that local area networks are not widespread, as most schools have too few computers (usually one) to warrant them.

Although most of the secondary schools have access to Internet, their dial-up connections tend to be slow, and they tend to use only email (without the WWW). Schools cannot afford to get better connections (such as a leased line) because of high prices and Lithuania's weak telecommunications infrastructure (the latter is a particular concern in rural areas). As only one or a few computers have simultaneous access to Internet, global networks are generally restricted to information exchange and extracurricular activities. Internet is rarely used for instructional purposes in most schools. The small number of WWW home pages for Lithuanian schools also confirms that Internet use in education remains marginal.

The ICT concerns most frequently mentioned by school principals and computer coordinators were an insufficient number of computers, an insufficient number of peripherals, out-dated school networks, and other hardware-related problems. These results reflect the technical difficulties being experienced by schools. Unfortunately, they do not give any indication of the extent to which software and teacher training issues are problems.

STAFF DE ELOP ENT

The Ministry of Education and the school-governing boards have made ICT training for teachers a priority, and have allocated funding for in-service training. The ministry requires that staff at the gymnasium level of the secondary schools have an ICT qualification. SITES results show that about 25 to 30% of schools provide rewards to encourage teachers to use ICT. However, these measures are on a small scale and are not producing the desired results. Most teachers still have only a rudimentary ICT knowledge. Furthermore, they lack ongoing training and external ICT support. The ICT-related knowledge of student teachers is also highly insufficient. The ministry and teacher training institutions are working together to find ways of ensuring that student and in-service teachers receive the necessary ICT training.

ANAGE ENT, ORGANI ATION, AND SUPPORT

For a long period, the Lithuanian education system was highly centralized. The Ministry of Education and Science prescribed curricula and selected and purchased educational tools. Nowadays, schools have more power to make their own decisions on which tools to buy and the purposes for which they should be used. However, school principals still expect the Ministry of Education to provide the necessary hardware and software, train teachers, and prescribe curricula.

National curricula and other educational laws offer few guidelines on ICT use in schools.

As such, the decisions made by schools in this area are crucial for the successful integration of technology throughout the Lithuanian educational system. However, SITES data show that only 30% of schools have written polices on the use of ICT, indicating that many schools are not assuming responsibility for ICT-related activities. Also, it is only recently that principals have begun using computers for school management.

A big disparity exists between urban and rural schools regarding ICT usage, with the situation more favorable in the urban regions. Most urban schools offer full secondary education (Grades 1–12), are equipped with computers, have more than 10 years experience of teaching informatics and using ICT, and have skilful informatics teachers or ICT specialists. Most basic schools (Grades 1–10) are located in remote country areas, and only about 15% of these schools have one or more computers. The student:computer ratio and other quantitative estimates for lower secondary schools would be much worse than SITES data indicate were non-using schools taken into account.

LU E BOURG

B Eschman

CONTE T

Luxembourg, the smallest member-state of the European Union, with approximately 400,000 inhabitants, has a unique linguistic situation. Its three national languages (Luxembourgish, German, and French) all serve as languages of instruction in the schools.

After two years of obligatory preschool education and six years of primary education, students attend either general secondary education, which is intended ultimately to lead to academic training, or technical secondary education, which is vocationally oriented.

While most of the responsibility for preschool and primary education lies with the local authorities, secondary education is in charge of the Ministry of Education and Vocational Training. Each secondary school has a principal and an official ICT coordinator, who is usually a teacher who has been given exemption hours for this function. At the preschool and primary level, a school committee constituted by the local authorities carries out functions of this sort. Given that the SITES Module-1 design is explicitly directed at principals and computer coordinators, Luxembourg decided not to include the primary school-age population in the SITES Module-1 study.

GENERAL POLICIES

The policies of the Ministry of Education and Vocational Training concerning the pedagogical use of ICT are directed at fully realizing the teaching and learning opportunities of these technologies. The ministry's broad objectives therefore are as follows:

- To develop in all students the competencies of information processing, communication, expression, and creativity.
- To instigate, diversify, individualize, and democratize the means of learning and thus better adapt the school to the aspirations, interests, needs, and resources of each student.

- To help students develop independent and life-long learning strategies that include ICT so that they can better fulfill their personal aspirations in the modern information and communication society.

The ministry consequently requires that ICT be integrated into general school activities and into inter-disciplinary projects. First and foremost, a pedagogical project has to be developed that precedes the purchase of hardware and software. In particular, classroom space will have to be reorganized to accommodate the new equipment, and other 'material' tasks associated with the introduction of ICT will need to be undertaken at the local level. Involving the relevant people at all levels, especially the local level, is particularly important, given that no one solution or type of ICT equipment will suit all local settings.

CURRICULU AND GOOD PRACTICES

In general, the curricula do not dictate how ICT should be taught in the schools. Rather, they suggest a diverse range of ways in which ICT can be used as part of pedagogical processes. Computer use is not compulsory but is strongly recommended in the primary curriculum. Teachers have access to many ICT-related teaching strategies, such as those based on projects like DECOPRIM (a primary-level project directed at developing students' communication and expression competencies; see www.decoprim.lu).

Students at the general secondary level are required to take computer awareness courses in the last year of obligatory education (that is, at age 15), while those in technical secondary education must take these courses from their first year on (that is, from age 12). Students taking specialist subjects during their secondary education are also required to take computer science courses.

All students and teachers are strongly encouraged to use nationally developed pedagogical software such as TEO (Text Editor Oral; see www.men.lu/script/deco/teoflex.htm) or the CD-ROMs 'Lisboa' and 'Instruction Civique', and to participate in national competitions and projects (for example, ROBBI and Cyberlycée Luxembourg) and international competitions and projects (for example, 'Netdays' and the 'European Schoolnet').

INFRASTRUCTURE AND SUPPORT

Since 1990, Luxembourg has had a national teleinformatics network for education (*Réseau Téléinformatique de l'Education Nationale*; see www.restena.lu), which offers a multitude of services for schools (for example, free ISDN Internet access), teachers, students, and central institutions. All secondary and higher educational institutions, as well as the ministry, many primary schools, and many individuals are linked to the system.

To receive help and information on the purchase and installation of equipment and software, the local authorities (for the preschool and primary levels) and the school communities (for the secondary level) can contact the *Centre de Technologie de l'Education* (CTE); cf. www.cte.lu. Recommendations regarding basic equipment needs are also available from the CTE.

While the local communities finance most of the ICT equipment at the preschool and primary levels, the *Service Informatique*, a department of the Ministry of Education and Vocational Training, is responsible for the basic equipping of secondary schools. In addition, local communities or schools that are ready for a major school development project can submit a request for funding under a given budget title. Furthermore, in the autumn of 1998, a national initiative was launched that offers an additional budget of LUF1M (approximately Euro2.5M) for improving ICT in secondary schools. Some SITES Module-1 results would look quite different if the study had been conducted in 1999, after the '100M project', instead of in 1998.

With regard to educational software, the country's small size and its unique linguistic situation cause problems. Often, for didactic or linguistic reasons, the use of foreign software is hardly meaningful in Luxembourgish education contexts. Some popular educational software, such as TEO and the CD-ROMs mentioned above, have been nationally developed. Otherwise, the ministry suggests the use of open software and the programming language Logo, which allows adaptations to be made that suit specific learning situations.

TEAC ER INITIAL AND IN-SER ICE TRAINING AND INFOR ATION

The students at the national training institute for preschool and primary teachers, ISERP, receive an initiation course in ICT in the first year of their studies. In the second and third year, they are taught the pedagogical implications of ICT. Students who wish to become secondary school teachers must first complete university studies of at least four years, most of which take place abroad, since there is as yet no full university curriculum in Luxembourg. Thereafter they undergo three years of initial training in Luxembourg. The initial training is currently being reformed, with a strong emphasis on practical ICT-based pedagogical training.

Each school year, several nationally organized in-service training courses on ICT are offered for preschool, primary, and secondary teachers. Additional in-service teacher training can be requested as part of the framework guiding local school projects. Furthermore, the new projects funded within the framework of the '100M project' (see above) focus substantially on in-service teacher training. Participation in in-service training takes place on a voluntary basis. For certain training activities, teachers receive compensation, either in the form of reimbursements or exemptions. In addition to the information offered by CTE and RESTENA, the ministry's server <www.men.lu> allows teachers to access a great variety of online information as well as diverse interactive exchange tools.

NEW EALAND

Cham erlain, S ay, and A Buc ley

The introduction of IT into education in New Zealand dates back to the early 1980s, and has included the implementation of a number of government-funded or government-supported initiatives, albeit on an ad hoc basis. These have involved pilot and research studies, professional development programs, the trial provision of a help-desk, and a pilot schools network. The government has also supported a number of IT initiatives, such as distance learning projects in rural areas and interactive second language learning programs.

In 1989, the administration of the education system underwent a major reorganization, which saw much of the responsibility for school management devolved to individual schools and their boards of trustees. As these large-scale administrative changes coincided with major innovations in computer technology and information processing, the ability of schools and boards of trustees to respond advantageously was variable.

The introduction of IT into New Zealand schools has essentially been uneven. While many schools have been successful with their use of IT, other schools have not had access to funding or expertise to integrate IT into their programs and administration.

CURRICULU

The New Zealand Curriculum Framework (1993) sets out the policy for learning and assessment in New Zealand schools. It states the principles that give direction to all teaching and learning. The framework specifies seven essential learning areas: language and languages (including English), mathematics, science, technology, social sciences, the arts, and health and physical wellbeing. National curriculum statements describe achievement objectives for each essential learning area, as well as providing the context for the development of eight groupings of essential skills.[28] The essential skills make both specific and general references to the use of IT. For example, the information skills grouping includes the statement that students will *'use a range of information-retrieval and information-processing technologies confidently and competently'*.

Technology, one of the seven essential learning areas, provides a specific setting for IT education; the curriculum statement refers to seven areas of technological study, one of which is *information and communication technology*. In this context, students are able to learn about new technologies, how they work, their uses, and the social and ethical effects of their use. The national curriculum statements for English (and for other language learning areas), mathematics, science, social studies, and health and physical education also make specific reference to the use of information technology to enhance learning. The use of IT to enhance the learning and use of Maori language is also advocated.

INFRASTRUCTURE

In general, there has been no national policy on acquisition of computer hardware or software. Instead, the purchase of hardware and software has been the responsibility of the individual school. These school-level initiatives have resulted in considerable variations in the amount and type of hardware (and software) and the effective use of IT in schools. The acquisition of hardware (including maintenance and replacement of equipment) and software has been influenced by such factors as the wealth of a community, and the expertise within it, as well as the commitment and expertise of staff in schools.

More recently, the government has promoted schools' participation in NetDay, a national voluntary project that provides practical help for schools wanting to create local area

28 The essential skills, as outlined in *The New Zealand Curriculum Framework*, include communication skills, numeracy skills, information skills, problem-solving skills, along with self-management and competitive skills, social and cooperative skills, physical skills, and work and study skills.

networks. As well, one of the current priorities under the Financial Assistance Scheme[29] is to assist with the cost of cabling for local area networks.

STAFF DE ELOP ENT

During the period 1993–1996, the focus of government support was in the area of professional development. The main aim of the professional development programs was to give teachers assistance to integrate IT into the classroom and across the curriculum. A major government-funded professional development initiative, underway at the time SITES was administered, was the Information Technology Professional Development (ITPD) project, which has allowed schools or clusters of schools to organize and manage their own training and development. At the time of writing, the government had signaled its intention to fund this project beyond 1999.

ORGANI ATION AND SUPPORT

The National Administration Guidelines, one of the areas of the National Education Guidelines,[30] set out the curriculum and administrative requirements with which boards of trustees and principals are obliged to comply. Any school policy, including an IT policy, is ultimately the responsibility of the board of trustees. Likewise, the individual board, generally in conjunction with the principal and school staff, determines the degree to which IT is used to support the organization and administration of the school. For example, the board, through the principal and teachers, is required to 'monitor student progress against the national achievement objectives'. It is the responsibility of each school to choose the means to meet this requirement.

RECENT DE ELOP ENTS

In October 1998, one month prior to SITES being administered in New Zealand, *Interactive Education: an information and communication technologies (ICT) strategy for schools* was announced by the government. This national strategy formally recognized the need for a coordinated approach to support the use of ICT in schools in order to enhance teaching, learning, and educational administration. The two focus areas of the strategy are (i) to build an infrastructure to increase schools' access to ICT, and (ii) to improve school capability by providing professional development opportunities for principals and teachers.

The strategy contained four new initiatives:

1. *An on-line resource center:* This provides all schools with a mechanism for the delivery of multimedia resources, including curriculum and administration resources, using the Internet.
2. *A computer recycling scheme:* This initiative involves a national publicity scheme that asks the corporate sector and local and central government departments to donate computers that can be recycled and upgraded for schools. The scheme will also inform

29 This scheme was introduced in 1991 to provide schools with at least 50% of the funding for approved capital projects.

30 State and state-integrated schools are funded directly by government to ensure that the financial obligations (other than salaries and major property costs) under the National Education Guidelines are met.

schools about the availability of this equipment.

3. *Principals First:* This professional development program is designed specifically for principals of schools. It aims to develop principals' leadership skills in planning for the use of IT in their schools. A planning and implementation guide will be developed that contains practical advice on purchasing and maintaining IT for teaching, learning, and school administration.
4. *ICT Professional Development Schools Project:* Twenty-three schools that were successfully using ICT to enhance teaching and learning were contracted for up to three years to provide professional development to schools within their own geographical areas. This project involves just over 300 schools.

Additional government support for the 1998 ICT strategy was announced in May 1999. As part of the government's 1999/2000 budget for education, provision was made for a one-off grant to support state and state-integrated schools in providing technical support to maximize the implementation of the ICT strategy. Provision in the budget also was made for additional (per student) funding in schools' operational funding to assist with the ongoing costs associated with the strategy.

NORWA

A uale

SC OOL S STE

The basic school (that is, primary and lower secondary) is compulsory for students up to age 16. Upper secondary school (for students aged 16–18) is not compulsory, but practically the whole age cohort (around 98%) completes it. In 1998 around 3,000 basic schools were registered in Norway, with almost 570,000 students enrolled, and there were around 500 upper secondary schools, with almost 165,000 students.

The primary school has seven grade levels; students start school at the age of six years. Lower secondary school has three grade levels, with students starting at the age of 13. The upper secondary school also has three grade levels, with students starting at the age of 16. Upper secondary education is comprehensive, containing both academic and vocational training. Vocational training is implemented in a combined system wherein the basic training is supplied in the upper secondary school and the specialized technical training is obtained through apprenticeships in industry.

POLICIES AND INTENTIONS

At the time of writing, the government's plan of action was set out in *ICT in Norwegian Education: a plan for 1996–1999.* This major policy document detailed the government's commitment to promote the use of ICT in education.

The plan begins with a general statement of intent: 'It is the Government's aim that the Norwegian educational system should be among the best in the world in its academic standards and in the breadth of its recruitment.' Its main points are summarized here:

1. *General goal:* Norwegian students, apprentices, teachers, and instructors in basic, upper secondary, adult, and higher education are to become personal users of ICT—in their learning, at work, and in their leisure time.
2. *General framework:* The plan covers the whole educational sector, from basic school to university, and has as its aim the integration of ICT as an aid in ordinary teaching, in order to promote better learning.
3. *Implementation:* The plan discusses the allocation of responsibilities, timetables for the various measures to be taken, and the consequences for various actors in and around the educational system. It is stipulated that detailed annual plans will be drawn up, specifying the areas of effort to be addressed in that year. Within each area, the amount of activity will be determined by annual budgets and resource allocation decisions, to be made at the local (municipality and county) school authority level.
4. *Teacher training and school development:* It is an explicit goal to upgrade ICT competence among teachers in basic and upper secondary schools. New curricula have been implemented in pre-service teacher education, for both the primary and secondary schools. A number of projects are being initiated and supported at the national and local levels, in the areas of teacher training. These include:
   - designing and implementing distance education ICT courses for teachers (to be given over the Internet);
   - establishing 'teacher meeting places' on the Internet, for discussion of didactic and other issues of common interest;
   - using the Internet (Web) as a data repository for information that can be used in the teaching of school subjects—natural sciences, history, geography, languages, etc.;
   - using standard software (word-processors, spreadsheets, etc.) in teaching;
   - using standard software for general school development;
   - upgrading competence in using ICT for project-oriented school activities;
   - using ICT as a tool in teaching students with special educational needs;
   - developing local school projects that promote ICT competence in teaching and learning;
   - developing educational software for use in various school subjects.
5. *International cooperation in the use of ICT in education:* The main focus of this goal is on achieving some coordination between the Nordic countries (Norway, Sweden, Denmark, Iceland, and Finland) given that these countries have a close linguistic, historical, and cultural background. However, interaction and exchange of experiences also are sought with other countries and international bodies, such as the European Union. In this connection, priority is given to participation in the European Schoolnet and its use in teaching.
6. *Gender equity:* This has long been a major issue of Norwegian educational policy. Several projects have been implemented, addressing such questions as: How can more women be attracted to higher studies in informatics? How do girls in the basic and upper secondary schools actually use ICT in their own learning processes?

7. *Use of the Internet:* In line with the general development of society, the plan attaches great importance to making accessible to teachers and students the global networks and the sources of information and contact they provide. Thus, the Norwegian School Net was established. This contains educational content and a centrally maintained and controlled web site for information about education. It also provides a national meeting-place on the Internet for schools.

PRACTICES

A broad statistical survey was carried out in 1997. A short summary of some of the results follows.

- Virtually all computers available to students were PCs (that is, DOS/Windows).
- Upper secondary schools had the most modern PCs, and primary schools had the least modern.
- The PC density among students (that is, the number of students per PC) was approximately 22 in primary schools, 16 in lower secondary schools, and six in upper secondary schools.
- The PC density among students for upper secondary schools and combined primary/lower secondary schools was highest in the three northern counties of Norway (Nordland, Troms, and Finnmark), and lowest in the capital region (Oslo and Akershus counties).
- In terms of PC density among students, the variations were greatest in the basic schools and least in the upper secondary schools.
- The PC density among teachers showed less geographical variation than the PC density among students.

These results will, of course, have to be re-appraised in the light of data that have emerged from SITES Module-1.

CURRICULA

In upper secondary education, ICT is a separate subject in the curriculum. In the 'academic' study track General and Business Studies, it forms (combined with basic economics) a compulsory course of five hours per week, taken in the first year of the three-year program. (A full-time school week is about 30 hours.) In the following two years, a total of four elective courses are offered, each of five hours per week, in the area of computer science. Two of these courses are in systems engineering, one in application programming, and one in network administration. In addition, many of the vocational study tracks also offer ICT courses, suitably adapted to their subject content profile. More importantly, the syllabuses of virtually all other subjects explicitly state that ICT should be used in teaching.

ICT is not on the list of compulsory subjects in basic school education. However, many lower secondary schools offer ICT as an elective course, usually in the form of an introduction to standard software (word-processors, spreadsheets, etc.) or to the Internet (email and information gathering on the Web). Here, too, the syllabuses of many of the subjects explicitly require that ICT is part of the learning process.

RUSSIAN FEDERATION

A Lesne s y

T E ISTOR AND CURRENT POLIC ON ICT IN EDUCATION

The history of computers in Russian schools begins at the end of the 1970s and is tied up with the names of G. Zvenigorodsky and A. Ershov. Zvenigorodsky is the author of the programming language 'RAPIRA', designed especially for children, and Ershov is the author of the approach that 'programming is the second literacy', which became the main principle underlying the national paradigm regarding implementation of computers in schools. In 1984, the Politburo issued a resolution prescribing that 'basics of informatics and computers' become a subject in the national curriculum. In 1985, Grades 9–10 students all over the Soviet Union started to learn this subject without computers. In 1985–1986, Soviet enterprises started to produce 8-bits computers for schools. About 50% of Russian schools are now equipped with these. At the beginning of the 1990s, large numbers of IBM-compatible computers were bought for schools in Russia. This process started with the so-called Gorbachov/Thatcher IBM project 'Pilot Schools'.

Th*e Federal Plan for the Development of Education* (1997) involves a two-phased implementation of ICT in education: (i) the elaboration and implementation of innovative educational technologies based on ICT; and (ii) the building of federal and regional educational computer networks. The goals of the project in the field of ICT were formulated in a rather abstract way and will be reformulated.

At present there is no federal budget for implementing ICT in education. However, plans are underway to implement ICT at both the regional and school levels. The regional plans usually relate to the regional budget, which is to be used for supplying schools with computers and peripherals. The plans at the school level usually cover such 'items' as teacher training and retraining, informatics courses, ICT in subject domains (for example, languages, mathematics, natural science) and the use of Internet. Computers and related facilities for schools frequently are bought by parents.

CURRICULU

The use of ICT now focuses on one subject only—informatics. If a school has computers and a teacher of informatics, or if it has access to computers in the special center, the subject can be introduced in Grades 7–9 and can occupy two hours per week during one year. (This subject sometimes is introduced from Grade 1 on.) Although a course in informatics is optional at Grades 10–11, those schools with computers usually devote a good amount of time to it.

TEAC ER CERTIFICATION, TRAINING, AND ICT

To become a secondary school teacher, a person must undertake four or five years of formal education at a teacher training institution, with specialization in one or two subjects and teaching practice. Alternatively, he or she can graduate from university with some pedagogical courses. Teacher training presently is being transformed into a double-level system corresponding to the Bachelor and Master degrees in education in other countries.

In the past, the level of a teacher's qualification certification and his or her salary depended not on professional skills but on his or her length of service (years of work as a teacher), political views, and the evaluation of his or her work by the school administration. Teachers had to participate in in-service training every five years. In 1993 the teacher attestation system was changed. At present, it is based mainly on the evaluation of a teacher's level of professional mastership by specialists in the given subject domain. It is for this reason that teachers, as a rule, are interested in developing their professional skills and in being involved in in-service training, even though in-service training is no longer compulsory for teachers. Furthermore, in-service teacher training is changing its orientation, from an emphasis on subject content to an emphasis on student development. As a consequence, teachers are better trained in active learning strategies (investigations, discussions, cooperative learning, and the like) and in developing their students' higher-order skills and critical thinking. Training in this direction usually is provided without any connection to ICT and its use.

In-service training courses in the field of ICT focus mainly on how to teach informatics and ICT itself. These courses are provided by institutions of retraining, which are well equipped with computers and peripherals.

SINGAPORE

S W Teng and eo

In April 1997, Singapore launched a bold, ambitious plan to incorporate ICT into the school curriculum. Called the Masterplan for IT in Education, the US$1.2B project provides a national blueprint for the use of ICT in all schools and seeks to create an ICT-enriched school environment for every child. The Masterplan is seen as integral to innovations in the education system to meet the challenges of the 21st century. It is also seen as a key strategy for producing a workforce of excellence for the future. Through ICT, the young will be equipped with learning skills, creative thinking skills, and communication skills.

GOALS OF T E ASTERPLAN

The Masterplan contains four overarching goals:

1. *To enhance linkages between the school and the world around it:* Teachers and students will communicate and collaborate with other institutions, enabling them to acquire richer perspectives in an increasingly borderless world.
2. *To generate innovative processes in education:* Development of new teaching and learning strategies will open new possibilities for curricula and assessment. Schools will be given autonomy to deploy ICT resources flexibly. New school designs will seek to maximize the potential of ICT in education.
3. *To enhance creative thinking, life-long learning, and social responsibility:* ICT-based learning strategies will help to develop students' ability to think flexibly and innovatively, to cooperate with one another, and to make sound value judgements.

4. *To promote administrative and management excellence in the education system:* ICT will be used to promote greater efficiency in administration and communication, thereby supporting more effective educational management.

ey Dimensions of Im lementation

The implementation of the Masterplan involves four key dimensions:

1. *Curriculum and assessment:* Learning will shift toward a better balance between acquisition of factual knowledge and mastery of concepts and skills. Students are encouraged to engage in more active and independent learning. To facilitate the development of such a learner-centered environment (supported by the availability of technology and digital resources), a 10 to 30% reduction in curriculum content was instituted toward the end of 1998. The active use of ICT has also been incorporated into the revised syllabi of practically all subjects at all levels. The use of project work as a form of assessment has also been incorporated so that students' abilities to apply information, to think, and to communicate can be incorporated into the overall assessment modes.
2. *Learning resources:* The current strategy is to buy 'off-the-shelf' multimedia courseware titles and standard office application software. A system of convenient procurement to help schools obtain software easily and on time is put in place, with a central clearinghouse set up at the Ministry of Education. In areas where there is a lack of existing titles, the Ministry of Education works with local and overseas publishers to develop and publish new software. The Internet is an important resource; useful web sites are identified and classified according to the curriculum structures. National licensing for online database access also has been activated. A convenient one-stop Web-based access/service for teachers, called the eduMALL, has been set up and is proving to be very popular with them.
3. *Teacher development:* An effective and continuous program for training teachers in the purposeful use of ICT for teaching is central to the success of the Masterplan. Sixty master teachers have been recruited to be ICT coaches to Singapore's 24,000-strong teaching force. These coaches fan out to schools to train and help teachers incorporate ICT-facilitated learning strategies into their teaching practice. (The focus is on pedagogy rather than technology.) Prior to this stage all teachers receive training in basic technical skills such as word-processing and spreadsheet use. Pre-service teachers are required to undergo compulsory courses to equip them with core skills in teaching with ICT.
4. *Physical and technological infrastructure:* The Masterplan sets out, as a guideline for schools, the following national standards for the ICT infrastructure:
   - student:computer ratio of 2:1;
   - students to have access to ICT and Internet in all learning areas in the school;
   - teacher-computer ratio of 2:1;
   - school-wide network, and all schools linked through Wide Area Network, eventually enabling high-speed delivery of multimedia services on an island-wide basis.

The Masterplan envisages that, by 2002, students will spend up to 30% of curriculum time using ICT. Moreover, because the Masterplan is part of the national education policy, every school will be expected to reach by 2002 the national standards of ICT provision that the plan sets out. However, there is room for variance depending on the readiness of schools. Hence, schools that are more advanced will be able to proceed at a faster pace.

SLO ENIA

B a el and Tro ec[31]

ICT POLICIES

The process of 'informatization' in Slovene schools began in the early 1970s at the level of secondary education. The development of computer literacy of students initially focused on the learning of programming in Fortran and later in Pascal. At the time, computer science was introduced as a non-compulsory subject. At the primary level of education, computer education was introduced in the mid-1980s in the form of learning and using the Logo.

As part of the reform of the Slovene school system in 1980, computer education became compulsory at the level of secondary education, where it was taught mostly by mathematics and physics teachers and teachers of economics who had finished an additional one year of computer science training. At present, computer science is a compulsory subject in the first grade of secondary education (the ninth year of schooling), with the exception of a few schools, where computer education is introduced in the second grade. The content of the subject is adapted to the school program or track, but in general it comprises use of basic computing tools and the Internet. The subject is taught as much as possible in special computer laboratories that provide each student with access to a computer. In most of the secondary schools, the computers in the computer laboratory are connected in a local network. A computer technician who assists teachers of computer education classes takes care of the hardware and software. However, a lack of such personnel sometimes requires computer education teachers to take care of this equipment themselves. In elementary schools, computer science remains non-compulsory, but students receive grades if they decide to attend the course.

T E RO PROGRA

In 1994 the six-year Computer Literacy Development program (RO) was launched at the national level as a part of the new educational policy adopted by the Slovenian Parliament. The RO program comprises activities that provide teacher training, hardware and software, and the development of policies for the overall 'informatization' of the educational system. The main purpose of the program is to raise the level of 'informatization' in Slovene schools so as to promote a problem-solving approach to learning. Achieving this purpose requires adherence to the following goals:

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31 This section is based on: Skulj, T. (Ed) *RO: the level of computer literacy in Slovenian education, 1994, 1995, 1996, and 1997,* Ministry of Education and Sport and National Education Institute, as well as internal materials of the RO (Computer Literacy Development) program and the National Education Institute.

- qualifying teachers and students in the use of ICT;
- standardizing computer-supported transmission of data between schools and other institutions;
- unifying computer software used in schools for the purposes of teaching, administration, and management;
- equipping schools with up-to-date ICT;
- enabling research and further development to encourage the introduction of new information technologies into schools.

The RO project therefore includes training school personnel and purchasing basic sets of programming tools and educational software, presentation hardware, and Internet access equipment. The project also includes research projects.

Until 1999 approximately 22,000 teachers (3,750 kindergarten teachers, 7,821 elementary school teachers, and 7,642 secondary school teachers), school principals, and other educational workers at schools, kindergartens, and faculties attended seminars and training on computer science and the use of ICT. The types of training available to them included:

- basic training, intended for all school staff who use ICT at their work;
- didactic-methodological training for teachers who use computers in their lessons;
- specialized seminars for ICT coordinators at schools and persons who are part of the RO program as lecturers or assistants;
- training for school administration.

In percentages, 42% of the seminars involved lesson planning, 25% working with Windows and word-processing, 9% processing school records, 7% computer communications/ Internet, and 5% graphic design and using computers for technical subjects. The remaining 12% encompassed a variety of other seminars.

Software

The RO program also makes sure that schools use legal software by providing them with licensed 'basic software baskets' containing the operating system and software for word-processing, tables and databases, drawing and computer graphics, Internet access, and computer programming. Teachers at home can also use most of the software for educational purposes. The didactic software is distributed for use in:

- nursery schools, to help educators at their work;
- special-needs schools as technical aids for general skill and coordination exercises, and for mother tongue, science, and social science lessons;
- primary schools in the first four years for crafts, arts, mother tongue, English language, geography, biology, mathematics, etc.;
- secondary schools for the areas of wood-working, building, textile and leather, glass industry, marine engineering, electronic engineering, medicine, economics, and trade.

Schools use the software according to their needs and preferences. So-called focus schools of the RO program test the software and recommend its suitability for the educational process.

ardware

In regard to hardware, all elementary and secondary schools (a total of 584 schools) and other educational institutions have been equipped with computers and additions such as printers, plotters, scanners, modems, CD-ROM drives, digital cameras, LCD displays, and the like. In the first year of the program, priority was given to equipping computer laboratories and providing equipment for teachers, but, in general, the computer hardware that has been distributed includes:

- a computer laboratory containing 12 (elementary schools) or 16 (secondary schools) personal computers linked into a local network, laser and color printers, modem, and CD-ROM drives;
- computer equipment for the library (personal computer, laser printer, optic bar-code reader, modem, CD-ROM drive);
- a personal computer and laser printer for the staff room;
- computer equipment for educators in kindergartens (personal computer, color printer);
- computer equipment for designing materials;
- a computer for each teacher and school principal;
- servers supporting computer networks;
- presentation hardware (personal computer, LCD display, overhead projector);
- multimedia computers;
- computer equipment for children with special needs.

For some schools, the Ministry of Education and Sport has met the entire cost of computer hardware. Other schools have contributed 20 to 50% of the entire value.

Internet

Internet access for schools is provided by the public institute known as the Academic Research Network of Slovenia (ARNES). Access is provided to all members of school staff and to students who use the Internet for educational purposes. Students are granted Internet access if their parents agree to this, and the school provides a mentoring teacher. Internet services are provided free of charge, although the schools are required to cover the costs of telephone lines or rent for hired lines. Schools are systematically joining the Internet and are being encouraged to showcase their activities (for example, through contests for the best home page), to take part in virtual conferences, and to join national and international educational projects.

The RO program supports research and development activities that promote computer literacy in schools. These activities include developing multimedia teaching aids, teaching on the basis of visually supported interactive learning processes, using networks for school purposes, developing artificial intelligence to support educational processes, and developing methodologies for ICT-supported teaching and learning. These fundamental tasks are all necessary for the successful implementation of the RO program and for undertaking tendered projects for the production of multimedia programs and materials.

The program has also established cooperative enterprises with two international associations, introduced multimedia technology into schools, and included the subject of multimedia teaching aids into the curriculum of one of the two Slovene faculties of education. Furthermore, it has developed an expert system named Talent. The aim of this system is primarily to direct students into individual sports, but it is also designed to recognize talented students in other areas and to help them decide about future areas of study and careers.

Another area of the RO program relates to the use of ICT for educational administration purposes. School managers and administration quarters have been equipped with ICT (including Internet access) for the purposes of:

- school management;
- administrative work;
- accounting and book-keeping;
- maintaining the school database;
- managing school meals;
- the school counseling service;
- designing school timetables.

The aim of the RO program is to raise the level of ICT in the Slovene educational system and thus contribute to more efficient, modern, creative, and friendly schools. To achieve this, ICT must be integrated strongly into the curricula, and the software and hardware in schools must be used in ways that will achieve these objectives. A particularly important part of this process will be ongoing critical assessment of the RO program within schools.

SOUT AFRICA

A uller

ISTOR

The use of computers in schools commenced in the early 1980s. The national and provincial departments of education responded with policy initiatives to ensure developments at the grassroots level. Computers initially were used in school administration, in particular the scheduling of timetables and the keeping of student records. Computers also were used for recording examination marks and generating school reports. Gradually, as education departments, private companies, and private individuals developed computer courseware (for mathematics especially), the potential of computers to benefit learning and instruction became more visible. At the time, many workshops and conferences organized by educational stakeholders were devoted to advocating the use of computers in learning and instruction, with particular attention focused on the planning processes educational institutions could employ to acquire computers suitable to their institutional and learner needs. Many schools, both public and private, and especially special education schools, responded, the latter viewing the computer as a new occupational field that would improve the employability of their students.

PRESENT SITUATION

The current emphasis in policy relates the use of technology to issues such as equity and redress in an effort to ameliorate some of the educational legacies of the apartheid era. As South Africa devotes some 6 to 7% of GDP and some 22% of national budget to education, it is difficult for education authorities to access more funding from the national education budget of some R47B (approximately US$7B) for the use of technology in education and training. Although provincial education departments do make provision in their budgets for the acquisition of different technologies, budgets do not permit, for example, the large-scale purchase of computers for learning and instruction. In that respect, the role of the parent and consequently of school-governing bodies to fundraise for the purchase of computers has been a necessity, but this situation does raise equity, redress, and access concerns, as previous disparities (such as urban-rural, 'haves/have-nots') can be perpetuated.

In 1995/1996 a major survey was done by a consortium that included the Human Sciences Research Council (HSRC) and the so-called Register of School Needs Survey. Amongst other activities, the technology products that are used at schools were recorded and captured on the HSRC education database. The database indicates that some 10% of schools have access to computers. These schools include those that previously were dominantly white as well as, to a lesser extent, those that were previously black. A number of schools have, of course, very few computers, and these tend to be used for school administration purposes rather than learning and instruction. Other schools are quite well provided for, with the computers in these schools very definitely used for learning and instruction.

Recently, much attention (in the popular press, publishing houses, ICT publications, educator circles, and education departments) has focused on the Internet and the World Wide Web, which have become big news in the education and training sectors. A number of national initiatives, one by the Foundation of Research Development (recently transformed into the National Research Foundation) and one by Telkom (the national provider of telecommunications services), have focused on connecting schools to the Internet. The above statistic regarding the penetration rate of computers in schools has therefore already shifted. At the time of writing, the Register of School Needs Survey was to be repeated during 1999, bringing a much-needed update of the changes that have taken place in schools since 1996, most notably the acquisition of and access to computers and the Internet.

Overall, when viewing the South African data collected for SITES Module-1, it would appear that the experiences of the computer-using schools regarding the use of computers in learning and instruction are not that different from those of the international community. The key phrase here is, of course, 'computer-using schools', as it must constantly be borne in mind that no more than 10% of South African schools have access to computers.

CURRENT ICT-RELATED POLICIES

During 1996 a ministerial committee, which had been given the task of developing policy around the implementation of technology in South African schools, prepared a report entitled *Technology-enhanced Learning Initiatives in South Africa: a strategic plan*. This document still constitutes the broad policy framework for the implementation of technology in education and training systems but has not yet become official ICT policy published in, for example, a white paper. The goals, values, and principles of the new education and training system (referring, of course, to the education system of post-1994 and the change in the political dispensation) are summarized in the report[32] as follows:

- a commitment to providing access to quality education, and a right to basic education as enshrined in the Bill of Rights;
- a commitment to developing the full potential of South Africa's people for their active participation in all processes of a democratic society and their contribution to the economic growth and development of the country;
- redressing imbalances of the past through the implementation of new teaching and learning strategies for the effective and flexible delivery of services within various learning contexts and through the equitable distribution of technological and other resources;
- implementing learner-centered and outcomes-based approaches to education and training in order to achieve quality learning based on recognized national standards;
- enabling all people to value, have access to, and succeed in life-long education and training;
- developing a problem-solving and creative environment in which new technologies are harnessed to produce knowledge, products, and services;
- integrating technology into the strategies intended to reach these goals so as to advance South Africa's ability to harness new technologies in its growth and development. (p11)

The Center for Educational Technology and Distance Education of the national Department of Education sees itself as enhancing and supporting the work in the general, further, and higher education sectors. Within the context of a policy framework, intervention strategies are foreseen that include:

- providing guidelines as to appropriate hardware, applicable technologies, and the necessary infrastructure;
- developing learning materials, courseware, and programs;
- determining educator development and training strategies;
- defining and advocating appropriate methodologies and approaches;
- proposing venues (for example, learning centers) and institutions to extend the current formal education and training infrastructure.

Much is made in the ministerial committee report of the capacity of ICT to act as a dissemination channel for learning materials, and recognition is given to the role that broadcasting can play (due to the more attractive economies of scale that can be achieved).

32 Department of Education (1997) *Technology-enhanced Learning Initiatives in South Africa: a strategic plan*. Discussion document prepared for the directorate. Pretoria: National Center for Educational Technology and Distance Education,

However, the main emphasis of the report is that ‘Ultimately the outcomes of the transformation process will be measured against the achievement of four key criteria: equity, access, redress, and quality’ (p11).

T AILAND

P Waitayang oon

STRUCTURE AND NATURE OF T E EDUCATIONAL S STE

The current educational system covers preschool, primary, secondary, and higher education. Preschool education is optional for children between three to five years of age. A six-year primary education is compulsory for children between six and 11 years of age. Secondary education comprises a three-year lower-secondary stage and a three-year upper-secondary stage for students between 12 to 14 and 15 to 17 years respectively. Higher education comprises three levels: below Bachelor’s degree, Bachelor’s degree, and graduate.

Education at the school levels is mainly under the responsibility of the Ministry of Education. Both the public and private sectors are involved in the organizational aspects of education. Private schools are supervised by the Office of Private Education Commission, while public schools are, for the most part, under the control of the Department of General Education. The Department of Curriculum and Instruction Development is responsible for developing the primary and secondary school curricula in most subject areas. The Institute for the Promotion of Teaching Science and Technology is responsible for developing science, mathematics, and technology curricula at all school levels.

The major source of funding in education comes from the government budget. In 1998 the budget appropriated for education was about 25.2% of the national budget, which is equivalent to 3.5% of the GDP. Of this amount, 44.2% had been allocated to pre-primary and primary education, and 24.9% to secondary education.[33]

ICT IN EDUCATION POLICIES AND PRACTICES

Education is provided in accordance with the 1992 National Scheme of Education and the Eighth National Education Development Plan (1997–2001). Policies regarding the use of ICT in education are clearly stated in the Ministry of Education’s IT Masterplan, the eighth plan of which calls for information technology to be used as an integral tool of education and training at all levels, and for teachers and students to learn about and use IT.

The SchoolNet Project (which is one of the IT projects initiated by the National Electronics and Computer Technology Center (NECTEC), Ministry of Science, Technology and Environment, in collaboration with the Ministry of Education and private sectors) affects the use of Internet in education. This project started in 1995 to extend Internet services to secondary schools. The Golden Jubilee Network Project is another project that stimulates the use of Internet in education. Initiated in 1996/1997 by NECTEC as a tribute to His

33 Office of the National Educational Commission, Office of the Prime Minister (1998) *Education in Thailand 1998*. Bangkok: Amarin Printing and Publishing.

Majesty the King on the 50th anniversary of his accession to the throne, the project provides massive educational content in the Thai language on the Web. It also, through a unique network, allows the public throughout Thailand to access this material. The network was extended in 1998 to allow schools to access the Internet without requiring a long-distance phone call to Bangkok, providing a great opportunity for schools to begin utilizing the Internet in their libraries, classrooms, and laboratories. As of April 1999, more than 850 schools were using SchoolNet services, with more than 200 schools running their own web sites.[34]

The computer curriculum has been implemented in schools as elective courses in the area of vocational education of the lower and upper secondary school curricula. The second revision of lower secondary courses and the third revision of upper secondary courses were implemented in schools in December 1997. Six courses exist for lower secondary students: 'introduction to computers and information technology', 'introduction to computer applications', 'introduction to database management', 'introduction to programming concepts', 'graphics and computer presentation', and 'computer creativity'. Upper secondary students can accommodate their interests by selecting from among 11 courses: 'computer and information technology', 'electronic spreadsheet', 'database management', 'computer applications and word-processing', 'advanced computer', 'multimedia presentation', 'programming I', 'programming II', 'introduction to computer architecture', 'data communications and computer network', and 'computer projects'. Each course earns students two units (comprising four periods of instruction per week per semester).

Much effort has been made to implement the above courses as the core subjects to promote ICT literacy in all students. However, this effort has been stymied by the lack of necessary resources—computer personnel, hardware and software, and funding. Moreover, the lack of Thai educational software inhibits the use of computers in many subject areas.

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C APTER

CURRICULU AND PEDAGOG

W. J. Pelgrum (University of Twente)

This chapter offers a description of ICT-related curriculum indicators. Distinctions are made between the objectives of schools, the prevailing pedagogical orientation, and the ICT-related learning opportunities that are offered to students. The results of first analyses of the collected information are presented at the end of this chapter.

INTRODUCTION

An educational system can be conceived as consisting of sub-systems that exist at different organizational levels:

- *macro-level:* the (administrative and political) system of a country or state that is responsible for the overall organization;
- *meso-level:* the school and the classroom;
- *micro-level:* the student.

At each level, decisions about educational goals and facilities are taken by (and/or influenced by) different groups of actors. At the school level, for example, these people include the school board, the principal, members of the subject-matter department, and the teacher. External influences may be exerted by, for example, business and industry or parents. The output of a sub-system at a certain level forms the input for the sub-system on the next level. For example, the output at the macro-level may consist of policies, intentions, and plans of governments, laid down in official documents, or existing as shared conceptions of what is expected from schools. These, in turn, form the input for schools, while the output at this level consists of the activities and the practices in the classrooms, the time allocations, and the ICT-related instructional practices of teachers. This input at the micro-level results in the realization of learning activities undertaken by students and the associated outcomes, for instance, the competencies and attitudes of students.

In order to describe curricula in a cross-national, comparative way, the IEA for a long time has made a distinction between the intended, implemented, and attained curriculum (see, for instance, Robitaille & Garden, 1989; Pelgrum & Plomp, 1993). These different perspectives (or manifestations of curricula) can be characterized as follows:

- The *intended curriculum* refers to the curriculum plans (at the macro-level), which may be set out in official documents or which may exist as shared conceptions of what constitutes important curriculum content.
- The *implemented curriculum* (at the meso-level) consists of the content, time allocations, instructional strategies, and so on that teachers actually realize in their lessons.
- The *attained curriculum* (at the micro-level) is defined as the competencies and attitudes of students that occur as a result of teaching and learning.

The school survey part[1] of SITES Module-1 made a distinction between:

- *School-intended curriculum:* This is the curriculum that schools intend to realize. It can be described in terms of, for instance, ICT-related objectives, achievement targets, and intended educational processes (instructional processes, role of teachers, evaluation procedures).
- *Implemented curriculum:* This is made up of perceptions of school principals of the educational processes that take place at the teacher and student levels. It can be described in terms of the learning opportunities offered to students.

For SITES Module-1 (which was a survey at the school level) it was seen as appropriate to collect data regarding the school-intended curriculum from school principals because one would expect these respondents to be well informed about their respective schools' intentions and plans. An attempt was also made in SITES Module-1 to collect estimates from school principals about the implemented curriculum.[2] In a full-scale IEA study, teachers and students usually provide such estimates. Therefore, it should be noted that estimates from school principals are likely to be more questionable in terms of reliability and validity than are answers to questions, which are related to the objectives of the school.

As a follow-on to the presentation of the overall framework for SITES Module-1 in Chapter 1, the more detailed framework for distinguishing and describing ICT-related curriculum indicators is shown in Figure 3.1.

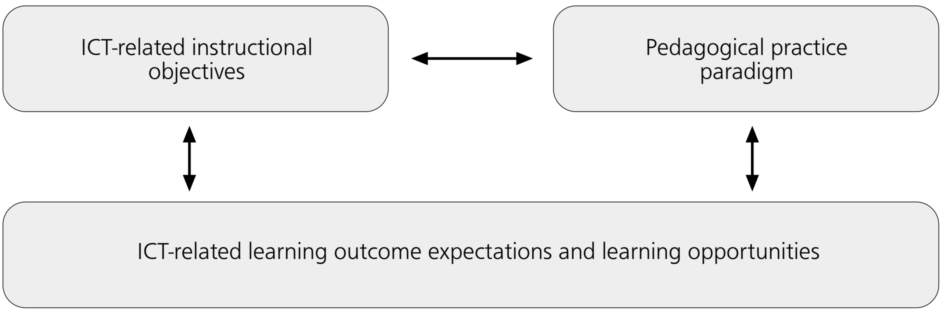


Figure 3.1 Framework for indicators of the curriculum and ICT.

The pedagogical paradigm of schools refers to emerging versus traditionally important pedagogical practices. A description of the extent to which schools have implemented practices that are related to each of these paradigms may offer important contextual information for understanding the ICT-related objectives and practices of schools.

In the following sections, each of the areas from Figure 3.1 is further defined in terms of questionnaire operationalizations and the indicators that were constructed on the basis of these questionnaires.

1 See Plomp, Law, Quale, and Anderson (in preparation) for information about the national context of ICT in education.

2 During the preparatory phase of SITES Module-1, participants collectively agreed that school principals would not be able to provide reliable estimates of learning outcomes of students.

Before summarizing the statistics regarding the curriculum indicators, we should point out that, at this stage of SITES, one needs to be cautious with regard to the interpretation of the indicators of pedagogical paradigms. These indicators seem to have face validity, and factor analyses showed the empirical tenability of the distinction between the emerging and traditionally important practices. However, the construct validity of these indicators has not yet been investigated in depth. Therefore it is not known yet if, for example, the indicator of emerging pedagogical practices really reflects the extent to which schools have implemented a curriculum that is focused on student-centered, active, and autonomous learning.

PEDAGOGICAL PRACTICE PARADIG

To investigate the extent to which schools had adopted particular pedagogical practices, a list of statements was used that had originally been developed by a Dutch research team involved in national monitoring of ICT in the Netherlands (see ten Brummelhuis, 1999). These statements as well as the stem of the related question are shown in Table 3.1.[3] For a full description of the question from which this list is extracted, see Appendix C, Principal Questionnaire, question number 7.

Table 3.1 Question and statements about the presence of pedagogical practices in the schools

To what extent is each of the following aspects of teaching and learning present in your school?

(Answer alternatives were 'not at all', 'to some extent', 'a lot'.)

1. Students developing abilities to undertake independent learning
2. Providing weaker students with additional instruction
3. Organizing teaching and learning so that differences in entrance level, learning pace, and learning route are taken into account
4. Students learning to search for information, process data, and present information
5. The emphasis in learning is on the development of skills
6. Students working on the same learning materials at the same pace and/or sequence
7. Teachers keeping track of all student activities and progress
8. Students being largely responsible for controlling their own learning progress
9. Students learning and/or working during lessons at their own pace
10. Students involved in cooperative and/or project-based learning
11. Students determining for themselves when to take a test
12. Students learning by doing
13. Combining parts of school subjects with one another (multidisciplinary approach)

3 The stem of the question that was used in the Netherlands is different from the one used in SITES Module-1. The Dutch version asked respondents to rate the importance of each aspect in relation to the educational objectives of the school.

Appendix F (Tables F.1.1–F.1.3) contains tables showing, for each educational level, the percentages of students whose principals indicated that each of these practices was present 'a lot' in the school.

A number of items in the list in Table 3.1 were seen as clear manifestations of the emerging practices (for example, items 1, 8, 9, and 10), while others were seen as reflecting the traditionally important practices (for example, items 5, 6, and 8). The researchers participating in SITES Module-1 found it not so easy to reach consensus on the practice orientations to which they should allocate the remaining statements. It therefore was decided to investigate this matter further via empirical analyses. These analyses (for further details, see Appendix E) provided substantial evidence that statements 1, 2, 3, 4, 8, 9, 10, and 13 could be interpreted as reflecting emerging practices, while statements 5, 6, and 7 could be combined into an indicator of traditionally important practices.

The box plots in Figure 3.2 provide a condensed summary of the median values per country and dispersion within countries of indicators on the emerging and the traditionally important practices. Tables F.1.1– F.1.3 present the average values (and associated standard errors) per country and educational level for each of these indicators.

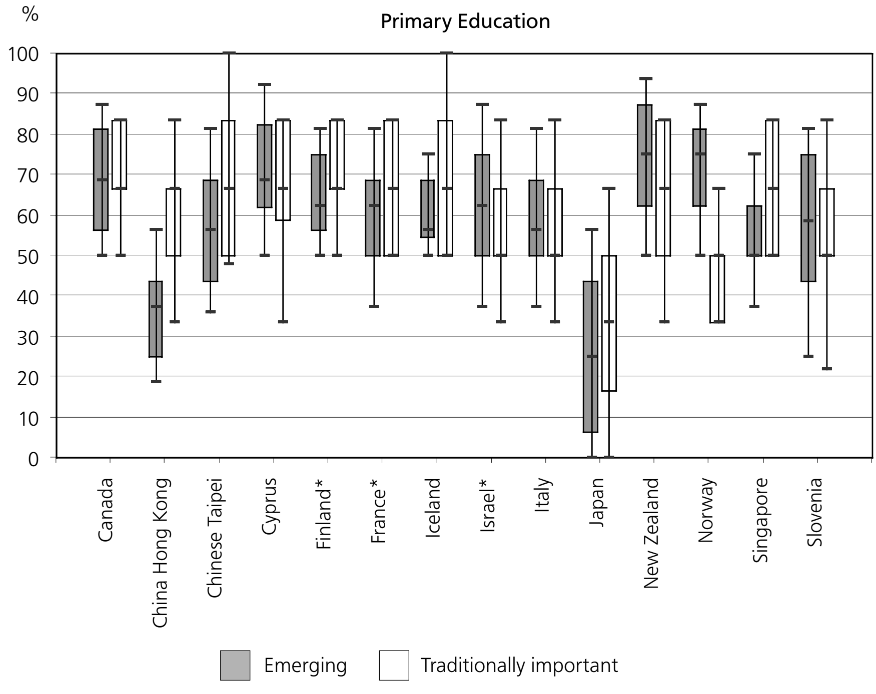
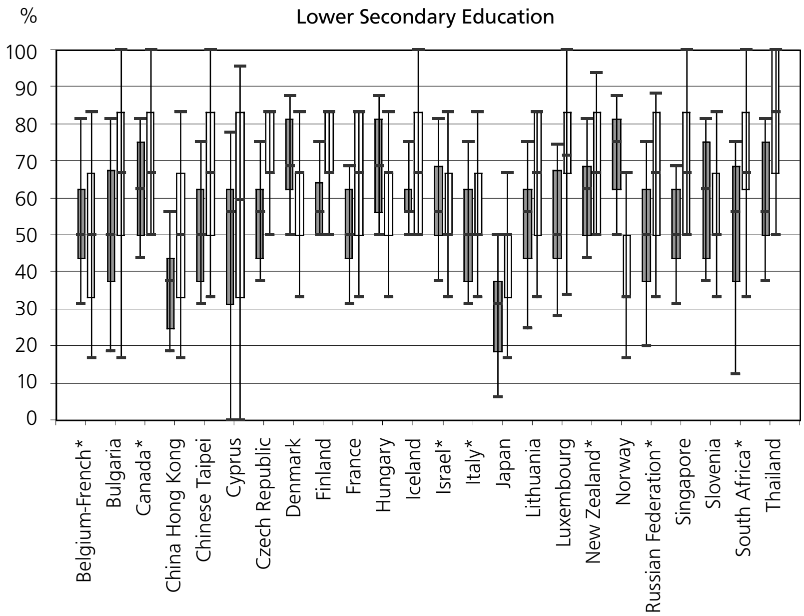
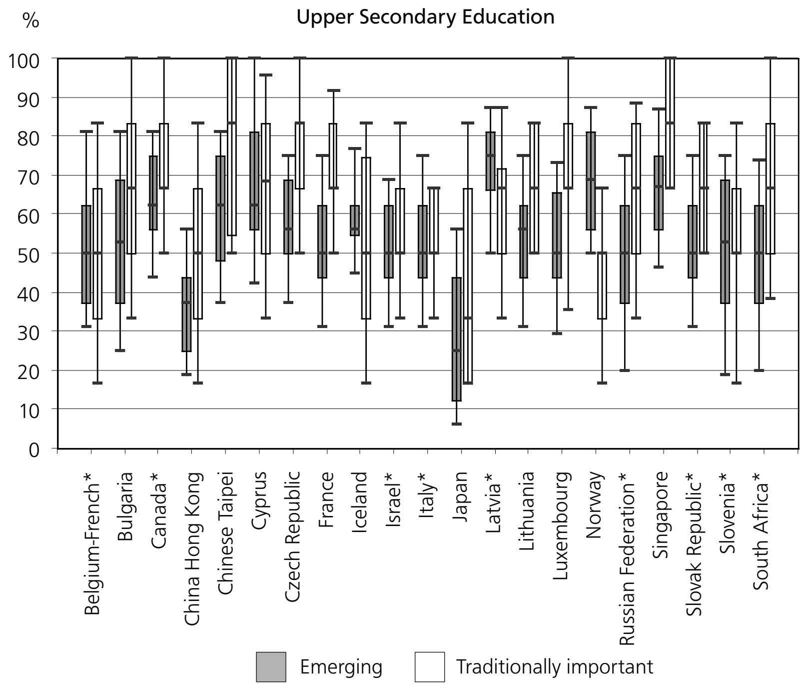


Figure 3.2 *(contd. on page 91)*





Notes: Boxes range from 25% lowest to 75% highest value; the horizontal line in the boxes represents the median; tiles show values for 10% and 90% of the cases. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2).

Figure 3.2 (contd. from previous page) Box plots of indicators concerning the emerging and traditionally important pedagogical practices paradigm for primary, lower secondary, and upper secondary education.

A general observation from Figure 3.2 is that the indicators vary quite substantially between as well as within countries.

Figure 3.2 shows that at the *primary level* the highest values on the emerging practices indicator were evident in Canada, Cyprus, New Zealand, and Norway. The lowest medians on this indicator were observed in China Hong Kong and Japan. The values for the traditionally important practices were (statistically) higher than or equaled the values for the emerging practices, except in New Zealand and Norway (these comparisons can most quickly be inspected in the last two columns of Tables F.1.1–F.1.3 in Appendix F).

Figure 3.2 reveals that for *lower secondary education* in some countries (especially Denmark, Hungary, and Norway), the presence of learning activities associated with the emerging practices was relatively high when compared with other countries. Relatively low median values on this indicator were observed particularly for China Hong Kong and Japan. The median values for the traditionally important practices were higher than or equaled the emerging practices, except in Denmark, Hungary, Norway, and Slovenia (see Table F.1.2).

At the *upper secondary level* it appeared that the average score for the emerging practices was highest in Canada, Chinese Taipei, Cyprus, Latvia, Norway, and Singapore. It was lowest in China Hong Kong and Japan. The values for the traditionally important practices were significantly higher or equaled the emergent practices, except in Iceland, Latvia, and Norway.

It was mentioned in Chapter 1 that a currently widely held belief is that the implementation of emerging pedagogical practices may be facilitated by applying ICT. A possible hypothesis that may be derived from this belief is that schools that have used ICT for a large number of years may have higher scores on the emerging pedagogical practices indicator than schools that had started only relatively recently. Conversely, this trend should not be expected for the traditionally important practices. The breakdown[4] (as shown in Figure 3.3) does not lend strong support to these hypotheses: both practice orientations tend to co-vary in a similar way with the number of years that ICT had been applied in the schools.

ICT-RELATED INSTRUCTIONAL OB ECTI ES

In order to acquire estimates of the ICT-related learning objectives that schools had adopted, the school principals were asked two questions (see Table 3.2). The first concerned the goals that were important in determining the current use of ICT in the schools. The second dealt with the adoption by schools of ICT-related policy goals on aspects of instruction (teaching and/or learning). Tables F.2.1–F.2.3 present the percentages of students at schools where the A-items and B-items were answered with respectively 'very important' and 'yes'.

Tables F.2.1–F.2.3 in Appendix F reveal that, especially in secondary education, the 'very important' goals (the A-items) were, amongst others, *increasing interest in learning, promoting independent and active learning, and preparing students for future jobs*. The following

4 The breakdown in Figure 3.3 is based on pooled data for lower secondary schools from all countries. Weights were applied to ensure that each country had the same weight.

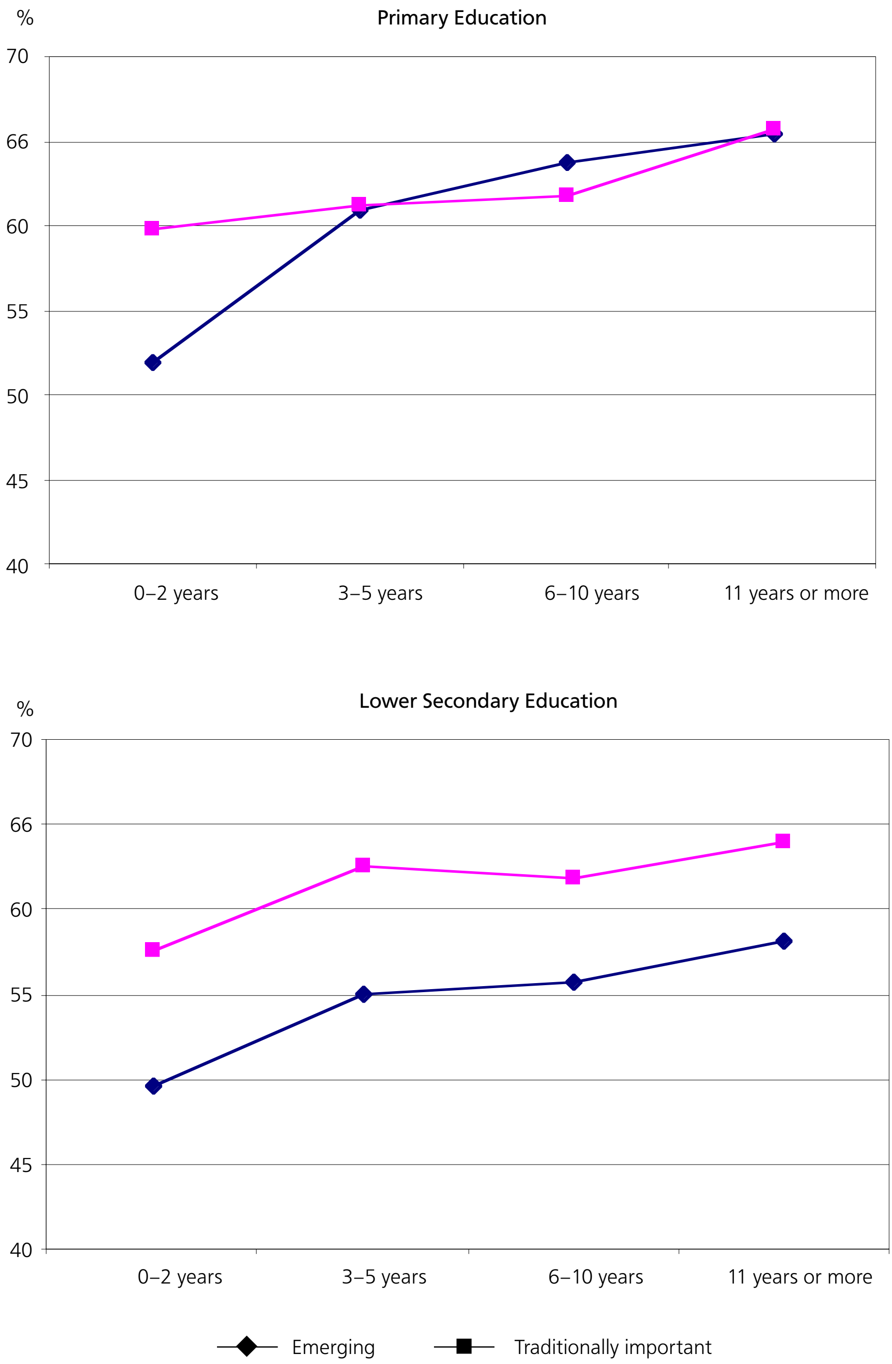


Figure 3.3 Breakdown of indicators of the emerging and traditionally important paradigm with regard to number of years that schools at different educational levels had been using ICT for instructional purposes. *(contd. on page 94)*

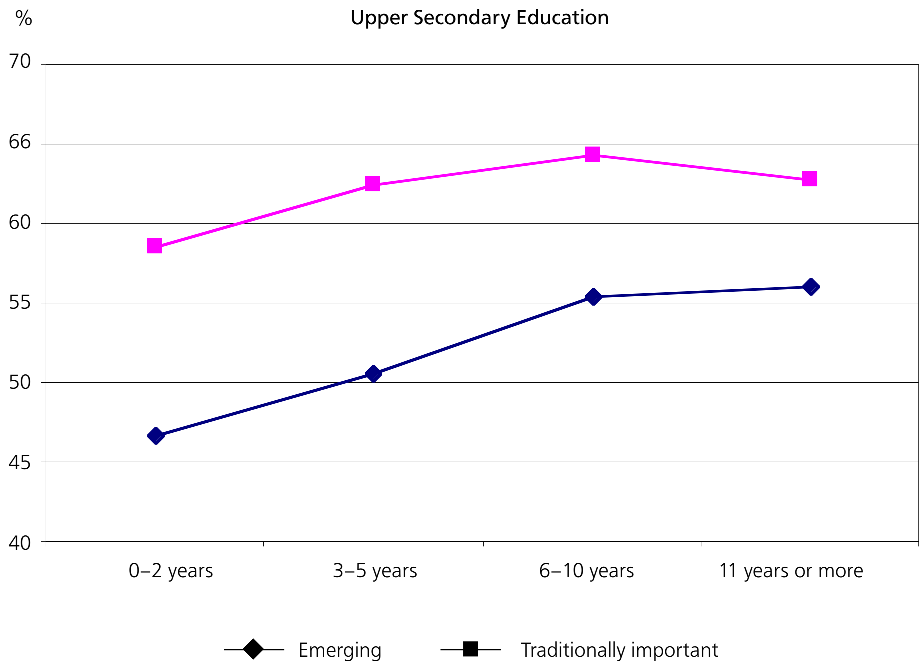


Figure 3.3 (contd. from previous page) Breakdown of indicators of the emerging and traditionally important paradigm with regard to number of years that schools at different educational levels had been using ICT for instructional purposes.

observations can be made in regard to the B-items[5] (as highlighted in the Appendix F tables).

Primary Education

- In Canada, Finland, Iceland, New Zealand, Norway, and Singapore, a very high percentage of students were at schools that were striving to make computers available to every classroom. This situation was evident to a much lesser extent in Italy and Japan.
- Almost all students were in schools that had adopted the objective that teachers use computers in their instructional practice. However, in Chinese Taipei and Cyprus more than a quarter of the students were in schools that indicated this was not the case.
- More than three-quarters of students attended schools in which the objective was adopted to use software for students with learning problems. These percentages were lower in China Hong Kong, Chinese Taipei, Japan, and Slovenia.

5 A comparison of these results with those from the ICT-monitor in the Netherlands (ten Brummelhuis, 1999) indicates that the percentages for items B1 to B5 were very high (above 80%) for primary education. The objectives of email use by students and the use of external databases were both about 35%. The percentages for lower secondary education in the Netherlands relating to items B1 to B5 were respectively 51%, 96%, 87%, 88%, and 93%. The objective of using external databases (B7) had a high percentage (81%).

- Encouraging independent learning as well as using computers as supportive learning aids were objectives for the majority of students in most countries, but this was the case to a lesser extent in Italy and Japan.
- The objectives of email use by students *and* the use of external databases were adopted for a substantive majority of students attending schools in Finland, Iceland, New Zealand, and Slovenia. In these countries, also, relatively high percentages of students attended schools that had adopted the objective of cooperation with other schools in the area of computers.

Table 3.2 Questions and statements about ICT-related instructional objectives of schools

A. How important was each of the following goals in determining how computers are now used at your school?

Answer options: 'not important', 'important', 'very important'.

1. To prepare students for future jobs
2. To improve student achievement
3. To promote active learning strategies
4. To individualize student learning experiences
5. To encourage more cooperative and project-based learning
6. To develop student independence and responsibility for own learning
7. To give students drill and practice exercises
8. To make the learning process more interesting

B. The following statements concern the use of computers in different aspects.

1) Is this a policy goal in your school?

Answer options: 'no', 'yes'

1. One or more computers available in every classroom
2. Teachers use computers in their instructional practice
3. Using software for students with learning problems
4. Encouraging students' learning on their own with the computer/encouraging independent learning with the aid of computers
5. Students using computers as supportive learning aids (e.g. searching, analyzing, and presenting information)
6. Students use email
7. Students access external databases via the Internet/WWW
8. Cooperation with other schools in the area of computers

Lower Secondary Education

- In Finland, Iceland, and Luxembourg a relatively high percentage of students were in schools that were striving to make computers available to every classroom. This objective was evident only for a low percentage of students in Cypriot, Czech Republican, Japanese, and Thai lower secondary schools.
- Almost all students attended schools that had adopted the objective that teachers use computers in their instructional practice. The exceptions were Cyprus and the Russian Federation.
- The objective to use software for students with learning problems was adopted by most schools in some countries (for example, Iceland, Norway, and others), but was rarely evident in other countries (for example, Cyprus, Japan, and Thailand).
- Encouraging independent learning as well as using computers as supportive learning aids were objectives for the majority of students in all countries except the Russian Federation.
- Large differences existed between countries in terms of percentages of students attending schools that had adopted objectives with regard to communication (items B6, B7, and B8).

U er Secondary Education

- Placing computers in classrooms was a widely adopted goal in (especially) Iceland, Luxembourg, Singapore, and the Slovak Republic. This goal was evident to a much lesser extent in the Czech Republic and Japan.
- Except for the Slovak Republic and the Russian Federation, most students attended schools that had adopted the goal that teachers use computers in their instruction.
- In some countries almost all students attended schools that had adopted the goals that students should use email (for example, Chinese Taipei, Iceland, Singapore, Slovenia), while in other countries this was the case for only a minority of students (for example, Belgium-French, Japan, and the Slovak Republic).

The goal statements listed in Table 3.2 contain objectives that may be qualified as emerging versus traditionally important. It was hypothesized that A3, A4, A5, A6, B4, B5, and B8 might be combined into an indicator of emerging objectives, while A1, A2, and A7 would manifest traditionally important objectives. From reliability analyses it appears that the hypothesized scale was moderately acceptable only for an indicator of emerging objectives comprising items A3, A4, A5, and A6 (the alpha on pooled country data varied for the different populations between .68 and .71). The reliability for a scale comprising items A1, A2, and A7 was unsatisfactory (between .41 and .46 for the pooled data set). However, further analyses showed quite plausible patterns when the co-variation[6] between the pedagogical practice indicators (from the previous section) and the objective indicators was examined for lower secondary education (see Figure 3.4).

6 Co-variation between two variables means that low and high values on one variable tend to be associated with respectively low and high values on the other variable.

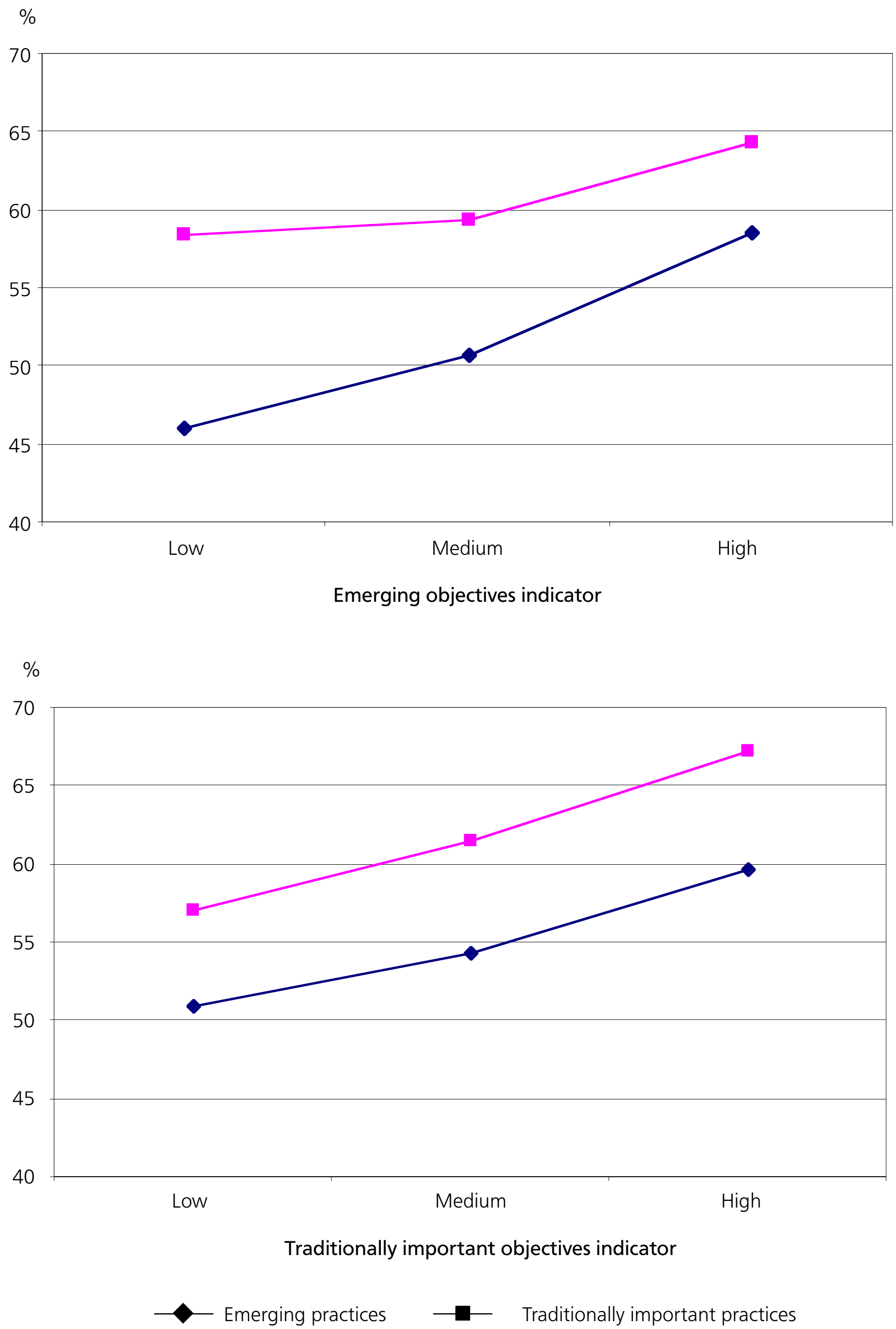


Figure 3.4 Breakdowns of present pedagogical practice indicators by low, medium, and high score-levels on indicators of objectives (regarding the emerging and traditionally important paradigm) for lower secondary education.

Figure 3.4 provides a slight indication that the emerging and traditional ICT-related objective indicators co-vary differently with indicators of the emerging and traditionally important pedagogical practices. These measures may still be worth considering even though they may offer pictures analogous to viewing a scene through distorted lenses.

Figure 3.5 contains the box plots for the indicators of emerging and traditionally important ICT-related objectives for all three educational levels. It shows that emerging ICT-related objectives had been adopted to a high degree in, for example, Israel and Singapore but to a lesser extent in Japan. The plots also illustrate that a high variation existed between schools.

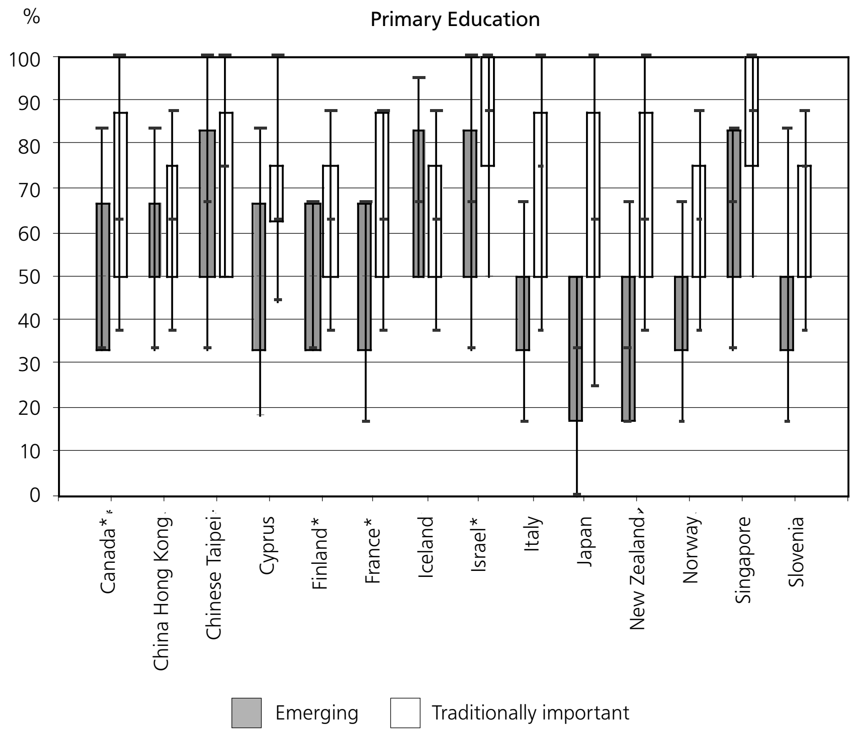
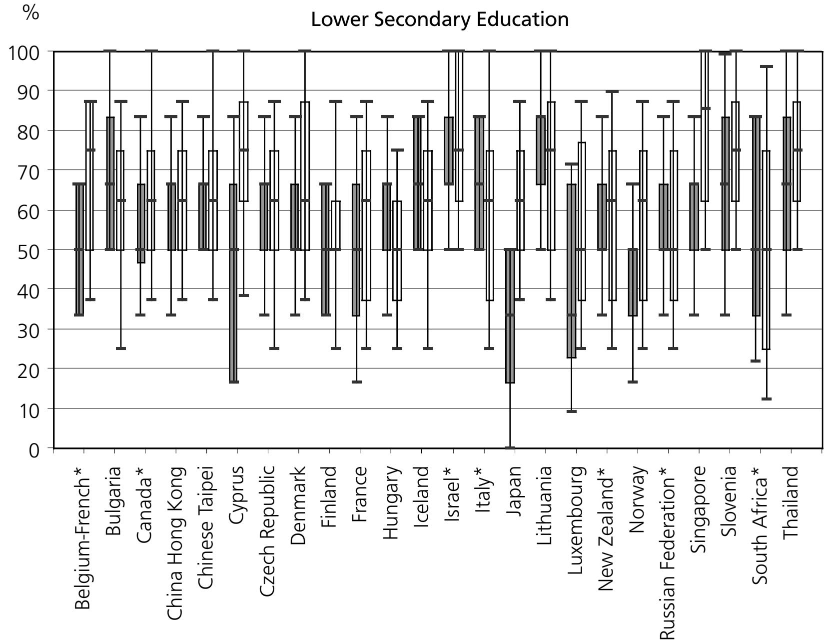
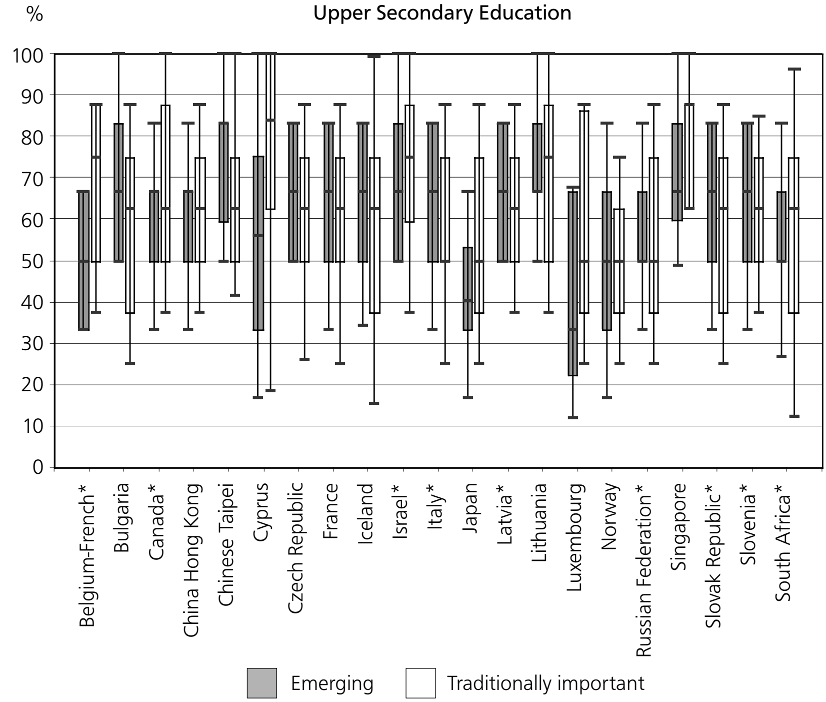


Figure 3.5 Box plots of indicators concerning the emerging and traditionally important objectives for primary, lower secondary, and upper secondary education. *(contd. on page 99)*





Notes: Boxes range from 25% lowest to 75% highest value; the horizontal line in the boxes represents the median; tiles show values for 10% and 90% of the cases. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2).

Figure 3.5 (contd. from previous page) Box plots of indicators concerning the emerging and traditionally important objectives for primary, lower secondary, and upper secondary education.

With regard to expectations regarding the outcomes of learning about ICT, school principals were requested to indicate, on the basis of the school's objectives, which of the following skills students should have acquired by the time they had reached the end of the target grade:

1. Operating a computer (saving files, printing, keyboarding)
2. Writing documents with a word-processor (typing, editing, layout)
3. Making illustrations with graphical programs
4. Calculating with spreadsheet programs (sheet creation, using formulas)
5. Writing simple programs (in e.g. Logo, Pascal)
6. Communicating via email with teachers and other students
7. Sending, searching for, and using electronic forms of information
8. Other

Tables 3.3.1–3.3.3 contain the percentages of students at schools where principals checked each of the items in this list. The tables also contain the percentages of the total number of items that were checked (these were averaged across the schools for each country).

A word of caution is necessary here. Table 1.2 (in Chapter 1) shows that the target grade definitions differed slightly between countries. It is not known to what extent these differences may have led to flaws in the comparisons.

It is evident from Table 3.3.1 (*primary education*) that most principals considered it important for students to learn to operate a computer, although this was the case to a somewhat lesser extent for principals in China Hong Kong and Japan. Word-processing was also a target for a substantial majority of students in most countries, except for China Hong Kong, Chinese Taipei, Iceland, Japan, and Slovenia. The other competencies showed a much more heterogeneous picture across countries. For example, in New Zealand the target of students learning how to make illustrations with graphical programs was considered important for about three-quarters of the students, while this was the case for only 10% of the students in Norway's primary schools. This variation can also be observed for skills regarding communications and the use of electronic information. Communication via email, for example, was expected from more than 50% of the students in New Zealand, but from 10% or less of the students in Iceland. The overall index in Table 3.3.1 indicates that the highest expectations with regard to ICT skills of students were observed in Canada, New Zealand, and Singapore, while the lowest figures were obtained for China Hong Kong, Iceland, Japan, Norway, and Slovenia.

Table 3.3.2 reveals that in most countries at the *lower secondary level* principals expected students to learn to operate a computer. However, this expectation was evident for only 50% or less of the students in the Russian Federation and Slovenia. A possible explanation for this observation (which was confirmed by the Slovenian research team) is that lower secondary schools expect that these skills will have been learned at the primary school level. Another noteworthy exception is that a relatively small proportion of the student

Table 3.3.1 Percentages of students whose school principals indicated that students should have acquired particular ICT-related skills by the end of the target grade—primary education

	1. Operating a computer	2. Word-processing	3. Illustrating with graphics	4. Calculating with spreadsheets	5. Writing simple programs	6. Communicating via email	7. Use electronic information	ICT skill coverage
Canada*	96	94	64	24	7	46	68	57 (0.6)
China Hong Kong	62	43	23	11	10	24	27	29 (2.0)
Chinese Taipei	75	56	51	7	1	38	35	38 (1.8)
Cyprus	92	96	66	14	23	27	31	50 (3.9)
Finland*	91	79	47	1	2	36	34	41 (1.5)
France*	97	96	39	16	6	39	43	48 (1.1)
Iceland	71	54	49	4	0	6	17	29 (1.8)
Israel*	80	80	69	16	13	24	24	44 (2.2)
Italy	78	76	49	16	12	36	31	42 (1.8)
Japan	58	34	50	5	3	12	7	24 (1.6)
New Zealand	96	94	74	22	6	58	67	60 (1.5)
Norway	72	69	10	6	5	16	28	29 (0.6)
Singapore	98	96	81	10	6	41	54	55 (1.4)
Slovenia	82	51	31	0	19	13	13	30 (1.5)

Notes: The last column presents average values and standard errors (between brackets) for indicators of ICT skill coverage. Standard error (se): value ± 2*se provides 95% confidence interval for the population. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages.

population (in Belgium-French, Cyprus, and the Russian Federation) was expected to learn how to write in electronic form.

The picture is much more heterogeneous for the other ICT-related skills in Table 3.3.2. For example, the expectation that students would be able to use computers for making illustrations was important for a substantial majority of students in Chinese Taipei and Singapore, but much less so in, for instance, Italy and Norway. A relatively high percentage of students in Denmark and Slovenia were expected to learn how to use spreadsheets. However, this was hardly the case in, for instance, Belgium-French, Bulgaria, Cyprus, Japan, and the Russian Federation. Programming was important for a majority of students in China Hong Kong, Hungary, and Slovenia, but rarely in, for instance, Denmark, France, Iceland, and Norway. The overall index in Table 3.3.2 suggests that the highest expectations with regard to students' ICT skills took place in Denmark, Singapore, and Slovenia, while the lowest expectations took place in Japan and the Russian Federation.

Table 3.3.2 Percentages of students whose school principals indicated that students should have acquired particular ICT-related skills by the end of the target grade—lower secondary education

	1. Operating a computer	2. Word-processing	3. Illustrating with graphics	4. Calculating with spreadsheets	5. Writing simple programs	6. Communicating via email	7. Use electronic information	ICT skill coverage
Belgium-French*	82	49	32	14	26	32	35	39 (2.1)
Bulgaria	87	65	37	19	38	25	19	41 (1.7)
Canada*	95	94	49	44	9	51	76	60 (0.8)
China Hong Kong	94	85	42	43	59	55	55	62 (1.6)
Chinese Taipei	99	92	80	30	10	70	66	64 (1.3)
Cyprus	74	44	72	6	10	29	22	37 (5.0)
Czech Republic	96	93	62	66	22	33	36	58 (1.4)
Denmark	99	98	64	77	3	62	79	69 (1.2)
Finland*	97	91	47	37	10	71	74	61 (1.6)
France	99	97	49	68	5	48	61	61 (1.1)
Hungary	98	89	65	53	51	28	44	61 (1.4)
Iceland	96	90	56	38	5	52	54	56 (2.5)
Israel*	94	92	73	69	21	36	35	60 (2.2)
Italy*	89	83	23	61	50	29	27	52 (1.7)
Japan	75	64	51	20	11	13	7	34 (1.6)
Lithuania	88	67	53	34	42	39	33	51 (1.8)
Luxembourg	100	95	40	33	12	57	82	60 (4.8)
New Zealand*	99	98	63	58	10	46	67	63 (1.4)
Norway	89	88	25	61	4	49	70	55 (0.9)
Russian Federation*	42	21	27	19	30	4	6	21 (2.6)
Singapore	97	99	89	42	10	67	73	68 (1.7)
Slovenia	51	73	79	75	55	79	79	70 (1.9)
South Africa*	83	68	40	34	16	30	26	42 (3.0)
Thailand	90	80	36	28	12	10	10	38 (1.1)

Notes: The last column presents average values and standard errors (between brackets) for indicators of ICT skill coverage. Standard error (se): value ± 2*se provides 95% confidence interval for the population. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages.

In *upper secondary education* (Table 3.3.3) the majority of students were expected to be able to operate computers as well as to write with word-processors and to calculate with spreadsheets. The writing of simple programs was expected from more than three-quarters of students in some countries (for example, China Hong Kong, Cyprus, Lithuania, and the

Russian Federation), but not in other countries (for example, France, Iceland, Norway, and Slovenia). Considerable variation between countries was also evident with regard to electronic communication skills. On the overall index, China Hong Kong, Luxembourg, and Singapore showed the highest percentages, while in Japan the percentage was relatively low.

Table 3.3.3 Percentages of students whose school principals indicated that students should have acquired particular ICT-related skills by the end of the target grade—upper secondary education

	1. Operating a computer	2. Word-processing	3. Illustrating with graphics	4. Calculating with spreadsheets	5. Writing simple programs	6. Communicating via email	7. Use electronic information	ICT skill coverage
Belgium-French*	71	83	52	76	33	71	66	65 (2.3)
Bulgaria	92	86	48	60	61	26	19	56 (1.5)
Canada*	97	97	58	65	30	62	87	71 (0.9)
China Hong Kong	93	93	71	78	73	78	78	80 (1.7)
Chinese Taipei	97	95	60	63	50	88	82	76 (1.6)
Cyprus	97	97	76	76	82	38	55	74 (3.3)
Czech Republic	100	100	65	91	30	67	73	75 (1.2)
France	97	95	52	81	12	59	72	67 (1.2)
Iceland	99	99	34	94	11	78	84	71 (3.2)
Israel*	99	97	79	93	61	55	59	78 (1.9)
Italy*	82	83	46	71	53	48	58	63 (1.7)
Japan	71	73	22	60	28	21	14	41 (1.9)
Latvia*	100	97	92	85	52	26	19	67 (1.8)
Lithuania	92	92	65	68	82	74	69	77 (1.0)
Luxembourg	98	98	77	98	58	94	96	88 (4.1)
Norway	95	97	37	84	8	65	81	67 (1.0)
Russian Federation*	87	72	67	67	79	12	14	57 (2.6)
Singapore	98	98	69	76	46	97	94	83 (3.2)
Slovak Republic*	96	95	69	95	42	53	58	73 (1.6)
Slovenia*	89	93	64	64	15	66	78	67 (2.2)
South Africa*	97	93	58	76	42	54	51	67 (2.5)

Notes: The last column presents average values and standard errors (between brackets) for indicators of ICT skill coverage. Standard error (se): value ± 2*se provides 95% confidence interval for the population. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages.

PERCEI ED ICT-RELATED LEARNING OUTCO E E PECTATIONS AND LEARNING OPPORTUNITIES

An issue that is related to the ICT objectives of schools (discussed in the previous section) is that of the ICT-related learning opportunities offered to students. The following categories of indicators were distinguished in regard to these opportunities (note that the indicators in this section are based on the perceptions of school principals or technical respondents):

- perceived opportunities for using ICT-applications;
- perceived opportunities for using the Internet;
- perceived ICT-related opportunities related to the emerging pedagogical practices;
- perceived ICT-related opportunities related to the traditionally important pedagogical practices.

Percei ed O ortunities for Using ICT A lications

To acquire an estimate of the opportunities offered to students for getting acquainted with several kinds of ICT applications, respondents were requested to indicate whether a typical student would have used any of the following technology applications at school by the end of the target grade:

1. Simulations of natural or man-made systems (e.g. work environments, human and animal populations, etc.)
2. Dynamic modeling and graphical modeling of mathematical functions
3. Software for simple data manipulation and statistical analysis
4. Word-processing/desktop publishing
5. Hardware and software for real-time data collection (data logging) and data manipulation for science investigations
6. Spreadsheets
7. Software supporting creative works (music/arts)
8. Computer-aided design/computer-aided manufacturing
9. An interactive multimedia encyclopedia on CD-ROM
10. Software for learning programming skills

Tables 3.4.1–3.4.3 contain, for each ICT application per country and educational level, the percentage of students at schools where respondents indicated that a particular application would have been used by the time a typical student would have reached the end of the target grade.[7]

7 The reader is referred to the word of caution that was expressed in connection with Tables 3.3.1, 3.3.2, and 3.3.3.

Table 3.4.1 Percentages of students whose schools (technical respondents) indicated that a typical student would have used particular ICT applications by the end of the target grade—primary education

	1. Simulations of natural systems	2. Modelling mathematic. functions	3. Software data manipul./statistics	4. Word-processing/desktop publ.	5. Hard-/softw. real time data coll.	6. Spreadsheets	7. Software creative works	8. Computer-aided design/manufac.	9. Interactive encycl. CD-ROM	10. Software for programming	Application coverage
Canada*	34	27	48	98	17	40	45	11	90	25	50 (0.5)
China Hong Kong	3	~	10	28	2	10	11	~	28	4	12 (0.8)
Chinese Taipei	3	~	0	57	1	5	23	~	23	1	14 (0.9)
Cyprus	7	~	12	93	3	25	68	~	70	7	36 (1.3)
Finland*	5	~	18	97	5	13	51	~	81	2	34 (1.0)
France*	3	~	13	93	7	17	23	~	61	3	27 (0.9)
Iceland	3	26	18	77	3	10	31	0	23	3	21 (0.8)
Israel*	24	~	24	83	23	21	31	~	42	14	33 (2.0)
Italy	14	~	26	55	17	17	51	~	62	8	31 (1.8)
Japan	14	~	10	39	11	13	46	~	24	3	20 (1.5)
New Zealand	22	~	60	99	16	43	53	~	96	32	53 (1.4)
Norway	4	5	15	87	3	28	24	0	72	3	30 (0.3)
Singapore	31	~	32	97	15	14	75	~	95	15	47 (0.0)
Slovenia	12	~	6	44	3	5	27	~	33	25	19 (1.4)

Notes: The last column presents average values and standard errors (between brackets) as an indicator of application coverage. Standard error (se): value ± 2*se provides 95% confidence interval for the population. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). ~: data not collected. See Appendix D for rules of thumb for estimating the standard error for percentages.

The results in these tables indicate that in almost all countries at the *primary* and *lower secondary levels*, word-processing was one of the most popular ICT applications. However, in primary schools in China Hong Kong, Japan, and Slovenia, the percentages for word-processing were relatively low. In Japanese *primary education*, it appeared that software for creative work was most popular. Interactive encyclopedias on CD-ROMs appeared to have been used by almost all students at the end of the target grade in primary education in Canada, New Zealand, and Singapore, but by only a quarter of the students in China Hong Kong, Chinese Taipei, Iceland, and Japan. The index of 'application coverage' in Table 3.4.1 indicates that primary education students in Canada, New Zealand, and Singapore had experienced the highest number of applications, while students in China Hong Kong, Chinese Taipei, Japan, and Slovenia had experienced the lowest number.

Table 3.4.2 Percentages of students whose schools (technical respondents) indicated that a typical student would have used particular ICT applications by the end of the target grade—lower secondary education

	1. Simulations of natural systems	2. Modelling mathematic. functions	3. Software data manipul./statistics	4. Word-processing/desktop publ.	5. Hard-/softw. real time data coll.	6. Spreadsheets	7. Software creative works	8. Computer-aided design/manufac.	9. Interactive encycl. CD-ROM	10. Software for programming	Application coverage
Belgium-French*	4	6	7	66	5	24	38	9	49	13	22 (1.5)
Bulgaria	8	13	19	64	5	22	19	1	16	24	19 (0.7)
Canada*	20	31	51	97	14	66	30	39	79	27	46 (0.6)
China Hong Kong	2	5	29	83	2	65	16	9	38	49	30 (0.6)
Chinese Taipei	1	2	2	97	0	40	31	11	20	6	21 (0.7)
Cyprus	20	0	0	57	6	0	22	52	16	20	19 (1.6)
Czech Republic	15	13	53	95	5	75	36	3	47	27	37 (1.2)
Denmark	22	44	57	99	10	96	54	1	85	8	48 (0.9)
Finland	6	25	38	99	5	89	45	3	63	47	42 (1.0)
France	12	33	39	99	18	91	23	54	84	10	46 (1.0)
Hungary	6	22	39	97	32	96	43	12	36	18	37 (6.4)
Iceland	9	31	26	89	12	47	30	2	34	3	28 (1.1)
Israel*	33	52	53	93	27	75	32	19	58	24	47 (1.8)
Italy*	10	32	48	81	21	73	16	22	53	40	40 (1.5)
Japan	10	44	27	72	12	33	30	7	14	31	28 (1.3)
Lithuania	6	7	21	72	3	31	40	0	20	44	24 (1.0)
Luxembourg	6	13	36	97	14	72	8	15	43	37	34 (1.5)
New Zealand*	25	26	71	98	16	85	43	36	92	23	52 (1.0)
Norway	4	8	27	96	4	79	28	0	70	4	32 (0.3)
Russian Federation*	0	22	13	35	3	23	37	1	5	39	18 (2.1)
Singapore	17	38	45	100	20	60	37	24	84	28	45 (0.0)
Slovenia	53	39	58	84	31	70	50	62	73	46	57 (1.8)
South Africa*	17	11	28	70	5	47	18	10	48	22	28 (2.3)
Thailand	7	9	37	85	8	61	35	12	22	18	29 (0.8)

Notes: The last column presents average values and standard errors (between brackets) as an indicator of application coverage. Standard error (se): value ± 2*se provides 95% confidence interval for the population. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages.

At the *lower secondary level*, word-processing was most popular in all countries. Spreadsheets were used in a good number of countries (usage was greatest in Denmark, Finland, France, and Hungary, and lowest in Belgium-French, Bulgaria, Cyprus, and the Russian Federation). The index of 'application coverage' was highest in New Zealand and Slovenia, and lowest in

Bulgaria, Cyprus, and the Russian Federation. It is interesting to note that the percentages for some applications in Table 3.4.2 (notably for spreadsheets) are higher than for comparable applications in Table 3.3.2. This situation seems to indicate that, in practice, certain learning activities occurred to a greater extent than might have been expected on the basis of the educational targets of the schools.

Table 3.4.3 Percentages of students whose schools (technical respondents) indicated that a typical student would have used particular ICT applications by the end of the target grade—upper secondary education

	1. Simulations of natural systems	2. Modelling mathematic. functions	3. Software data manipul./statistics	4. Word-processing/desktop publ.	5. Hard-/softw. real time data coll.	6. Spreadsheets	7. Software creative works	8. Computer-aided design/manufac.	9. Interactive encycl. CD-ROM	10. Software for programming	Application coverage
Belgium-French*	13	42	43	80	31	74	35	21	67	32	44 (1.6)
Bulgaria	6	21	43	81	4	68	18	10	14	45	31 (1.1)
Canada*	41	58	72	100	41	89	60	60	92	67	68 (0.7)
China Hong Kong	1	11	53	90	5	79	12	12	45	56	36 (0.6)
Chinese Taipei	2	5	9	99	6	79	17	35	19	76	35 (0.8)
Cyprus	7	9	76	89	11	86	30	22	54	97	48 (0.8)
Czech Republic	12	24	75	100	11	95	25	29	59	37	47 (1.0)
France	15	38	54	90	35	86	14	31	79	15	46 (1.1)
Iceland	19	53	72	100	11	95	9	12	58	23	45 (1.4)
Israel*	39	66	68	96	34	96	39	37	63	64	60 (1.8)
Italy*	19	45	59	78	28	77	24	34	58	39	46 (1.6)
Japan	3	8	23	61	6	51	16	7	9	29	21 (1.2)
Latvia*	7	28	57	96	16	90	20	12	49	48	42 (1.4)
Lithuania	9	19	42	90	9	70	45	2	28	77	39 (0.3)
Luxembourg	18	43	65	94	40	95	28	33	48	76	54 (2.6)
Norway	10	23	41	96	24	92	21	25	55	11	40 (0.5)
Russian Federation*	15	66	41	83	17	75	66	2	10	78	45 (2.1)
Singapore	38	40	64	100	43	70	40	51	72	56	58 (0.0)
Slovak Republic*	5	15	71	93	8	96	25	19	43	51	43 (1.0)
Slovenia*	15	24	57	95	8	73	17	28	47	23	39 (1.4)
South Africa*	11	18	45	87	19	76	19	19	57	54	41 (2.3)

Notes: The last column presents average values and standard errors (between brackets) as an indicator of application coverage. Standard error (se): value ± 2*se provides 95% confidence interval for the population. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages.

In *upper secondary education*, word-processing and spreadsheets were used by the majority of students. The overall index on 'application coverage' showed high values for Canada and Israel, and a relatively low value for Japan.

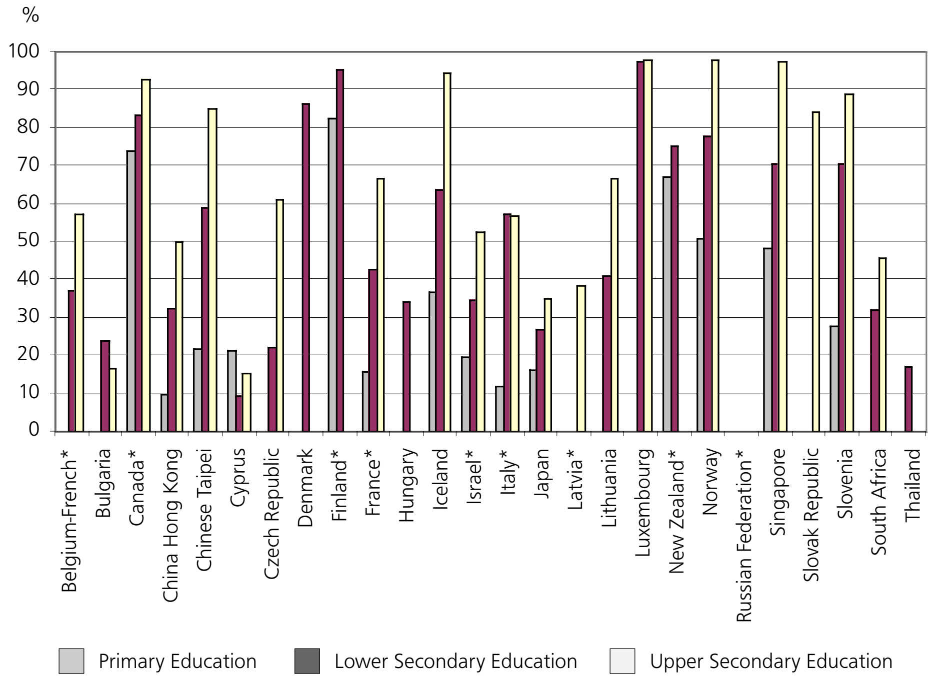
Percei ed O ortunities for Using Email or the World Wide We WWW

For most citizens, email and the WWW have probably been the most visible appearances of the technology revolution in the past decade. Many governments have acknowledged the potential educational value of worldwide access to databases and electronic mail. In past cross-national assessments of ICT in education, notably the Computers in Education study in 1992, only marginal attention was paid to the use of external networks for instructional purposes. On the basis of data collected in 1992, Pelgrum, Janssen Reinen, and Plomp (1993) concluded that only a minority of schools (except for 60% of upper secondary schools in the United States) possessed modems for gaining access to external communication facilities. The use of these facilities therefore was not explored further at that time.

In SITES Module-1, a number of questions were asked that referred to access to and use of email or the WWW for instructional purposes. With regard to access, the respondents were asked to indicate whether the school (as a whole) had access to the Internet for instructional purposes. Questions also were asked about whether email or the WWW actually were used in the grade range for instructional purposes, the percentage of students that would have used this facility by the end of the target grade, and the percentage of teachers from the grade range that had used this facility. The information about access (which is considered to be a characteristic of the ICT infrastructure of schools) is reviewed in Chapter 4. In this present chapter, the statistics that are presented derive from the questions about the use of email/WWW for instructional purposes. Figure 3.6 contains, for each educational level, the percentages in schools that reported that they used email or the WWW for instructional purposes for students within the grade range.[8]

The results in Figure 3.6 show that, overall, the use of email or the WWW was most widespread in *upper secondary education*, was less widespread in *lower secondary education*, and was least evident in primary education. The countries where lower and/or upper secondary level students were most likely to be in schools using email or the WWW for instructional purposes (within the grade range) were Canada, Chinese Taipei, Denmark, Finland, Iceland, Luxembourg, Norway, Singapore, the Slovak Republic, and Slovenia. The countries where students at this level were least likely to be in schools using email and the WWW for instructional purposes were Bulgaria, Cyprus, Japan, and Thailand. Only in Canada, Finland, Luxembourg, New Zealand, and Norway were more than 50% of the students at each educational level in schools using email/WWW for instructional purposes (within the grade range).

8 The reader is referred to the word of caution that was expressed in connection with Tables 3.3.1, 3.3.2, and 3.3.3.



Notes: *: country did not satisfy all sampling criteria for one or more levels (see Chapter 1, Table 1.2). Missing bars: data not collected.

Figure 3.6 Percentages of students whose schools (technical respondents) indicated that email/ WWW was used, within the grade range, for instructional purposes—primary, lower secondary, and upper secondary education.

Respondents who indicated that the school used email or WWW for instructional purposes answered a number of additional questions, namely:

1. What percentage of students (will) have used email and/or the WWW by the end of the target grade?
2. What percentage of teachers (who teach in the grades range) use email and/or the WWW in their teaching in some way?
3. Will a typical student have done any of the following at the school by the end of grade [X]:
   - Communicating via email with teachers within and/or outside the school for learning purposes?
   - Communicating via email with peers from other schools within and/or outside the country?
   - Using email or bulletin boards for group projects/collaboration within the school and/or with other schools?
   - Using external databases to retrieve and extract information from different sites across the Internet and/or WWW?
   - Designing and maintaining web sites?
   - Disseminating information via the Internet and/or WWW (e.g. publishing projects)?
   - Discussing, debating and exploring ideas by video-conferencing with others (e.g. schools or experts) outside the school?
   - Other?

Given the fact that in many countries the percentage of schools using the Internet/WWW was far below 100%, further statistics relating to the answers to these additional questions were considered to be insufficiently representative for all country samples. However, Appendix F includes these statistics (see, in particular, Tables F.3.1–F.3.3 for the percentages of students and teachers using Internet and the WWW; and Tables F.4.1–F.4.3 for Internet-related activities). While the small sample representation needs to be kept in mind, it seems warranted to conclude that a substantial number of students and/or teachers have had at least some experience with the Internet/WWW in the following countries:

- *Primary education:* Canada, Finland, and New Zealand.
- *Lower secondary education:* Canada, Denmark, Finland, Iceland, Luxembourg, New Zealand, Norway, and Singapore.
- *Upper secondary education:* Canada, Chinese Taipei, the Czech Republic, Iceland, Luxembourg, Norway, Singapore, and Slovenia.

As can be inferred from Appendix F (Tables F.4.1–F.4.3), the most popular use of the Internet in primary as well as lower and upper secondary education was the use of external databases and email. Other activities, such as publishing information and video-conferencing, were not, as yet, very popular.

Percei ed ICT-Related O ortunities Regarding the Emerging Pedagogical Practices

In the above section regarding the pedagogical paradigm of the schools, Table 3.1 was included to show the list of instructional activities that was presented to school principals, who were then asked to indicate to what extent these practices were present in their schools. This same list was used when principals were asked to rate the extent to which these activities had been realized through ICT (the answer options were 'not at all', 'to some extent', and 'a lot').

Appendix F (Tables F.5.1–F.5.3) contains the percentages of students at schools where principals claimed that, for each activity, it was realized 'a lot' via ICT. A first observation from these tables is that extreme high percentages do not occur. However, given that the percentages reflect opinions about *a lot of ICT contribution*, it may be argued that, in some countries, a substantial number of school principals indicated that ICT is used for realizing pedagogical practices in the school. Overall, it seems that 'learning to search for information' and 'learning by doing' were perceived as major contributions of ICT. Also, school principals in a substantial number of countries mentioned 'a lot' of ICT contribution in relation to the item on independent learning. These observations suggest that those on the educational work-floor acknowledge the potential that ICT has to facilitate strategies related to active learning.

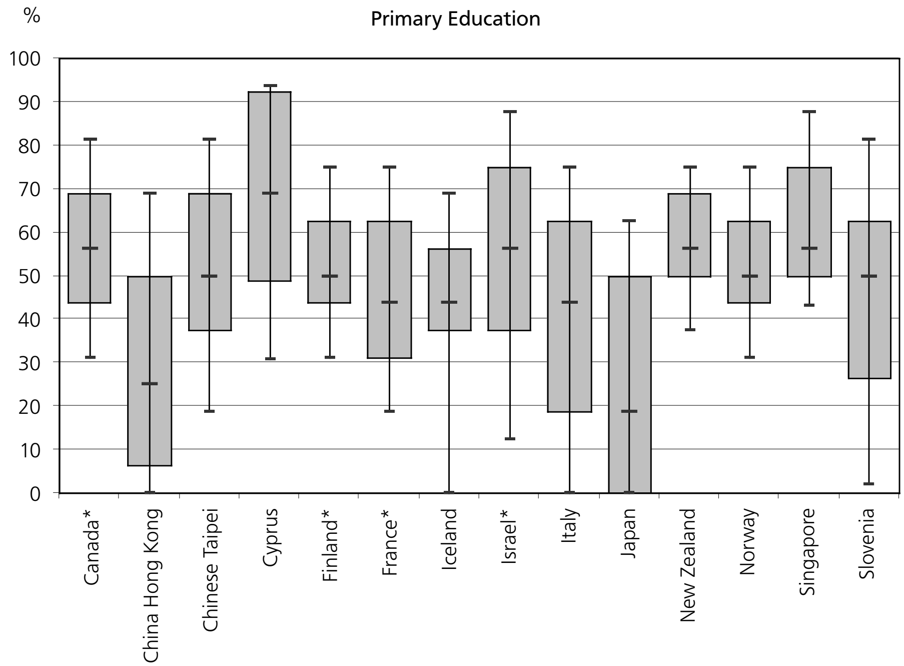
As was done for the objectives (see above), the items listed in Table 3.1 were condensed into an indicator of emerging ICT-related opportunities.[9] The definition of this indicator relied on the same items as were used for the emerging pedagogical practices, namely, statements 1, 2, 3, 4, 8, 9, 10, and 13.

The box plots of the *emerging ICT-related opportunities* indicator shown in Figure 3.7 contain information about the median value and the dispersion of the values across schools in each country. (This value was calculated per schools as a percentage of the sum of scores divided by the maximum possible score across all activities in the list.) The table shows that for *primary education*[10] the indicator was relatively high in Canada, Cyprus, Israel, New Zealand, and Singapore, but low in China Hong Kong and Japan. Relatively high values on the indicator were observed at the *lower secondary level*[11] in Canada, Denmark, Hungary, Israel, New Zealand, Norway, and Slovenia. For *upper secondary education* the highest values were evident in Canada, Chinese Taipei, Cyprus, the Czech Republic, Latvia, Norway, and Singapore.

9 Note that, in this case, the assumption is made that 'realization via ICT' can be conceived as an indicator of opportunities for students to use ICT.

10 The ICT-monitor data from the Netherlands gave the values of this indicator as 25% and 56% respectively for the lower and upper value of the boxes and 13% and 69% respectively for the lower and upper tiles, while the median value was just below 40%.

11 The distribution of values and the median for the Netherlands at this level were comparable to those from Japan.



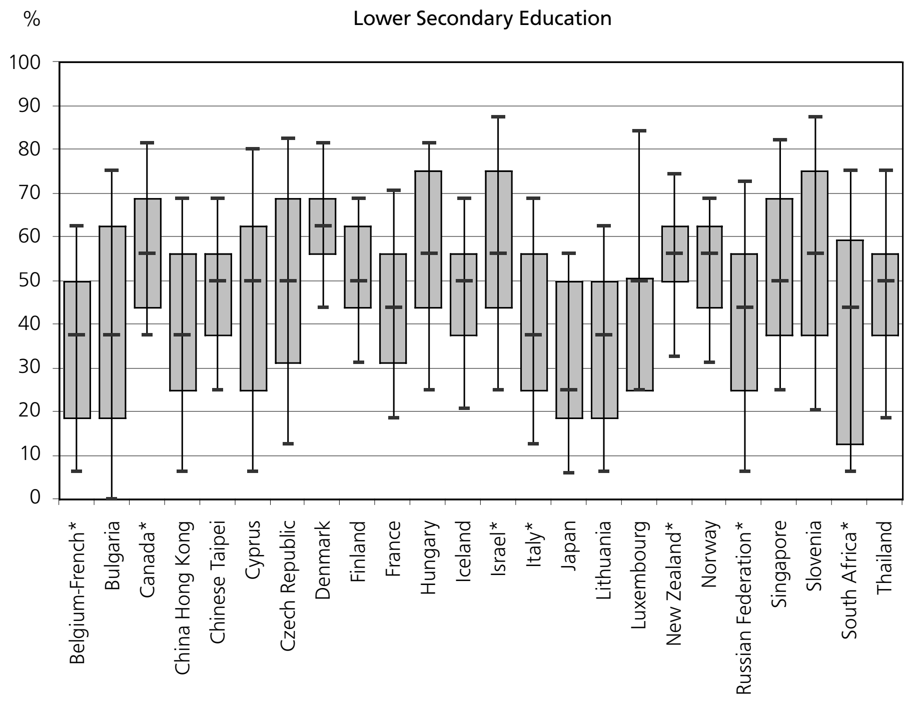
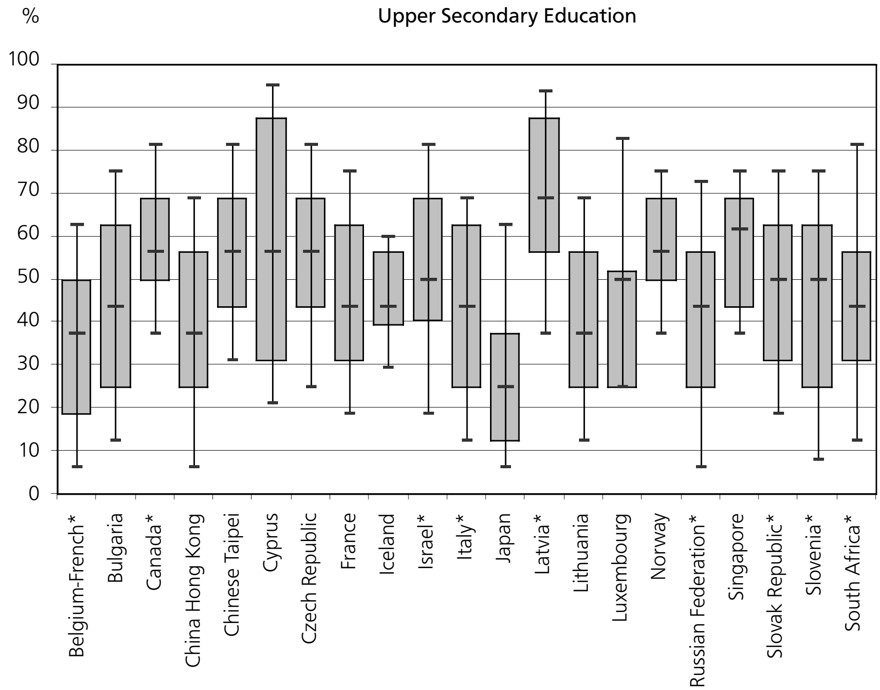


Figure 3.7 (contd. on page 113)



Notes: Boxes range from 25% lowest to 75% highest value; the horizontal line in the boxes represents the median; tiles show values for 10% and 90% of the cases. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2).

Figure 3.7 (contd. from previous page) Box plots of indicators concerning emerging ICT-related opportunities—primary,[12] lower secondary,[13] and upper secondary education.

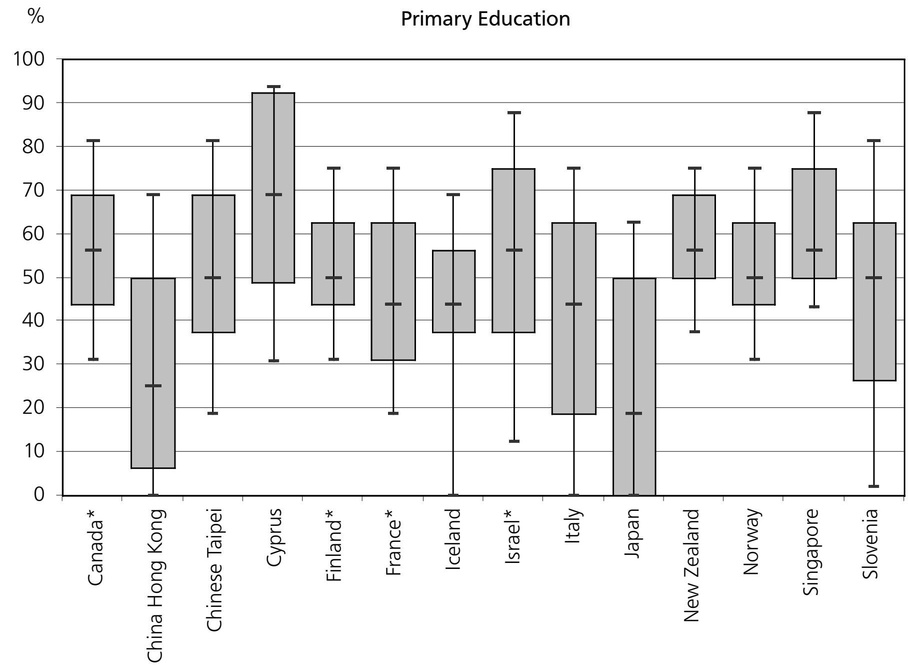
Percei ed ICT-Related O ortunities Regarding the Traditionally Im ortant Paradigm

The instructional activities listed in Table 3.1 included activities that were seen as indicative of the traditionally important paradigm. These items are 5, 6, and 7 (see also Tables F.1.2–F.1.3 for results).

The box plots in Figure 3.8 suggest that the indicator of traditionally important ICT-related opportunities was relatively high in *primary education* in Cyprus and Singapore. The lowest realization was reported in Italy and Japan. At the *lower secondary level*, most percentages for the indicator of traditionally important ICT-opportunities were slightly above or below 50%. For the *upper secondary level*, relatively high median values were observed in Chinese Taipei, Cyprus, the Czech Republic, Latvia, and Singapore, and relatively low ones in Belgium-French and Norway.

12 The ICT-monitor in the Netherlands puts the values of this indicator for the lower and upper value of the boxes at 33% and 50% respectively, the lower and upper tiles at 17% and 50% respectively, and the median value at 50%.

13 The ICT-monitor in the Netherlands suggests that the values of this indicator were 17% and 50% respectively for the lower and upper value of the boxes, and 0% and 67% respectively for the lower and upper tiles, while the median value was 33%.



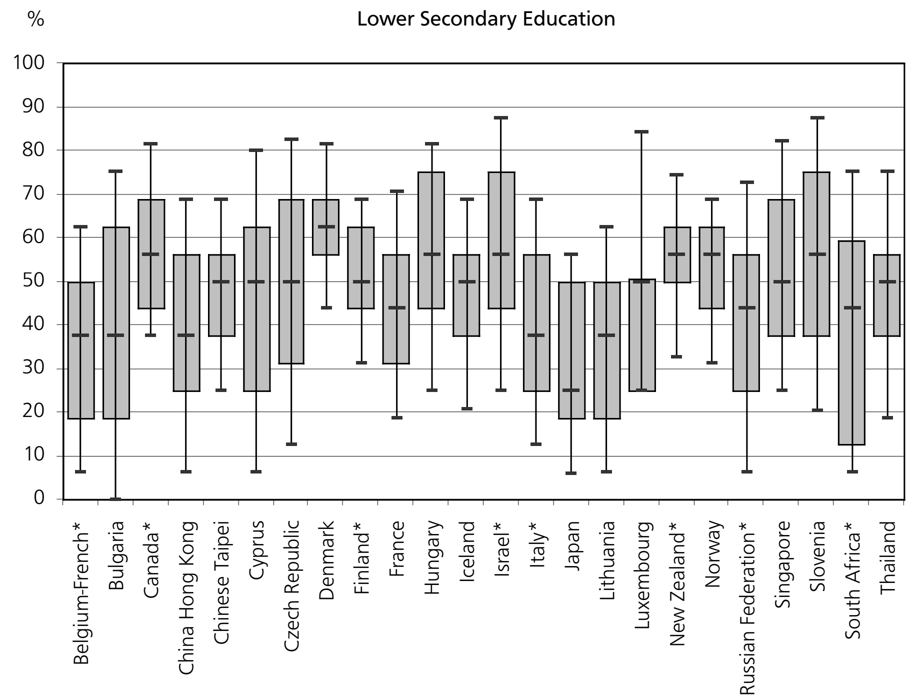
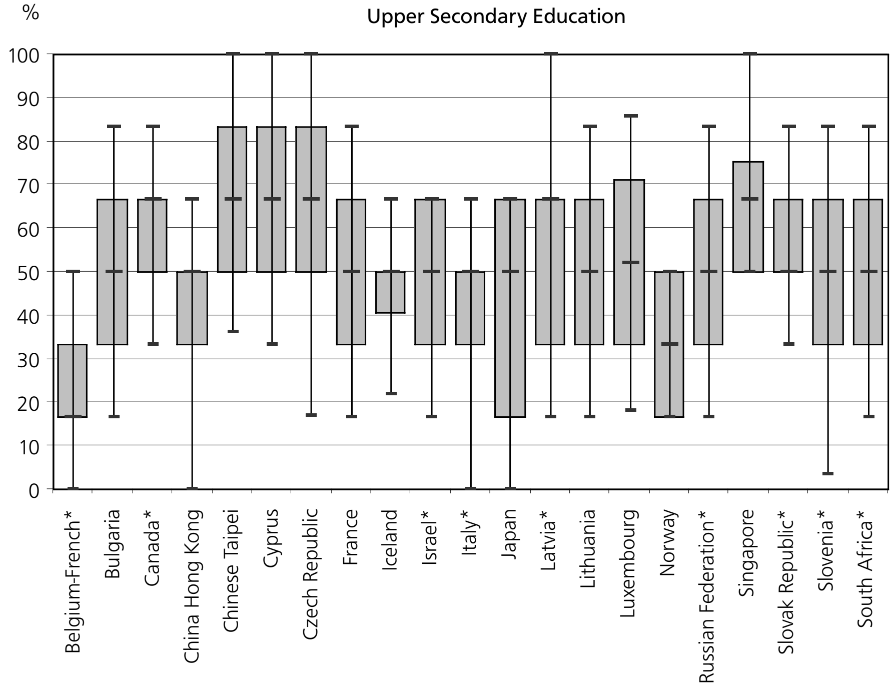


Figure 3.8 *(contd. on page 115)*



Notes: Boxes range from 25% lowest to 75% highest value; the horizontal line in the boxes represents the median; tiles show values for 10% and 90% of the cases. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2).

Figure 3.8 (contd. from previous page) Box plots of indicators concerning the traditionally important ICT-related opportunities—primary, lower secondary, and upper secondary education.

A comparison of Figures 3.7 and 3.8 suggests that, according to the perceptions of school principals, ICT plays a role in realizing both emergent and traditionally important ICT opportunities.

SU AR AND REFLECTIONS

This chapter has shown that the presence of both emergent and traditionally important ICT orientations differed substantially between countries. Schools in some countries seemed to have adopted and implemented the emerging practices to a greater extent than schools in other countries. A major question for further investigation concerns the extent to which ICT may contribute to the process of reforming schools so that they are better placed to adopt and implement this paradigm.

A first breakdown of the pedagogical practice indicators by the number of years of ICT use did not lend strong support to the hypothesis that long-term experience with ICT would facilitate the emerging practices (and not the traditionally important practices). However, some further explorations showed that other conditions might be more suitable candidates for explaining variation between schools with regard to each of these orientations. One such example is illustrated in Figure 3.9, which shows the breakdown of the mean values on indicators of the emergent and traditionally important pedagogical practices by levels

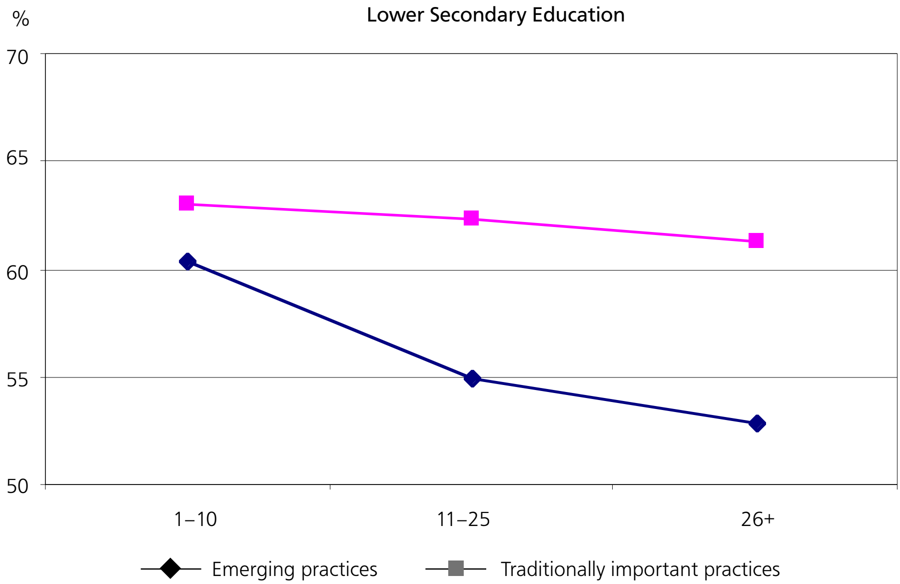


Figure 3.9 Average value on indicators of emerging and traditionally important practices for different categories of student:computer ratios.

of student:computer ratios in the schools (based on the pooled data set giving each country the same weight). This graph indicates that whereas schools with high emerging practice conditions tended to have low student:computer ratios, this trend was not apparent for the traditionally important pedagogical practices. Given that low student:computer ratios point to favorable conditions regarding computer hardware in the schools, the hypothesis could be drawn that ICT might differentially affect emerging pedagogical practices.

The scope of this book and the amount of time that was reserved for its production unfortunately did not allow for extensive analyses. Readers interested in the factors that might explain the existence of emerging pedagogical practices in the SITES Module-1 schools are referred to articles that will appear in the scientific literature during the near future.[14]

14 See also the project's web site at: http://www.mscp.edte.utwente.nl/sitesm1

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Cha ter

INFRASTRUCTURE

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This chapter describes the hardware and software infrastructure that was available in schools at the end of 1998. Indicators are presented with regard to student:computer ratio, the quality of the available equipment, availability of peripherals, access to the Internet, availability of software, problems and priorities with regard to hardware and software, as well as expenditures from school budgets. The chapter also presents results of the first analyses, which address questions relating to relationships between different indicators.

INTRODUCTION

On the basis of the IEA Computers in Education (CompEd) studies, which were conducted in 1989 and 1992, the following conclusions were drawn with regard to the hardware and software infrastructure in schools (Pelgrum, Janssen Reinen, & Plomp, 1993):

> In 1989 the USA was the only country, among all those participating in the study, wherein all schools at the elementary and secondary level had computers available for instructional use. Since then an increasing number of schools in the other countries also acquired access to computers, but a substantial number of elementary schools in Japan (about 64%) and the Netherlands (17%), lower secondary schools in Bulgaria (17%) and Japan (29%), and upper secondary schools in India (85%) did not yet possess computers for instructional use in 1992.
>
> In almost all countries the number of computers in schools increased considerably in those three years, but (except for Austria, Japan, and Slovenia) most equipment still consisted of quite old-fashioned 8-bits machines. While most computer coordinators perceived the shortage of hardware less as a problem than in 1989, a majority of students (except for those in Japanese secondary and Dutch lower secondary schools) complained about computers not being available when they wanted to use them, although this problem did not occur very often.
>
> Access to external networks was quite rare, except in the USA, Austrian upper secondary schools and Dutch lower secondary schools, and regular use of networks occurred seldom (except for about 15% of the schools in the USA).
>
> In some countries many students had access to computers at home. In Austria, Germany, the Netherlands, and the USA computers were available in roughly half or more of the homes.
>
> The availability of instructional tool software increased between 1989 and 1992, except in Greece, India, the Netherlands and Japanese upper secondary schools. Shortage of software was still seen as an important problem, although only slightly less so than in 1989. In all countries a majority of students complained that programs were difficult to handle. (pp117–118)

Before CompEd and SITES, no international, large-scale, comparative statistical surveys had been conducted of the ICT infrastructure in education. A few questions relating to ICT were included in the IEA Third International Mathematics and Science Study (Beaton, Mullis, Martin, Gonzalez, Kelly, & Smith, 1996), which was conducted in 1995 in approximately 45 countries. However, the only information collected about infrastructure was the number of computers in schools. This chapter, drawing as it does on data from SITES Module-1, provides some of this missing detail by describing the ICT infrastructure existing in the SITES schools at the end of 1998.

ARDWARE

Student com uter ratios

A general basic indicator of hardware availability in schools is the number of PCs (or work-stations) that are available to students and/or teachers of the target grades[1] for teaching and/or learning purposes. In the technical questionnaire, respondents were asked to specify the total number of computers available to students in the target grades. Although it is possible to calculate the mean or median of this variable, doing so would be meaningless unless the size of the schools was taken into account.

One indicator of the extent to which students can access hardware in a school is the student:computer ratio. This ratio indicates how many students on average have to share one computer and can be determined by dividing the total number of students in the school by the total number of computers available. A ratio of 30, for example, indicates that for every 30 students there is one computer available. Furthermore, if these 30 students spend about 30 hours in lesson time per week in their school, then each student, on average, could use a computer for one hour per week.

Obviously, there are different ways of calculating the ratio, perhaps by taking into account the non-using schools in a country, or counting all the computers in the whole school or in a particular range of grades, or determining the number of students that use the available equipment. Each of these measures has limitations. For example, calculating the student:computer ratio on the basis of the number of students in the grade range divided by the number of computers available for these students can result in a downwards biased (that is, in this case, a too favorable) estimate because students other than those from the target grades may be using the computers. Alternatively, if the ratio is calculated on the basis of the number of students in the whole school divided by the number of computers in the whole school, the estimate might be inaccurate for the students in the target grade range. The assumption here is that these students have access to the computers when, in fact, they may not; the computers may be available only to students from other grade levels. Such a situation can occur if, for example, lower and upper secondary schools share the same building and facilities but the computers are available only to upper secondary students. (This happens in schools where computer use is restricted to computer science courses such as programming.)

1 SITES Module-1 was conceived as producer of baseline information for SITES Module-3, in which samples of students at a particular grade level (the so-called target grade) will participate. In order to provide school-context information that is relevant for this group, Module-1 focused as much as possible on students at the target grade (see Chapter 1 for further explanations).

In order to capture these different situations, the technical questionnaire included a whole series of questions about available computer equipment for the grade range, the entire school, numbers of students using computers, and so on (see Appendix B, technical questionnaire, questions 15–24). After extensive analyses of the results it was concluded that the student:computer ratio could best be based on:

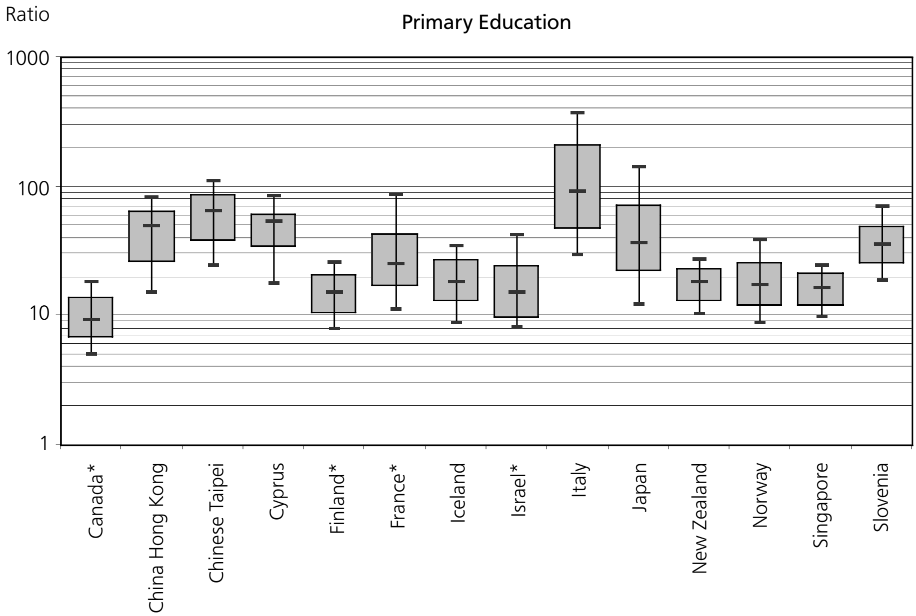
$$\text{Student:computer ratio} = \frac{\text{total number of students per school}}{\text{total number of computers available for student use in the whole school}}$$

The reasons for using this indicator were as follows:

- In many schools, the number of computers listed for the grade range appeared to be roughly the same as the number of computers for the whole school.
- The grade range definitions varied quite a lot between countries.

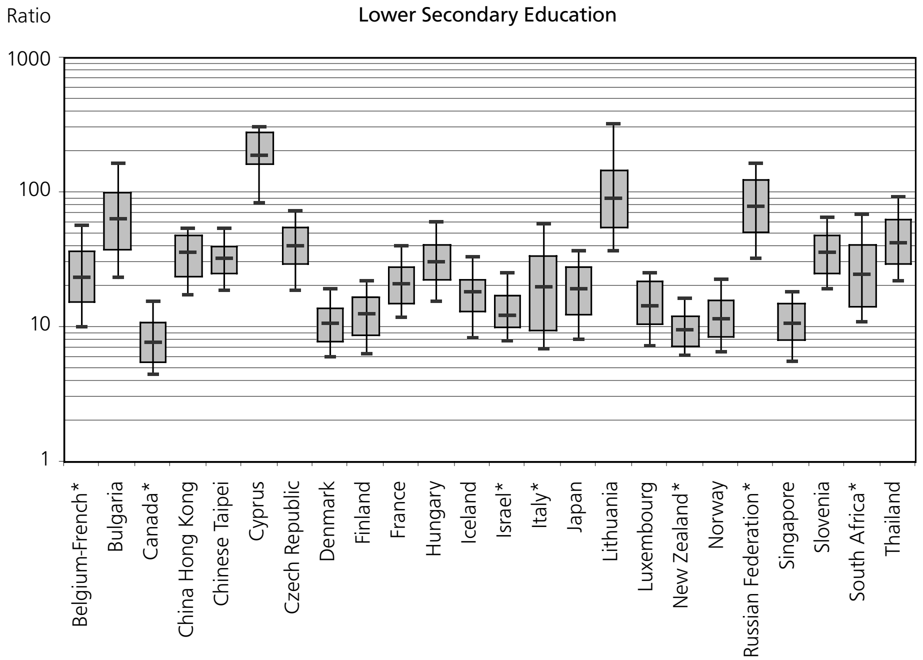
Appendix G (Tables G.1.1, G.1.2, and G.1.3) presents several of the alternative estimates of student:computer ratios, including an index that takes into account the non-using schools. (Table 1.2 in Chapter 1 provides an overview of the percentages of computer-using schools per country and educational level.)

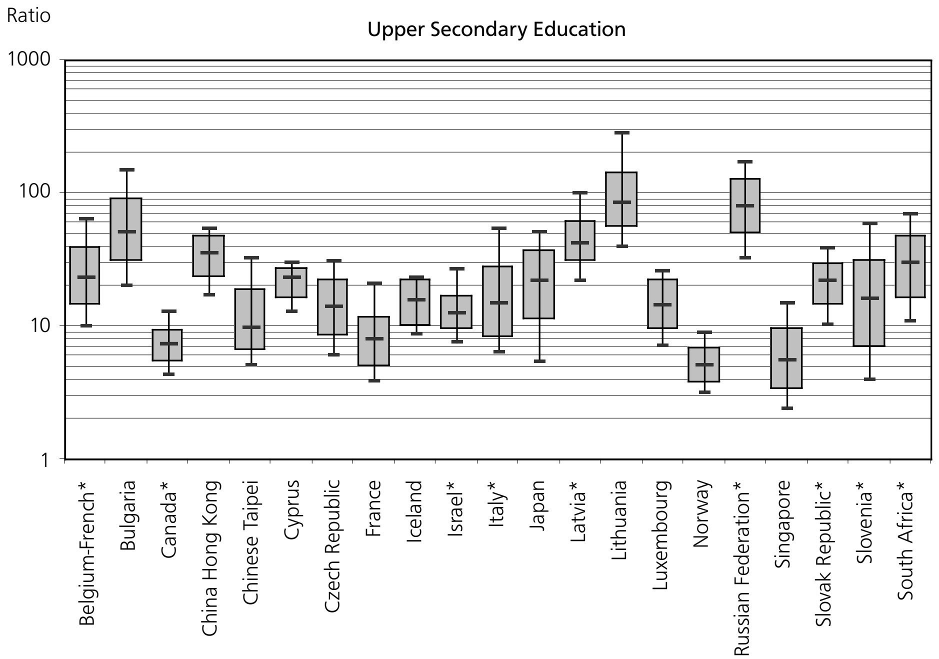
Figure 4.1 contains the box plots for the student:computer ratios (calculated on the basis of the above definition) in computer-using schools for each country and educational level.



Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). Boxes range from 25% lowest to 75% highest value; the horizontal line in the boxes represents the median; tiles show values for 10% and 90% of the cases. Because of the huge differences between countries, these box plots are presented on a logarithmic scale; the gridlines should be read as 1, 2, 3, ..., 10, 20, 30, ...,100, 200, 300, ...

Figure 4.1 Box plots of student:computer ratios in computer-using schools—primary, lower secondary, and upper secondary education. (contd. on page 122)





Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). Boxes range from 25% lowest to 75% highest value; the horizontal line in the boxes represents the median; tiles show values for 10% and 90% of the cases. Because of the huge differences between countries, these box plots are presented on a logarithmic scale; the gridlines should be read as 1, 2, 3, ..., 10, 20, 30, ...,100, 200, 300, ...

Figure 4.1 (contd. from previous page) Box plots of student:computer ratios in computer-using schools—primary, lower secondary, and upper secondary education.

The overall impression gained from Figure 4.1 is that the student:computer ratios differed quite substantially across countries, but also within countries (for example, at one extreme, 25% of the primary schools in Italy have a ratio of roughly 50 or less, while at the other extreme, 25% have ratios of 200 or more).

For *primary education*, the median student:computer ratios differed quite substantially between countries. Relatively low ratios were observed in, for instance, Canada, Finland, Iceland, Israel, New Zealand, Norway, and Singapore. Less favorable ratios (30 or more) were observed in China Hong Kong, Chinese Taipei, Cyprus, Italy, Japan, and Slovenia.

The student:computer ratios at *lower secondary schools* also differed substantially between countries: the medians varied, for instance from below 10 (in Canada and New Zealand) to higher than 50 in Bulgaria, Cyprus, Lithuania, and the Russian Federation.

At the *upper secondary level,* the student:computer ratios tended to be more favorable than at the lower secondary and elementary levels. Low median (and, hence, most favorable) ratios of less than 10 were observed in Canada, Chinese Taipei, France, Norway, and Singapore.

Com arison of student com uter ratios etween and

In the Third International Mathematics and Science Study (TIMSS), a few questions were posed about the number of computers that were available in schools (see Beaton et al., 1996).

The TIMSS data regarding computers were based on the following questions that were included in the TIMSS school questionnaire.

Write in a number for each. Write 0 (zero) if there are none.

15. In your school, how many computers are...

A. available for use by teachers or students ______

B. used by teachers for administrative purposes
(e.g. grade reports, attendance, etc.) ______

C. used by teachers during instructional time ______

D. used by students for educational purposes ______

E. used by office staff for school record-keeping ______

17. The students in your school:

Write in the answer for each of the following. Write 0 (zero) if there are none.

	boys	girls
a) What is the total school enrollment (number of students)?	_____	_____
b) ...		

For calculating the student:computer ratio in a country on the TIMSS data the following procedure was used.

First of all it had to be decided which variable (15A or 15D) should be used. It appears that not all countries treated this question in a similar way, because in at least one country the sum of questions 15B to 15D was lower than the number under 15A, whereas in other countries the values on 15D were about the same or even higher than the values on 15A. The OECD-network C members decided to use 15A, so this includes use of computers by teachers. One should also keep in mind that in TIMMS the participating schools included those that did not use computers for instructional purposes at all at that time (and so answered 0 on 15A to 15D), whereas the SITES data came from computer-using schools.

For the TIMSS respondents both the total number of students and the total number of computers (from 15A) were computed. After this summation, the ratio was computed. Given that the TIMSS respondents are considered to be representative of their respective countries, this same ratio was used as an estimate for the student:computer ratio for the whole country.

An issue that arose before summation was that of how to weight the data. Eventually it was decided to weight the data by student weights, although the use of school weights would have resulted in ratios that deviated no more than 10% from the presented estimates.

The SITES data were taken from the following questions:

15. How many computers are available for use by students in the *entire* school?
    TOTAL number of computers ☐

16. What is the total number of students in the *entire* school?
    TOTAL number of students ☐

A further source of information was an estimate by each NRC of the 'percentage of students in ICT-using schools' for each stratum distinguished in the sampling of schools.

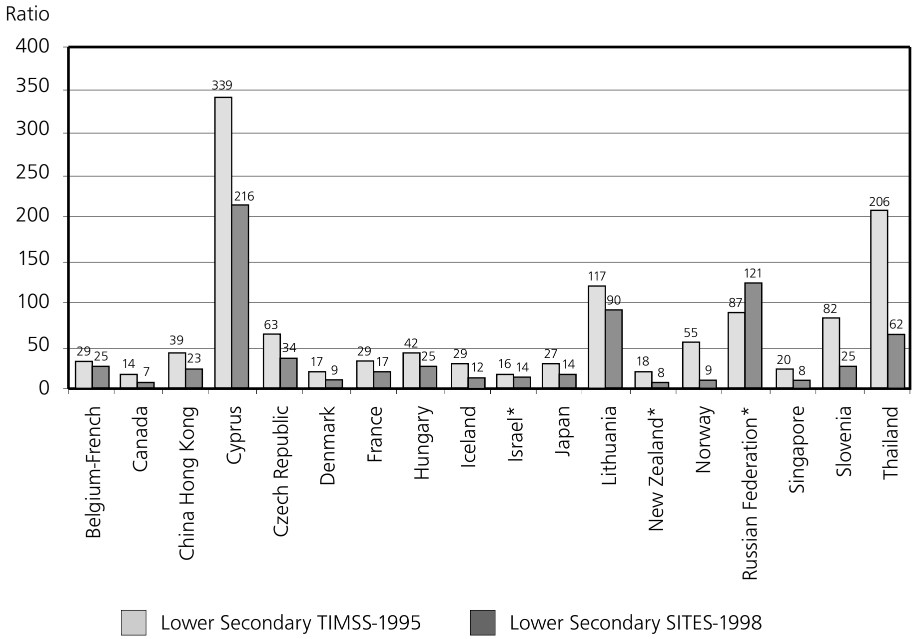
The calculation of the student:computer ratio on the SITES data was made as described below.

As with TIMSS, totals of students and computers were computed over all respondents. However, in order to compensate for the fact that non-using schools were not included, the subtotals of students per stratum were multiplied by 100/(percentage of students in ICT-using schools) before the totals per country were computed.

From the above it seems that, although the questions in TIMSS and SITES were not strictly comparable, one can be reasonably confident that the trend statistics offer a fair estimate of the amount of change that took place between Spring 1995 and Autumn 1998.

Figure 4.2 reveals that considerable improvements occurred in all countries except the

Russian Federation across the intervening three-and-a-half years. Figure 4.2 also reveals that one of the most noteworthy declines (and, hence, improvements) occurred at the lower secondary level for Norway (from 55 in Spring 1995 to 9 in Autumn 1998). The extent of improvement seemed, at first, quite implausible. However, comparisons of the current estimates with the results from a national survey on ICT in Norway conducted in 1997 validated the current estimates.



Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). Estimates are for all schools, that is, including non-computer using schools.

Figure 4.2 Comparison of student:computer ratios in 1995 and 1998 for lower secondary education[2] (includes all schools: computer-using as well as non-using).

Tables G.1.1.1–G.1.1.3 in the appendices further indicate that ratios based on the grade range were, in some countries, much more favorable (and maybe downwards biased, that is, giving a too favorable impression) than the ratios for the whole school. This finding tends to occur when schools do not differentiate between computer equipment for the whole school and computer equipment for the grade range. However, in some countries it appeared that the grade range ratios were less favorable, suggesting that in these countries

2 A comparison of data for the United States with results from TIMSS (1995) and a national survey that was conducted in Spring 1998 (Anderson & Ronnkvist, 1999) revealed a decline for lower secondary schools from 15 to 7 (roughly comparable to the developments in Canada). Comparisons of the SITES results with data collected recently in national ICT surveys in the the Netherlands, the United Kingdom, and the United States provided the following additional information. A survey that was conducted in the United Kingdom (Department for Education and Employment/DfEE, 1998) in Spring 1998 revealed an average number of students per computer of 18 in primary education and 9 in secondary education. In the United States (Anderson & Ronnkvist, 1999), these numbers were respectively 8 for primary education and 7 for lower as well as for upper secondary education (comparable to Canada), while in the Netherlands, the numbers were respectively 23 and 20 (ten Brummelhuis, 1998, 1999).

there may be a tendency to reserve this equipment for students other than those in the grade range. This scenario may well explain another statistic shown in Tables G.1.1.1-G.1.1.3, namely the percentage of students in the entire school using the equipment available for the entire school. In some countries, the percentage was below 50%.

As shown in Figure 4.3 the student:computer ratios generally improved over the years. Those schools that recently had begun to introduce computers typically had a ratio of 60 to 70 students per computer at the elementary and lower secondary levels (and 30 at the upper secondary levels), while (across the educational levels) schools that had started 11 or more years ago had ratios of 20 and lower.

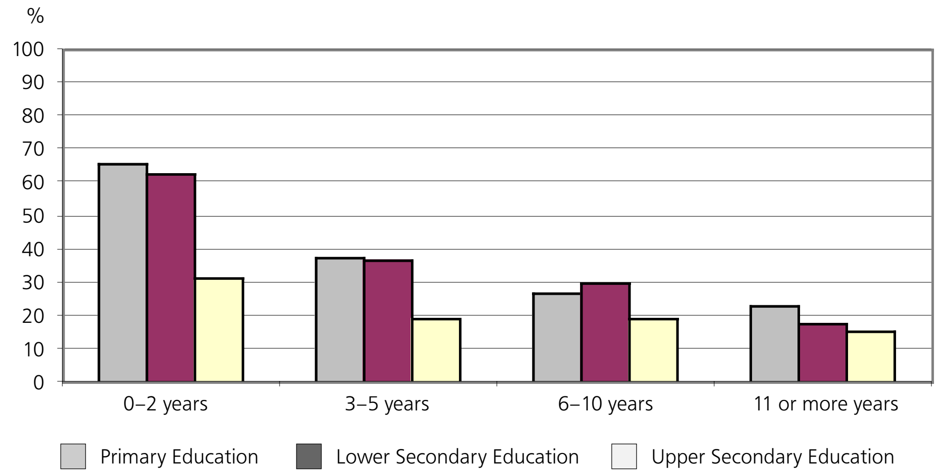


Figure 4.3 Breakdown for computer-using schools in primary, lower secondary, and upper secondary education of student:computer ratios by number of years schools had used ICT.

A question that was of interest (especially in terms of it providing a benchmark for judging future developments) to the researchers who participated in SITES concerned the use of laptop-computers. In the technical questionnaire one item asked for an estimate of the percentage of students from the entire school who brought their own laptops to the school. The percentage proved to be nearly zero in all countries, although schools in two countries (two lower secondary schools in Japan and one in Norway) noted that more than 50% of their students had their own laptops. As a general conclusion, then, laptop use among students was negligible in 1998.

Hardware functionality

The student:computer ratio, although of interest to policy-makers (given that policy targets in many countries refer to planned ratios), is a rather crude indicator of the available ICT infrastructure. More illuminating for the purpose of interpreting the ICT-related curriculum indicators discussed in Chapter 3 are indicators of the quality and (potential) functionality of the available equipment.

One potential indicator of hardware functionality is the percentage of computers in schools that are suited for multimedia applications. The respondents who filled out the technical questionnaire were asked:

> 26. With respect to the total number of computers from question 20 (that is the number of computers available for the grade range): How many are multimedia computers (equipped with a CD-ROM and a sound card)?
>
> Number of multimedia computers [ ]

The average percentage of equipment suited for multimedia purposes is shown in Figure 4.4. Here, it is evident that for the targeted grade range in *primary education*, more than 70%, on average, of the available computers in China Hong Kong, Cyprus, Italy, Japan, and Singapore were suited for multimedia applications. In other countries, for example, Israel, Norway, and Slovenia, these types of computers were less available.

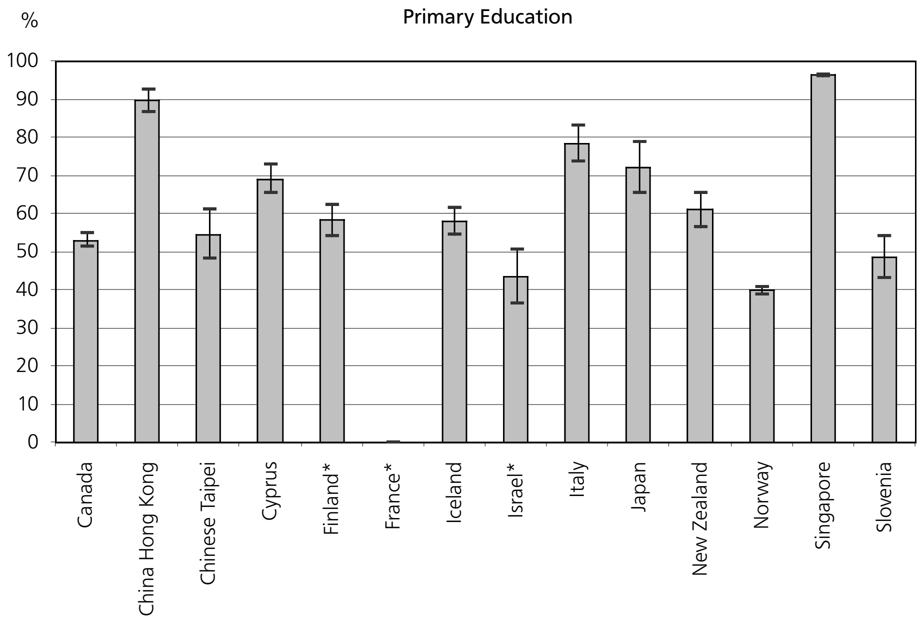
For the targeted grade range at the *lower secondary level*, the average percentage of multimedia computers was very high (greater than 70%) in China Hong Kong and Singapore and very low (less than 30%) in Bulgaria, the Czech Republic, Lithuania, Luxembourg, New Zealand, the Russian Federation, South Africa, and Thailand.

For the defined grade range at the *upper secondary level*, high percentages of multimedia computers were observed in China Hong Kong and Singapore, while low percentages were evident in Bulgaria, Cyprus, the Czech Republic, Iceland, Lithuania, Luxembourg, Norway, the Slovak Republic, Slovenia, and South Africa.

It is interesting to note from Figure 4.4 that, in many countries, the targeted grade range in primary education tended to have a relatively higher percentage of multimedia computers than in upper secondary education, even though, as indicated in Figure 4.1, the student:computer ratios in upper secondary schools tended to be much more favorable. A potential explanation for this phenomenon is that upper secondary schools began to introduce computers earlier than did primary schools and so had more old-fashioned equipment available. Moreover, multimedia computers might be considered pedagogically more appropriate or appealing (given their diverse multi-sensory functions) for younger children than for older students.

A further indication (see Tables 4.1.1–4.1.3) of the potential functionality of the hardware infrastructure is possible by calculating the percentage of computers (available for the grade range) equipped with one of the following types of processor:

- equivalent to Pentium, Mac 603 and higher, SUN, Alpha, etc.;
- 386/486 SX/DX, Macintosh SE, Mac II up to 68030, Atari ST, Amiga, etc.;
- 16-bits computers, such as AT/XT 80286;
- 8-bits computers, Apple II/IIe, Apple II clones, C64, and other old 8-bits.



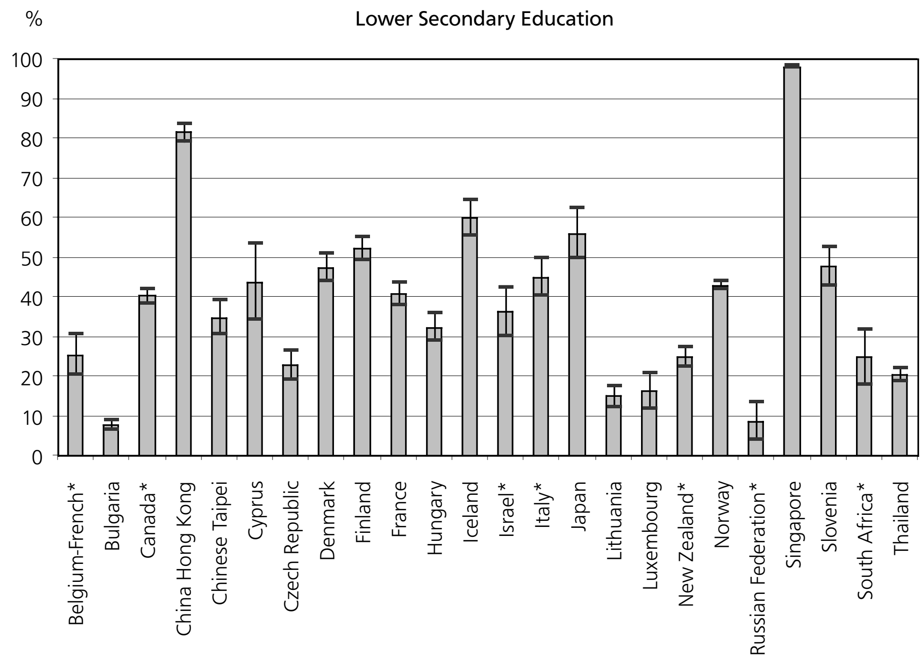
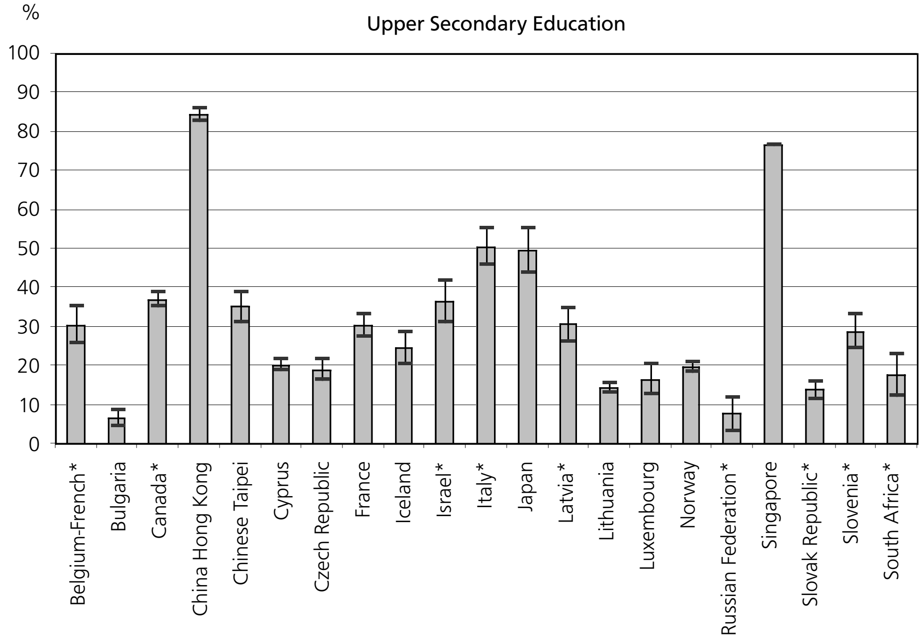


Figure 4.4 *(contd. on page 129)*



Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). Top of bar displays 95% confidence interval. Missing boxes: data not available.

Figure 4.4 [3] *(contd. from previous page) Bars and 95% confidence interval of average percentages of multimedia computers for the grade range in computer-using schools—primary, lower, and upper secondary education.*

The average percentage of computers equipped with one of the following operating systems/user interfaces (see Tables 4.1.1–4.1.3) also helps shed light on hardware quality/functionality in the schools:

- Windows 95/98, Win NT, or MacOs 7.5 and higher;
- Windows 3.0/3.1 or OS/2 or MacOs lower than 7.5;
- MS DOS (from 3.1 to 7.0) without Windows /no graphical system;
- other systems.

The percentage of computers for each of the above-mentioned categories was calculated for each school, and these percentages were then averaged across schools in each country. The results, as presented in Tables 4.1.1–4.1.3,[4] reveal that at the targeted grade range in primary education in China Hong Kong, Chinese Taipei, Italy, and Singapore, the average percentage of computers equipped with high-speed processors and Windows 95/98, Windows NT or MacOs 7.5 or higher exceeded 70%. In Israel and Japan, the average percentage was around 50% or lower.

3 In addition to the SITES countries, results from a national survey conducted in the United States during the spring of 1998 revealed for primary, lower secondary, and upper secondary education percentages of multimedia computers of respectively 48, 49, and 49 (Anderson & Ronnkvist, 1999). The percentage of computers suited for multimedia applications in the Netherlands was 30% in primary education (ten Brummelhuis, 1998) and 20% in lower secondary education (ten Brummelhuis, 1999).

4 In the United States in 1998 the percentages of computers equipped with Pentiums and PowerMacs were 35, 43, and 43 respectively for primary, lower secondary, and upper secondary schools (Anderson & Ronnkvist, 1999).

Table 4.1.1 Average percentages (and standard errors) of computers equipped with different processor types and different operating systems at the grade range—primary education

	% INTEL Pent.+Mac 103+higher	% 386/486SX/DX,Mac up to 68030	% 16-BIT Compat. AT/XT80286	% 8-BIT Compatible,APPLE2/2E	% Wind.95/98,WinNT,MacOS7,5+	% Wind.3.0/3.1,OS/2,Mac-OS <7.5	% MS DOS(3.1–7.0)without Wind.	% Other Operating Systems
Canada*	52 (1.3)	36 (1.2)	6 (0.6)	5 (0.6)	58 (1.0)	36 (1.1)	9 (0.7)	11 (0.9)
China Hong Kong	91 (2.3)	6 (1.9)	2 (1.2)	1 (0.8)	95 (1.0)	13 (2.5)	1 (0.5)	1 (0.7)
Chinese Taipei	72 (3.0)	26 (2.8)	3 (1.2)	0 (0.0)	73 (3.2)	19 (2.8)	10 (2.0)	0 (0.0)
Cyprus	48 (5.5)	45 (5.2)	7 (4.6)	~	55 (4.1)	57 (3.4)	2 (1.2)	15 (8.9)
Finland*	53 (2.2)	39 (2.1)	6 (1.0)	2 (0.7)	56 (2.3)	40 (2.4)	2 (0.6)	1 (0.6)
France*	~	~	~	~	~	~	~	~
Iceland	67 (1.8)	31 (1.7)	1 (0.2)	1 (0.4)	69 (1.5)	27 (1.5)	0 (0.1)	13 (1.7)
Israel*	51 (8.5)	38 (8.2)	8 (4.5)	4 (3.4)	49 (4.2)	59 (4.2)	15 (4.3)	12 (5.8)
Italy	73 (2.8)	20 (2.4)	4 (1.2)	3 (1.0)	77 (2.7)	20 (2.5)	5 (1.3)	1 (0.8)
Japan	44 (4.1)	27 (3.7)	20 (3.4)	9 (2.5)	49 (3.7)	26 (3.3)	25 (3.5)	10 (2.5)
New Zealand	50 (2.8)	40 (2.8)	5 (1.2)	5 (1.0)	58 (2.5)	24 (2.2)	3 (0.8)	14 (2.3)
Norway	39 (1.0)	55 (1.0)	4 (0.4)	2 (0.3)	52 (0.6)	46 (0.6)	6 (0.4)	3 (0.4)
Singapore	93 (0.0)	7 (0.0)	0 (0.0)	0 (0.0)	96 (0.0)	3 (0.0)	1 (0.0)	0 (0.0)
Slovenia	64 (2.7)	35 (2.7)	2 (0.7)	0 (0.1)	82 (2.4)	16 (2.3)	0 (0.2)	1 (0.7)

Notes: Percentages per school calculated as: (total number of particular type divided by total number of computers available at the grade range)*100. Standard error (se): value ± 2*se provides 95% confidence interval for the population. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). ~: data not collected.

At the targeted grade range in *lower secondary education*, China Hong Kong, Iceland, Luxembourg, and Singapore seemed to be the most advanced countries in terms of availability of computers with high-speed processors and recent operating systems. Eight-bits computers were (as was expected) no longer common, although relatively substantial percentages were still observed in Bulgaria, Lithuania, and the Russian Federation.

In *upper secondary education*, a high percentage of computers equipped with high-speed processors and recent operating systems was observed at the targeted grade range in China Hong Kong, Chinese Taipei, Iceland, Luxembourg, and Singapore. Low availability of high-speed processors was observed in Bulgaria, Lithuania, the Russian Federation, and the Slovak Republic.

Table 4.1.2 Average percentages (and standard errors) of computers equipped with different processor types and different operating systems at the grade range—lower secondary education

	% INTEL Pent.+Mac 103+higher	% 386/486SX/DX,Mac up to 68030	% 16-BIT Compat. AT/XT80286	% 8-BIT Compatible,APPLE2/2E	% Wind.95/98,WinNT,MacOS7,5+	% Wind.3.0/3.1,OS/2,Mac-OS <7.5	% MS DOS(3.1–7.0)without Wind.	% Other Operating Systems
Belgium-French*	35 (3.0)	50 (3.2)	9 (1.8)	6 (1.8)	40 (3.2)	40 (3.2)	19 (2.6)	1 (0.7)
Bulgaria	12 (1.0)	27 (1.3)	30 (1.3)	31 (1.6)	15 (1.1)	23 (1.2)	34 (1.4)	31 (1.6)
Canada*	48 (1.4)	40 (1.2)	10 (0.8)	1 (0.3)	55 (1.2)	38 (1.1)	17 (1.0)	8 (1.1)
China Hong Kong	84 (1.3)	16 (1.3)	0 (0.2)	0 (0.0)	81 (1.1)	18 (1.2)	5 (1.0)	1 (0.4)
Chinese Taipei	63 (1.9)	35 (1.9)	2 (0.6)	0 (0.3)	73 (1.9)	19 (1.7)	7 (1.0)	2 (0.9)
Cyprus	51 (8.5)	49 (8.5)	0 (0.0)	~	57 (6.1)	65 (6.3)	0 (0.0)	0 (0.0)
Czech Republic	32 (3.3)	59 (3.5)	6 (1.7)	4 (1.4)	47 (2.9)	55 (3.0)	16 (2.5)	6 (1.7)
Denmark	45 (2.8)	51 (2.9)	3 (0.7)	1 (0.5)	53 (2.1)	53 (2.1)	6 (1.4)	0 (0.3)
Finland	57 (1.3)	36 (1.3)	5 (0.6)	2 (0.5)	55 (1.7)	40 (1.6)	5 (0.7)	0 (0.0)
France	45 (1.6)	46 (1.6)	6 (0.8)	3 (0.6)	47 (1.6)	43 (1.6)	10 (1.1)	0 (0.2)
Hungary	48 (2.0)	43 (2.0)	7 (1.0)	2 (0.6)	46 (2.3)	46 (2.5)	17 (2.0)	4 (1.1)
Iceland	71 (1.8)	27 (1.8)	1 (0.2)	1 (0.3)	76 (1.6)	19 (1.4)	1 (0.2)	8 (1.6)
Israel*	42 (5.5)	48 (5.5)	7 (3.0)	2 (1.8)	44 (3.7)	56 (3.9)	14 (3.2)	7 (2.7)
Italy*	52 (2.6)	32 (2.4)	12 (2.0)	4 (1.2)	57 (2.5)	27 (2.3)	17 (2.1)	0 (0.3)
Japan	43 (3.4)	33 (3.4)	22 (2.9)	2 (1.2)	42 (3.2)	8 (1.9)	47 (3.3)	13 (2.6)
Lithuania	32 (2.3)	43 (2.3)	15 (1.6)	10 (1.5)	44 (2.3)	33 (2.2)	15 (1.6)	8 (1.4)
Luxembourg	75 (3.3)	24 (3.2)	1 (0.7)	0 (0.0)	69 (3.9)	31 (3.7)	1 (0.5)	0 (0.0)
New Zealand*	53 (1.6)	43 (1.5)	3 (0.4)	1 (0.2)	57 (1.6)	35 (1.7)	2 (0.4)	5 (0.9)
Norway	48 (1.2)	48 (1.2)	2 (0.3)	2 (0.3)	60 (0.6)	39 (0.7)	3 (0.3)	1 (0.2)
Russian Federation*	15 (3.1)	18 (3.6)	10 (2.8)	57 (4.8)	17 (3.4)	11 (2.8)	20 (3.8)	38 (4.6)
Singapore	96 (0.1)	4 (0.1)	0 (0.0)	0 (0.0)	95 (0.0)	18 (0.4)	0 (0.0)	1 (0.1)
Slovenia	61 (2.5)	37 (2.5)	1 (0.3)	0 (0.3)	79 (2.3)	21 (2.3)	0 (0.2)	2 (0.9)
South Africa*	40 (4.4)	43 (4.6)	13 (3.2)	4 (2.0)	49 (4.8)	21 (4.1)	30 (4.4)	0 (0.3)
Thailand	52 (1.6)	43 (1.6)	4 (0.7)	2 (0.5)	54 (1.6)	20 (1.3)	22 (1.4)	0 (0.2)

Notes: Percentages per school calculated as: (total number of particular type divided by total number of computers available at the grade range)*100. Standard error (se): value ± 2*se provides 95% confidence interval for the population. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). ~: data not collected.

Table 4.1.3 Average percentages (and standard errors) of computers equipped with different processor types and different operating systems at the grade range—upper secondary education

	% INTEL Pent.+Mac 103+higher	% 386/486SX/DX,Mac up to 68030	% 16-BIT Compat. AT/XT80286	% 8-BIT Compatible,APPLE2/2E	% Wind.95/98,WinNT,MacOS7,5+	% Wind.3.0/3.1,OS/2,Mac-OS <7.5	% MS DOS(3.1–7.0)without Wind.	% Other Operating Systems
Belgium-French*	46 (2.6)	47 (2.6)	6 (1.1)	1 (0.4)	53 (2.9)	40 (2.8)	7 (1.3)	0 (0.1)
Bulgaria	10 (1.4)	24 (1.8)	32 (1.9)	33 (2.4)	16 (1.7)	20 (1.7)	38 (2.2)	30 (2.3)
Canada*	49 (1.2)	42 (1.1)	8 (0.6)	2 (0.3)	55 (1.1)	42 (1.1)	10 (0.7)	3 (0.6)
China Hong Kong	87 (1.0)	13 (1.0)	0 (0.1)	0 (0.0)	86 (0.8)	15 (1.0)	4 (0.8)	1 (0.4)
Chinese Taipei	72 (1.5)	26 (1.4)	2 (0.3)	0 (0.0)	79 (1.4)	5 (0.7)	14 (1.3)	0 (0.2)
Cyprus	41 (3.0)	51 (3.4)	7 (2.1)	~	32 (1.3)	62 (1.5)	8 (1.9)	20 (5.9)
Czech Republic	41 (2.7)	56 (2.7)	3 (0.8)	0 (0.0)	55 (2.3)	47 (2.5)	12 (1.8)	1 (0.8)
France	53 (1.6)	43 (1.5)	4 (0.6)	0 (0.2)	53 (1.7)	43 (1.7)	4 (0.6)	0 (0.1)
Iceland	86 (1.6)	12 (1.4)	1 (0.5)	0 (0.2)	81 (1.4)	13 (1.1)	1 (0.5)	2 (0.4)
Israel*	51 (4.6)	46 (4.6)	3 (1.2)	1 (0.4)	53 (3.0)	40 (3.2)	13 (2.8)	5 (2.3)
Italy*	58 (2.4)	33 (2.3)	8 (1.3)	1 (0.4)	65 (2.1)	25 (1.9)	11 (1.7)	2 (0.8)
Japan	47 (3.5)	35 (3.4)	17 (2.8)	1 (0.8)	50 (3.0)	20 (2.6)	38 (3.2)	7 (2.1)
Latvia*	47 (7.3)	34 (6.3)	8 (3.4)	11 (3.5)	66 (2.7)	42 (3.5)	16 (3.5)	15 (5.3)
Lithuania	27 (0.8)	45 (0.9)	13 (0.6)	14 (0.7)	41 (0.9)	33 (0.9)	15 (0.6)	12 (0.7)
Luxembourg	73 (2.8)	24 (2.8)	3 (0.9)	0 (0.0)	71 (3.4)	28 (3.2)	1 (0.4)	0 (0.0)
Norway	57 (1.1)	42 (1.1)	1 (0.2)	0 (0.0)	61 (0.9)	39 (1.0)	2 (0.3)	0 (0.2)
Russian Federation*	15 (3.0)	19 (3.7)	11 (2.7)	55 (4.7)	17 (3.3)	11 (2.8)	20 (3.8)	38 (4.6)
Singapore	83 (1.4)	17 (1.4)	0 (0.1)	0 (0.0)	92 (0.0)	7 (0.8)	0 (0.0)	1 (0.2)
Slovak Republic*	12 (5.9)	27 (10.3)	23 (5.4)	38 (10.1)	40 (1.9)	49 (2.5)	44 (2.5)	39 (16.2)
Slovenia*	58 (2.3)	40 (2.3)	2 (0.5)	0 (0.0)	82 (1.9)	16 (1.9)	1 (0.4)	0 (0.1)
South Africa*	39 (4.2)	47 (4.3)	12 (2.8)	3 (1.5)	45 (4.4)	34 (4.3)	25 (4.1)	5 (2.5)

Notes: Percentages per school calculated as: (total number of particular type divided by total number of computers available at the grade range)*100. Standard error (se): value ± 2*se provides 95% confidence interval for the population. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). ~: data not collected.

Connections to internal networks

Another important means of evaluating the ICT infrastructure in schools is the extent to which the available equipment is connected to an internal network. The respondents who filled out the technical questionnaire were given the following question:

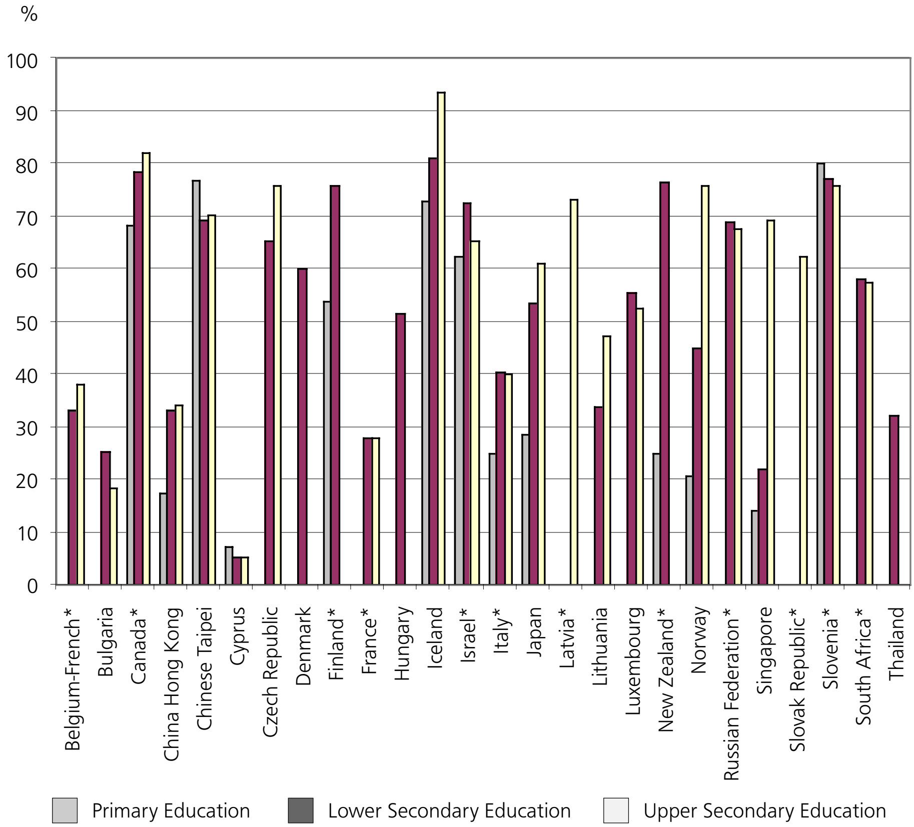
> How many of the total number of computers from question 20 are in a local network?[5]
>
> Number of computers in local network ☐

5 Question 20 referred to the total number of computers available for use in the targeted grade range.

Figure 4.5 contains the average percentage of computers connected to a local network at the targeted grade range in each country. Note that the wording of the question may have led respondents to interpret the term 'local network' in a broader sense than the term 'local area network'.

At the targeted grade range in *primary education* (see Figure 4.5) in Canada, Chinese Taipei, Iceland, Israel, and Slovenia, most of the computers seemed to be connected to an internal network. This was barely (that is, less than roughly 20%) the case in China Hong Kong, Cyprus, and Singapore.

At the targeted grade range in *lower secondary education*, there were a few countries where nearly all computers were connected to an internal school network (Canada, Finland, Iceland, Israel, New Zealand, and Slovenia). Countries where this was the case to a much lower extent were, for instance, Bulgaria, Cyprus, France, and Singapore.



Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). Top of bar displays 95% confidence interval. Missing boxes: data not available.

Figure 4.5[6] Bar graph of average percentages of computers accessible at the grade range connected to a local network—primary, lower, and upper secondary education.

6 In addition to the SITES countries, it appeared that in the Netherlands nearly half of the computers (48%) were connected to an internal school network in primary education (ten Brummelhuis, 1998), and 73% were connected in lower secondary education (ten Brummelhuis, 1999).

At the targeted grade range in *upper secondary education* in Canada, Chinese Taipei, the Czech Republic, Iceland, Latvia, Norway, and Slovenia, most computers were connected to an internal network. This was much less the case in, for instance, Bulgaria, Cyprus, and France.

It was expected that the substantial number of schools that began introducing computers in the 1980s would suffer from outdated or malfunctioning equipment. An indication of the extent to which this was the case can be obtained from the SITES respondents' answers to the following question:

> Does your school have any computers (in addition to the computers listed in questions 15 and 18[7]) which are not currently in use by teachers and/or students for teaching and/or learning purposes?
>
> *If none, write 'none' or '0' and proceed to question 26.*
>
> Number of computers not in use: ☐
>
> Why are they not in use?
>
> ☑ *Please tick all that apply.*
>
> ☐ Computers are outdated
> ☐ They are not compatible with other computers
> ☐ They are broken
> ☐ Teachers/students do not know how to use them
> ☐ Other reason

The results are given in Table 4.2.1, which shows that a high percentage of *primary schools* did not have computers in use because they were broken. (This was especially true of Iceland.) Across countries, the average number of broken computers in schools ranged from 0.5 to 4.

Tables 4.2.2 and 4.2.3 show that in a good number of countries a substantial percentage of *lower and upper secondary schools* possessed equipment that was not in use for instructional purposes. The absolute number of computers not in use at these levels ranged from 1 to 18. The most common reason for computers not being in use was, as expected, that they were out of date or broken. It is interesting to observe (from a comparison of the statistics from different educational levels) that, overall, schools at the *upper secondary level* were more inclined to report the existence of computers not being in use than were schools at the primary level.

7 The computers listed in questions 15 and 18 referred respectively to (i) the total number of computers available for students in the entire school, and (ii) the total number of computers in the entire school that were available for administration and for teachers only.

Table 4.2.1 Percentages of students whose schools had computers that were not in use—primary education. For this sub-group: average number of computers (standard errors in parentheses) not in use and percentages of schools that checked reasons for computers not being in use

	% schools having comp. not in use	Number of computers not in use	Reason 1: Computers are outdated	Reason 2: Not compat. oth. comp.	Reason 3: They are broken	Reason 4: Don't know how to use
Canada*	51	3.9 (0.2)	73	27	53	10
China Hong Kong	32	1.3 (0.3)	71	11	35	5
Chinese Taipei	11	0.6 (0.2)	40	11	27	13
Cyprus	19	0.5 (0.3)	67	13	64	0
Finland*	49	1.7 (0.2)	75	16	55	8
France*	~	~	~	~	~	~
Iceland	78	4.1 (0.4)	77	34	33	2
Israel*	32	3.2 (0.7)	70	3	38	3
Italy	35	1.4 (0.2)	75	18	31	9
Japan	~	~	~	~	~	~
New Zealand	49	1.9 (0.3)	71	22	61	9
Norway	~	~	~	~	~	~
Singapore	48	4.1 (0.5)	75	18	24	0
Slovenia	41	1.5 (0.2)	86	14	18	4

Notes: Standard error (se): value ± 2*se provides 95% confidence interval for the population. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). ~: data not collected. See Appendix D for rules of thumb for estimating the standard error for percentages.

Table 4.2.2 Percentages of students whose schools had computers that were not in use—lower secondary education. For this sub-group: average number of computers (standard errors in parentheses) not in use and percentages of schools that checked reasons for computers not being in use

	% schools having comp. not in use	Number of computers not in use	Reason 1: Computers are outdated	Reason 2: Not compat. oth. comp.	Reason 3: They are broken	Reason 4: Don't know how to use
Belgium-French*	36	3.1 (0.4)	73	16	42	2
Bulgaria	60	5.4 (0.3)	71	24	67	4
Canada*	61	11.0 (0.5)	85	25	52	5
China Hong Kong	50	6.8 (0.3)	87	19	61	1
Chinese Taipei	23	3.9 (0.6)	72	3	63	7
Cyprus	50	1.1 (0.1)	92	37	26	24
Czech Republic	26	1.0 (0.2)	73	16	42	4
Denmark	57	3.7 (0.4)	65	13	57	2
Finland	73	5.6 (0.3)	84	22	47	4
France	~	~	~	~	~	~
Hungary	42	2.1 (0.2)	32	8	24	1
Iceland	81	5.4 (0.4)	80	30	34	3
Israel*	27	2.3 (0.5)	71	16	29	3
Italy*	37	4.7 (0.8)	85	12	42	3
Japan	–	–	–	–	–	–
Lithuania	32	1.7 (0.2)	66	36	65	9
Luxembourg	~	~	~	~	~	~
New Zealand*	68	6.9 (0.4)	76	18	59	6
Norway	~	~	~	~	~	~
Russian Federation*	41	2.7 (0.5)	18	6	33	0
Singapore	55	18.3 (0.1)	81	7	45	0
Slovenia	43	1.5 (0.2)	85	14	18	3
South Africa*	56	4.3 (0.7)	62	20	56	8
Thailand	39	3.1 (0.2)	57	8	67	1

Notes: Standard error (se): value ± 2*se provides 95% confidence interval for the population. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). ~: data not collected. See Appendix D for rules of thumb for estimating the standard error for percentages

Table 4.2.3 Percentages of students whose schools had computers that were not in use—upper secondary education. For this sub-group: average number of computers (standard errors in parentheses) not in use and percentages of schools that checked reasons for computers not being in use

	% schools having comp. not in use	Number of computers not in use	Reason 1: Computers are outdated	Reason 2: Not compat. oth. comp.	Reason 3: They are broken	Reason 4: Don't know how to use
Belgium-French*	33	2.7 (0.4)	72	15	47	0
Bulgaria	61	5.6 (0.5)	70	17	67	7
Canada*	58	12.5 (0.6)	84	19	59	2
China Hong Kong	50	6.8 (0.3)	87	19	61	1
Chinese Taipei	24	9.0 (1.8)	43	12	22	8
Cyprus	63	7.9 (0.7)	94	8	44	5
Czech Republic	29	1.3 (0.2)	73	15	35	3
France	~	~	~	~	~	~
Iceland	54	8.9 (1.8)	100	48	32	0
Israel*	38	4.1 (0.7)	56	5	28	3
Italy*	53	7.1 (0.8)	81	10	43	3
Japan	~	~	~	~	~	~
Latvia*	80	5.4 (0.6)	38	21	27	2
Lithuania	38	2.0 (0.1)	68	37	63	7
Luxembourg	~	~	~	~	~	~
Norway	~	~	~	~	~	~
Russian Federation*	40	2.6 (0.5)	18	6	33	0
Singapore	22	4.8 (0.0)	89	35	34	0
Slovak Republic*	100	5.8 (0.6)	45	11	21	0
Slovenia*	39	2.1 (0.3)	90	10	33	0
South Africa*	35	2.3 (0.5)	69	22	57	7

Notes: Standard error (se): value ± 2*se provides 95% confidence interval for the population. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). ~: data not collected. See Appendix D for rules of thumb for estimating the standard error for percentages.

Peripherals

The additional computer-related equipment (peripherals) available in schools for educational use is another useful indicator of hardware accessibility and functionality. The SITES researchers considered the following list to contain the most up-to-date types of peripherals:

- Laser printer
- Devices for disabled students
- Color printer
- Graphic tablet
- Scanner
- CD-ROM drive
- Devices for digital image processing
- CD-writer
- Video-projector
- LCD panel

Appendix G (Tables G.2.1–G.2.3[8]) contains the percentages of students at schools where it was reported that a particular type of equipment was available for educational use at the targeted grade range. The following findings were drawn from the data presented in these tables.

First, certain equipment was present at the targeted grade range for almost all students in primary schools in some countries but hardly at all in other countries. For example:

- A laser printer (at least one) was present for use by three-quarters or more of the students at the targeted grade range in Canada, Finland, and Iceland, but in less than a quarter of the schools in Chinese Taipei, Cyprus, France, and Italy.
- A LCD-panel was rarely available to students except for those in schools in Singapore and Slovenia.

Second, the overall index in Table G.2.1 regarding the average percentage of peripherals possessed by schools in primary education indicated that, especially in Singapore, the availability of peripherals for educational use at the targeted grade range was relatively high, whereas it was quite low in Chinese Taipei.

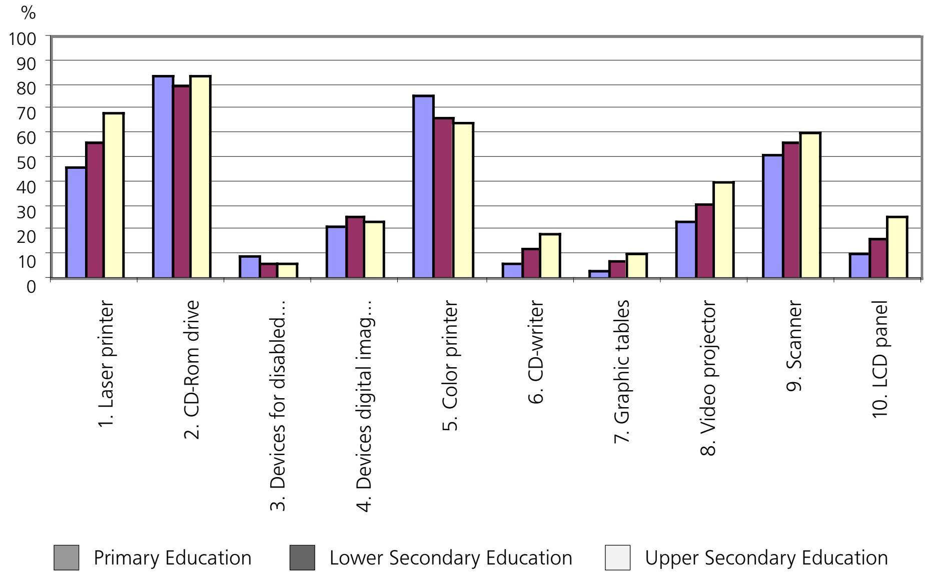
Table G.2.2 reveals that, in many countries, some peripherals (for example, a laser printer, CD-ROM drive, color printer, and scanner) were available for almost all students at the targeted grade range in lower secondary education, while in other countries quite substantial variation regarding availability was evident. The overall index of availability of peripherals was relatively high in, for instance, Luxembourg and Singapore, but very low in other countries (less than 20% in Bulgaria, Cyprus, Lithuania, the Russian Federation, and Thailand).

At the targeted grade range in upper secondary education, on average more than 50% of the listed peripherals were available in Canada, China Hong Kong, Italy, Luxembourg,

8 Some of the peripherals that were listed in the questionnaires for the ICT-monitor in the Netherlands (ten Brummelhuis, 1998, 1999) were the same as in SITES. Specifically, they were CD-ROM (69% of primary and 89% of lower secondary schools had one or more of these), color printer (45% primary, 65% lower secondary), CD-writer (2% primary, 13% lower secondary), video-projector/LCD panel (1% primary, 35% lower secondary), and scanner (19% primary, 75% lower secondary).

Norway, Singapore, and Slovenia. Low percentages of availability were observed in Bulgaria, Lithuania, and the Russian Federation.

Figure 4.6 presents a condensed overview of the availability of peripherals for each educational level, averaged across countries. A comparison of the data for the different educational levels shown in this figure reveals that, at the targeted grade range, primary schools had fewer types of peripherals than did secondary schools (except for devices for disabled students, devices for digital image processing, color printers, and CD-ROM drives).



Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). Missing bars: data not collected. See Appendix D for rules of thumb for estimating the standard error for percentages.

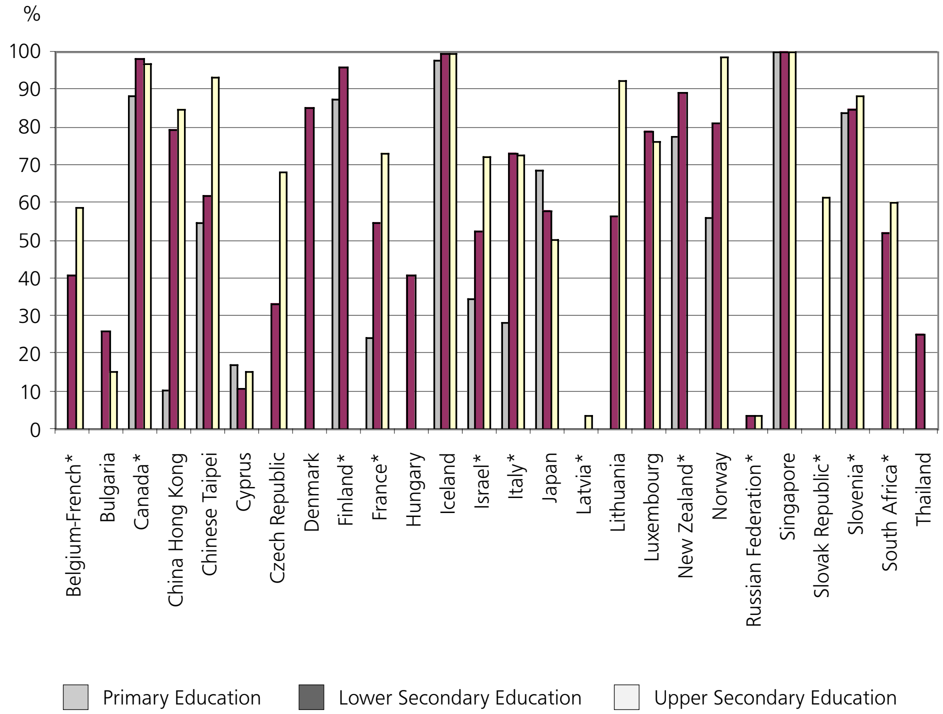
Figure 4.6 Percentages of students whose schools possessed particular peripherals for use in the grade range—primary, lower, and upper secondary education.

Access to Communication Facilities

The Internet and WWW are probably the most visible ICT innovations of the past 10 years. The ability of citizens and schools to access the Internet is rapidly increasing. Many governments have formulated explicit plans to equip schools with access to the Internet before or shortly after the year 2000. Although, as Chapter 2 shows, quite a number of the countries participating in SITES Module-1 had adopted such policies in 1998, many had not. The SITES researchers therefore asked a number of questions in order to determine if schools had access to the Internet for instructional purposes. This question was different from the one reported in Chapter 3, which dealt with the use of email/WWW for instructional purposes at the targeted grade range.

Figure 4.7[9] shows the percentages of students attending schools that indicated they had access to the Internet for instructional purposes. It should be noted, however, that the actual percentages of schools that had access to the Internet but used it for purposes other than instruction are likely to be higher.

As a general trend, upper secondary schools had the highest access to the Internet by the end of 1998. Overall, the percentages were lower at the lower secondary level and lower still at the primary level. Access percentages of over 80% were observed in Canada, China Hong Kong, Chinese Taipei, Denmark, Finland, Iceland, Lithuania, New Zealand, Norway, Singapore, and Slovenia. Low percentages existed especially in Bulgaria, Cyprus, and Thailand.



Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). Missing bars: data not collected. See Appendix D for rules of thumb for estimating the standard error for percentages.

Figure 4.7 Percentages of students whose schools had access to the Internet for instructional purposes—primary, lower, and upper secondary education.

9 Anderson and Ronnkvist (1999) report percentages of schools with access to the Internet of 87%, 94%, and 98% respectively for primary, lower secondary, and upper secondary education in the United States. In the United Kingdom, these percentages were 17% and 83% for, respectively, primary and secondary education (DfEE, 1998). In the Netherlands (according to ten Brummelhuis, 1998, 1999), the percentage at the primary level (23%) was lower than the percentage at the lower secondary level (72%).

Those respondents who reported that the school had access to the Internet for instructional purposes were asked a number of additional questions, namely:

- whether the school had plans to acquire access to the Internet;
- the number of computers that could simultaneously access email;
- the number of computers that could simultaneously access the WWW;
- whether the school had its own home page and, if yes, what content was available at the school's home page.

The responses to these questions are summarized in Appendix G,[10] Tables G.3.1–G.3.3 and G.4.1–G.4.3. From Tables G.3.1–G.3.3 it appears that, in many countries, schools that did not yet have access reported that they planned to acquire it in 1999 or 2000.

Table G.3.1 indicates that, on average, a relatively large percentage of the available computers in the primary schools of Chinese Taipei, Finland, Iceland, and Slovenia could simultaneously access the Internet. This situation was seen to a much lesser extent in the other countries.

At the *lower secondary level* (Table G.3.2), roughly the same picture emerged: the average percentages of computers with simultaneous access to the Internet were relatively high in Canada, Chinese Taipei, Finland, Iceland, and Slovenia. Very low figures were observed in Bulgaria, France, Italy, Japan, Lithuania, and the Russian Federation.[11]

In *upper secondary schools* (Table G.3.3) in Canada, Chinese Taipei, Iceland, Norway, Singapore, and Slovenia, the percentages of computers with simultaneous access to the Internet were relatively high. These percentages were low in Bulgaria, Cyprus, France, Italy, and the Russian Federation.

In many countries, schools that did not have access reported that they planned to acquire access to the Internet before the year 2001. However, substantial percentages of schools in Bulgaria, China Hong Kong, Cyprus, the Czech Republic, Japan, Latvia, the Russian Federation, and Thailand indicated that they did not have even these plans.

As can be inferred from Figure 4.8, the percentage of students at schools with a home page (that is, the percentage that used email/WWW for instructional purposes at the grade range and that had a home page) was relatively high in a few countries but small in many others. At the *primary level*, a relatively large group of schools had home pages in Finland and Iceland. This was also the case for a majority (more than 50%) of schools at the *lower secondary level* in Canada, China Hong Kong, Chinese Taipei, Denmark, Finland, Iceland, Luxembourg, and Singapore. However home pages were rarely evident in the lower secondary schools of Bulgaria, Cyprus, France, Hungary, Israel, Japan, Lithuania, South Africa, and Thailand. At the *upper secondary level*, the percentage of schools with home pages was high in China Hong Kong, Chinese Taipei, Iceland, Luxembourg, Norway, Singapore, and Slovenia.

10 For the United States, Anderson and Ronnkvist (1999) reported the following average percentages for computers with simultaneous web access: primary education, 21; lower secondary education, 33; and upper secondary education, 37.

11 The percentages are based on those schools that had access to the Internet/WWW for instructional purposes.

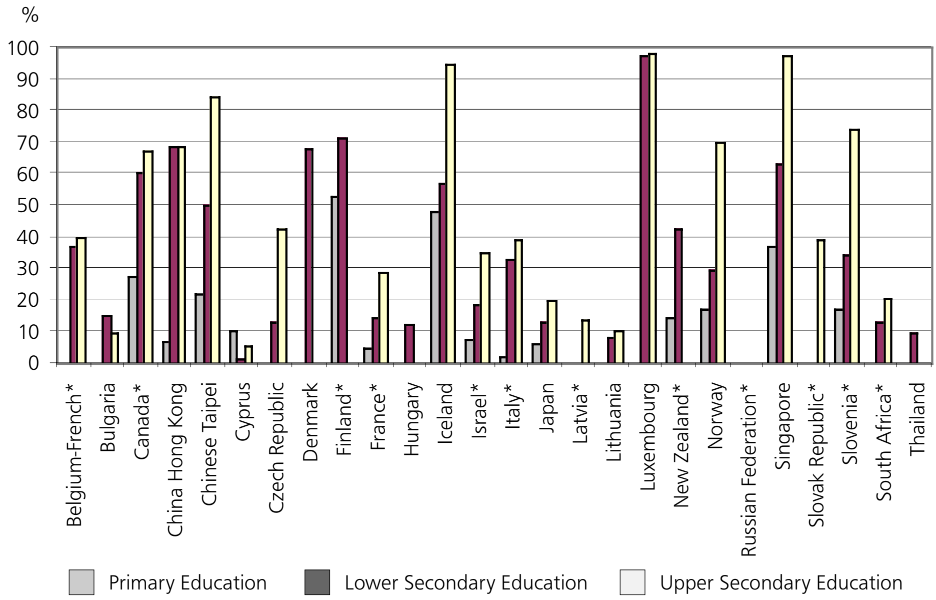


Figure 4.8 Percentages of students whose schools had their own home page (that is: use of email/WWW for instructional purposes at the grade range and had own home page)—primary, lower, and upper secondary education.

With regard to the content of the schools' home pages, the questionnaire respondents were asked if these contained the following types of information and features:

General information
- General information about the school
- Special information for parents (e.g. parent meetings, parent/teacher conferences)
- Information about changes in the time schedule

Information for teachers
- Information on staff development activities
- Lesson plans
- Curriculum guidelines and frameworks
- Clickable links to resources for teachers

Information for students
- Results of student projects (essays, artwork, videos)
- Tests
- Assignments
- Clickable links to resources for students
- Curriculum materials
- Announcements about events
- Other

Given that the percentages of schools that possessed home pages was relatively low in a good number of countries, attempts to compare the available content of home pages across countries should be treated with caution. Summary information about the various types of content is shown in the bar graphs in Figure 4.9 (these statistics are based on the pooled data set, achieved by giving each country the same weight). As Figure 4.9 indicates, general information about the school was, overall, the most frequently available content of the home pages. The frequencies were much lower for the other types of content.

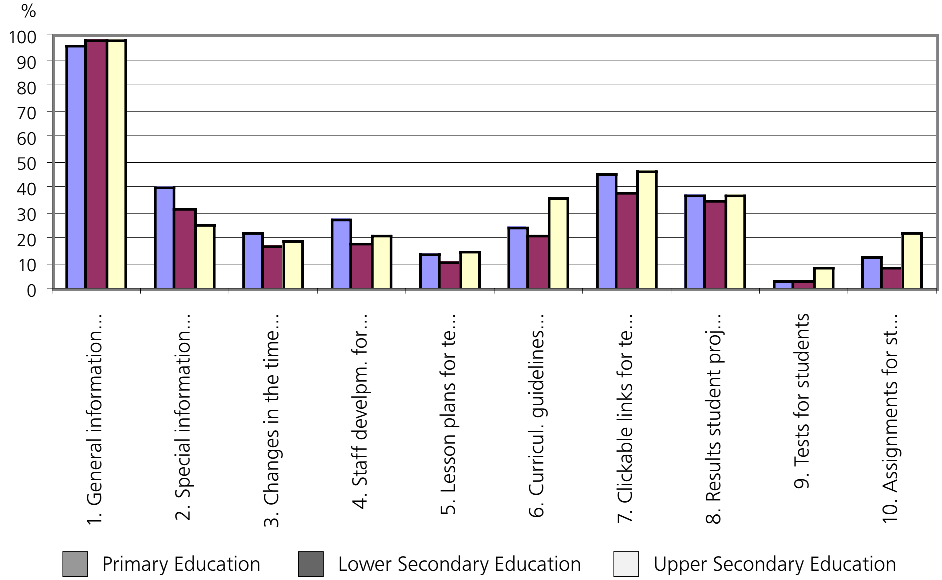


Figure 4.9 Percentages of students at schools that had included particular information on their home pages, averaged across countries (percentages based on the subgroup that used email/ WWW for instructional purposes at the grade range and had own home page)—primary, lower, and upper secondary education.

A further inspection of the data (see Tables G.4.1–G.4.3) led to several other interesting observations. For example, at the lower secondary level:

- Clickable links for students were available at many home pages in Chinese Taipei.
- Many Finnish school-web sites contained curriculum guidelines for teachers.
- Placing the results of students' projects on the web was quite popular in Luxembourg.

Percei ed O stacles Regarding ardware Infrastructure

In the sections above, a variety of indicators provided a bird's-eye view of the hardware infrastructure available in schools at the primary, lower secondary, and upper secondary levels at the end of 1998. The comparative data from across countries should help interested audiences make some decisions about which measures to take to improve this infrastructure in their schools. However, an additional piece of information may help inform debates on future policy initiatives. This is the perception that educational practitioners have of needs and priorities regarding the hardware infrastructure in the schools.

Tables G.7.1–G.7.3 and G.8.1–G.8.3 show the percentages of respondents (school principals and computer coordinators) who indicated that particular hardware problems were *major obstacles* for realizing the computer-related goals of the school for students at the targeted grade range. In order to interpret the relative magnitude of the percentages for the hardware-related items, these should be compared with the percentages for the other items in the list, which included problems relating to software, instruction, and the Internet/WWW.

Respondents identified the following hardware obstacles:

School principals (Tables G.7.1–G.7.3)

1. Insufficient number of computers

Technical respondents (Tables G.8.1–G.8.3)

1. Insufficient number of computers
2. Insufficient peripherals (printers, scanners, transviewers)
3. Outdated or lack of school network or LAN
11. Insufficient computers with simultaneous access to the Internet/WWW
12. Slow or unreliable network performance
13. Too complicated to connect to the network

An 'insufficient number of computers' was seen as a major obstacle by a majority of respondents in most countries. Relatively low percentages were observed in primary education in Singapore, in lower secondary education in Italy, and at the upper secondary level in Chinese Taipei, France, Italy, Luxembourg, Singapore, and Japan. Other problems that were frequently mentioned (although a good measure of variation existed between countries) were 'not enough simultaneous access to the Internet/WWW', 'lack of technical assistance', and 'outdated school networks'.

SOFTWARE

The second main area of ICT infrastructure in schools dealt with software. The two main categories of software distinguished for SITES Module-1 were (i) general purpose software and (ii) school subject-specific software. The importance of this distinction was documented by Pelgrum and Schipper (1993), who showed that the integration of computers in the school curriculum was associated with the availability of subject-specific educational tool software. In other words, the more educational tool software available, the more computer use was integrated into the learning of subjects. However, the extent to which general-purpose programs was available was shown to be associated with an emphasis on an informatics type of curriculum.

In order to determine which types of software were available in schools, the technical questionnaire respondents were asked the following question:

In your school, which of the following types of software are available for teaching and learning (in grades *-*) on at least one computer?

☑ *Tick all that are available.*

1. Word-processing, desktop publishing
2. Spreadsheet
3. Database
4. Graphics: presentation, no professional drawing
5. CAD (computer-aided design), CAM (computer-aided manufacturing)
6. Statistical/mathematical programs
7. Programming languages
8. Accounting, book-keeping, financial software
9. Drill and practice programs
10. Tutorial programs (for self-learning)
11. Simulations (e.g. real world simulations)
12. Educational games
13. Recreational games/other games
14. For exams/tests/constructing tests/administrating tests
15. Internet browser
16. Email software
17. Encyclopedia on CD-ROM
18. Video/audio/authorware
19. Music composition
20. Presentation software (e.g. PowerPoint)
21. Software supporting microcomputer-based laboratories.

Tables G.5.1–G.5.3[12] present summative data drawn from the answers to this question. From an inspection of these tables, it appears that most primary, lower, and upper secondary schools possessed software for word-processing at the grade range. Spreadsheet software was also quite commonly available, except in the primary schools of Chinese Taipei and the lower secondary schools of Cyprus, Lithuania, and the Russian Federation. For the other types of software, a much greater variation across countries was observed. Software

12 The results regarding the availability of types of software for the lower secondary schools in the Netherlands (ten Brummelhuis, 1999) were comparable to the results for the other countries. The percentage for the availability of word-processing/desktop publishing, spreadsheet, and database software was nearly 100%. The percentages for the other types of software varied from relatively high (graphics, 91%) to low (music composition, 18%; multimedia, video/audio authorware, 5%).

for simulations, for video/audio/authorware, for testing students, and for microcomputer-based laboratories were not yet commonly available in most schools.

Figure 4.10 offers a more condensed presentation of the data relating to software availability. The figure shows that the median percentage of available types of software (for use in the grade range) was, for *primary education*, low in Chinese Taipei, France, and Italy, but relatively high in Canada, Iceland, New Zealand, and Singapore.

The average availability (in the grade range) of types of software was relatively high at *lower secondary schools*[13] in Canada, Denmark, Finland, Iceland, New Zealand, Norway, Singapore, and Slovenia. The availability was low in Belgium-French, Bulgaria, Chinese Taipei, Cyprus, Lithuania, the Russian Federation, and Thailand.

At the *upper secondary level*, a relatively high average percentage of types of software appeared in Canada, Iceland, Norway, and Singapore. This index was relatively low in Bulgaria and Japan.

The software types in the previous list were mainly general purpose.

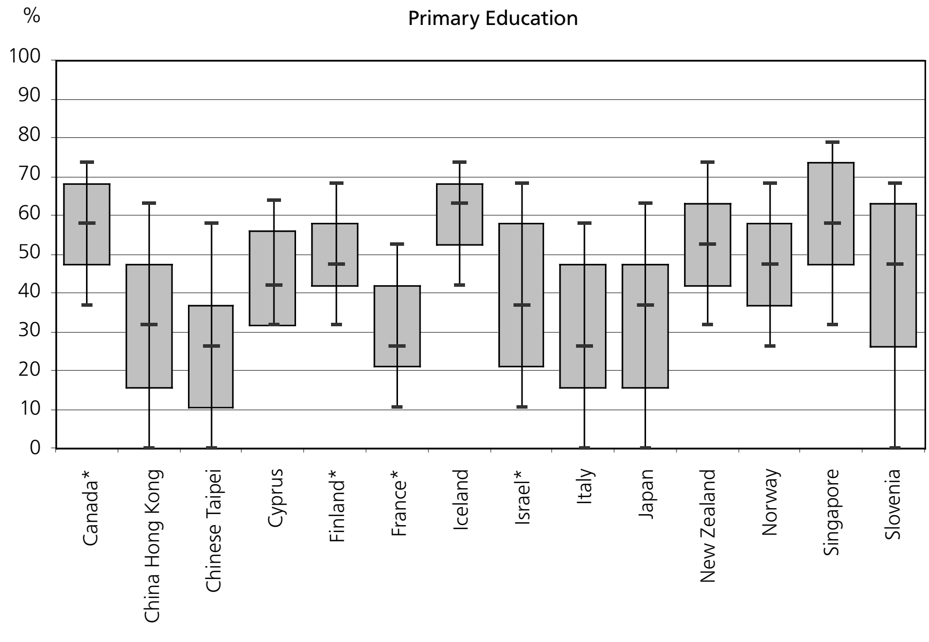
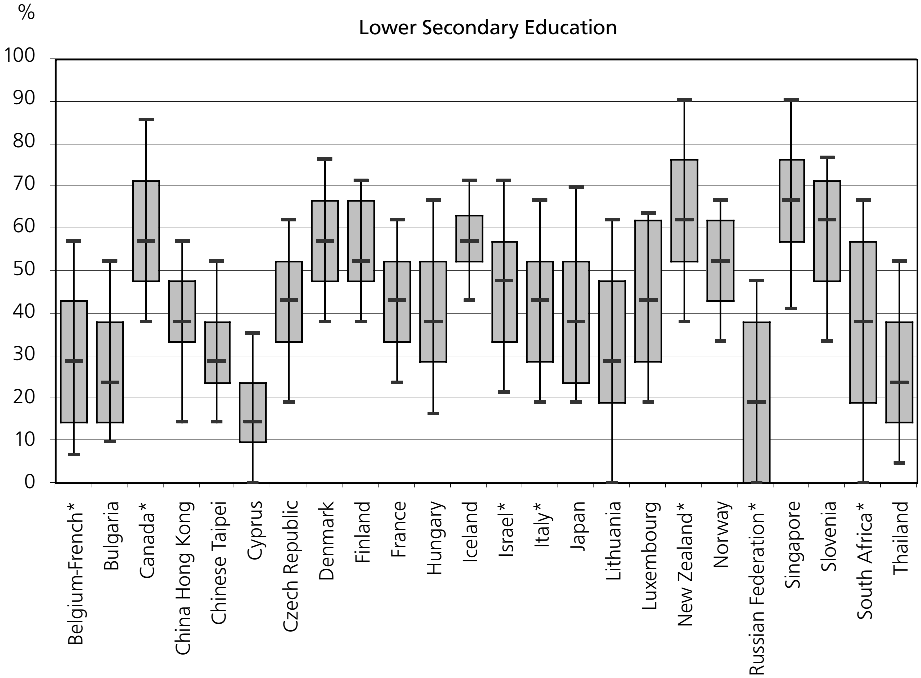
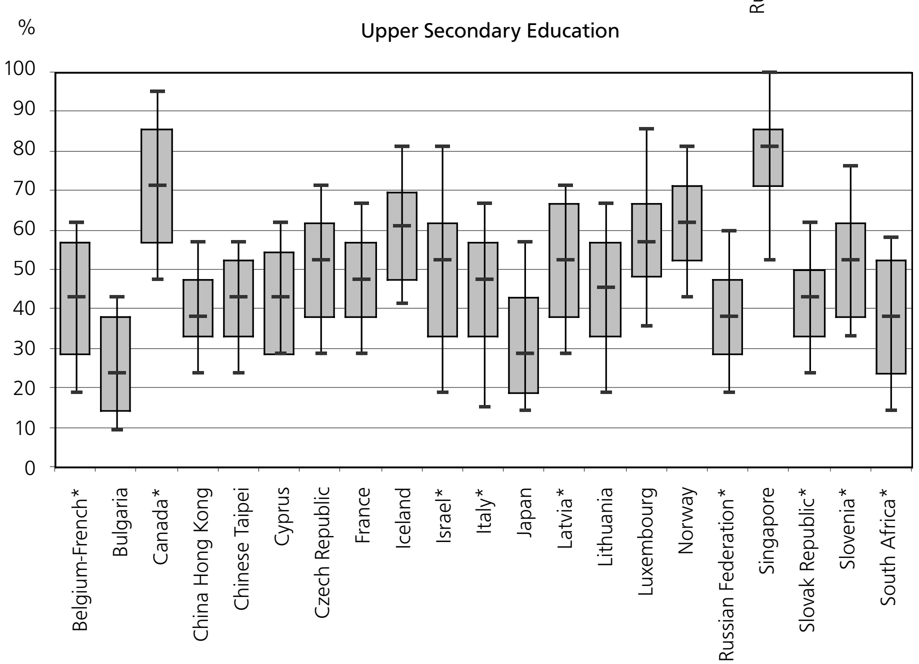


Figure 4.10 *(contd. on page 147)*

13 With regard to the availability of software in the lower secondary schools, the item 'software supporting microcomputer-based laboratories' was not included in the questionnaire for the ICT-monitor in the Netherlands (ten Brummelhuis, 1998). When this same item was removed from the analysis for other countries, it became evident that the availability of the remaining types of software was high in the Netherlands compared to that of the other countries (median = 60). Only Singapore (70) and New Zealand (65) had higher median scores.





Notes: Availability per school was calculated as: (number of types available/21)*100; Items 5 and 8 (see text) were excluded for primary education. Boxes range from 25% lowest to 75% highest value; the horizontal line in the boxes represents the median; tiles show values for 10% and 90% of the cases. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2).

Figure 4.10 (contd. from previous page) Box plots of availability of types of software for use at the grade range—primary, lower, and upper secondary education (average percentage available from a list of 21 types).

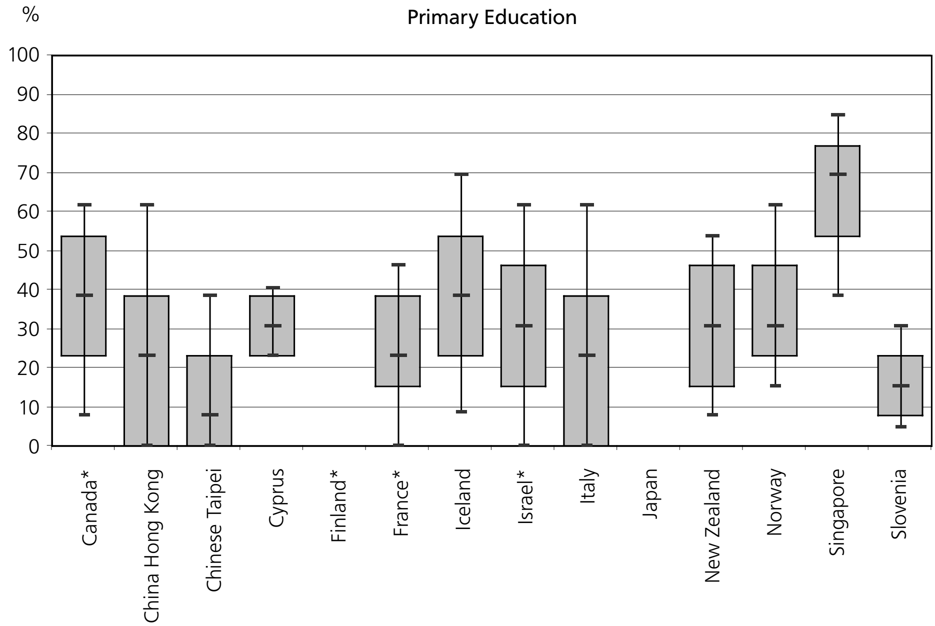
In order to understand the extent to which schools possessed software specifically dedicated to school subjects, the following question was included in the technical questionnaire:

> For which of the following subjects (or subject areas) is educational software available in your school for use in grades *-*?
>
> *Exclude programming languages or office programs (like word-processing and spreadsheet programs) as educational software.*
>
> ☑ *Tick all subjects (or subject areas) for which software is available (including software for multidisciplinary approaches).*
>
> 1. Mathematics
> 2. Physics
> 3. Chemistry
> 4. Biology/life science
> 5. Earth science
> 6. Language/mother tongue
> 7. Foreign language(s)
> 8. Creative arts (music, visual arts)
> 9. History
> 10. Civics
> 11. Economics
> 12. Geography
> 13. Vocational subjects
> 14. Computer education/informatics
> 15. Multidisciplinary projects or activities

The CompEd study of 1992 revealed a low availability of school-subject specific software in the participating schools. One would expect that, after so many years of ICT developments, most schools would have possessed at least one piece of software for most subject areas by the end of 1998. Tables G.6.1–G.6.3 show that this was clearly not yet the case in all countries. For example, the availability of software for mathematics for use in the grade range in *lower secondary education* was very low in Bulgaria, Chinese Taipei, and Cyprus. However, software for mathematics was available at a relatively high percentage of lower secondary schools in the Czech Republic, Denmark, Iceland, Italy, Norway, and Singapore. For the other school subjects, the figures showed that an even greater number of countries had little such software available for use in the grade range.

Although, in general, mathematics (among all the school subjects) had the highest availability of software, there were some noteworthy exceptions to this trend. In lower secondary schools[14] in Belgium-French, the most common subject for which software was available, for use in the grade range, was mother tongue. In Bulgaria, China Hong Kong, Chinese Taipei, Hungary, Lithuania, the Russian Federation, and Thailand the most frequently mentioned subject was computer education/informatics. In Finland, it was foreign language(s).

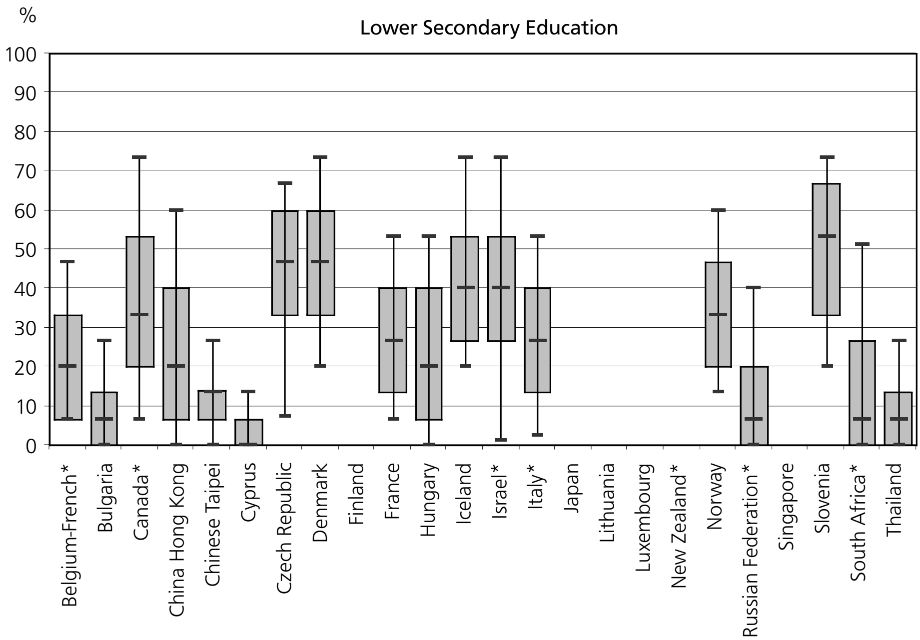
Figure 4.11 contains the box plots of the subject-software coverage indicator. From this index it appeared that in *primary education* the availability of subject-specific software for use in the grade range was relatively high in Singapore. The subject coverage was very high in *lower secondary education* in Slovenia but was considerably lower in other countries. In *upper secondary education*, the median of the subject-software coverage was below 40 in all countries except Singapore. The lowest medians appeared in Bulgaria and Chinese Taipei.

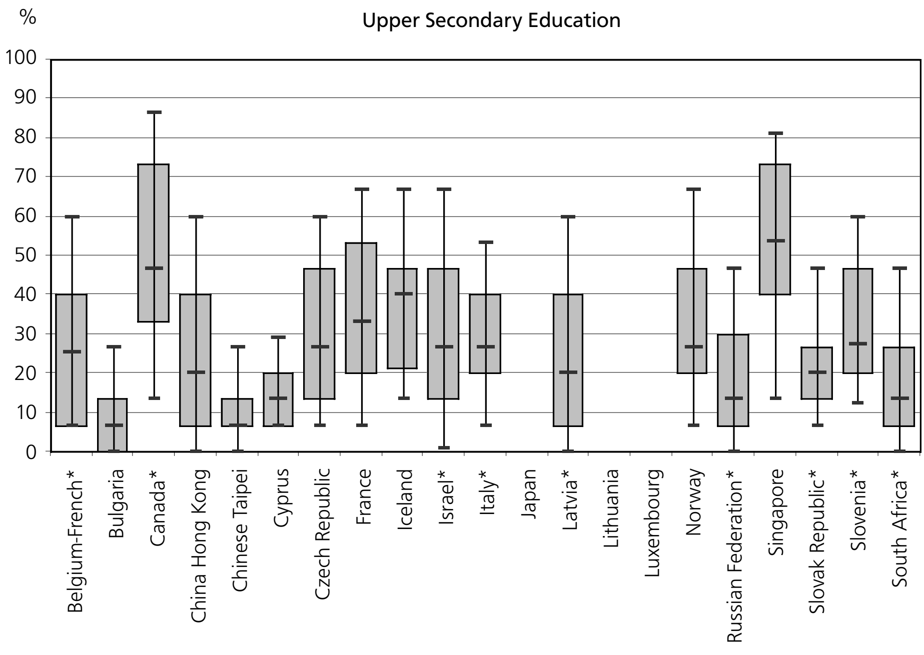


Notes: Software coverage per school was calculated as: (number of subjects for which software was available/ 15)*100. Boxes range from 25% lowest to 75% highest value; the horizontal line in the boxes represents the median; tiles show values for 10% and 90% of the cases. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2.) Missing boxes: countries did not use complete international list.

Figure 4.11 *(contd. on page 150)*

14 In the Netherlands ICT-monitor (ten Brummelhuis, 1998), the following subjects were mentioned in the questionnaire for primary schools (the percentages in brackets are for Grade 7): mathematics (82%), biology/life science (24%), language/ mother tongue (84%), foreign language (11%), creative arts (20%), history (9%), and geography (85%).





Notes: Software coverage per school was calculated as: (number of subjects for which software was available/ 15)*100. Boxes range from 25% lowest to 75% highest value; the horizontal line in the boxes represents the median; tiles show values for 10% and 90% of the cases. *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2.) Missing boxes: countries did not use complete international list.

Figure 4.11 (contd. from previous page) Box plots of software coverage of school subjects for use at the grade range—primary, lower, and upper secondary education (average across schools of percentage available from a list of 13 school subjects (primary education) and 15 (lower and upper secondary education).

Percei ed O stacles with Regard to Software

Tables G.7.1–G.7.3 and G.8.1–G.8.3 present the percentages of respondents (school principals and/or computer coordinators) who said that particular software problems (respondents could choose items from the following list) were preventing realization of the schools' computer-related goals for students in the targeted grade range.

Principal questionnaire (Tables G.7.1–G.7.3)

2. Not enough copies of software for instructional purposes
3. Not enough types (variety) of software

Technical questionnaire (Tables G.8.1–G.8.3)

4. Not enough copies of software for instructional purposes
5. Software too complicated for teachers and/or students to use
6. Software not specific enough and/or not adaptable for use in subjects
7. Lack of information about software or its quality prior to purchasing
8. Most of the software is not in the language of instruction
9. Cultural incompatibility of imported instructional software
10. Curricular incompatibility of imported instructional software

The tables show that the most frequently mentioned obstacle from the above list in almost every country, at all educational levels, was 'not enough copies of software for instructional purposes'. However, in Israel and Singapore, the obstacle most mentioned by respondents from the *primary and secondary school levels* was 'software not specific enough and/or not adaptable for use in subjects'.

SC OOLS IN EST ENTS IN ARDWARE AND SOFTWARE

An interesting, albeit difficult to investigate, question is this: How much should schools spend from their own budgets on different ICT items (hardware, software, staff development, maintenance, and staff salaries) for the targeted grade range? This information was collected (in national currencies) in 14 countries.[15] It makes little sense to present the raw figures here because these figures are meaningful only if they are presented alongside contextual information, such as the size of the school. Figure 4.12 contains the average amount of money (in US$ per student) that schools at the primary, lower secondary, and upper secondary educational levels had spent, from their own budgets, over the previous two years, on hardware and software.[16] It is interesting to note that the amounts spent on software were only a fraction of the sums spent on hardware. As may be expected, the differences

15 The SITES researchers from these countries considered that collecting this data from school principals would be feasible. This was not the case in the other countries in the study.

16 The actual question to principals was in terms of expenditures for the grade range. However, there were indications that the answers were given for the whole school. Therefore, the expenditure per student was calculated on the basis of all students in the school.

between countries were very high. For example, in primary education the expenditure per student in Finland was approximately US$50 while in Italy it was US$15.

To determine if there was a demonstrable relationship between schools' investments in hardware and their student:computer ratios, the latter was categorized into three levels (between 0–10, 11–25, and 26). Breakdowns of the hardware expenditures by these three groups showed clear relationships within countries. The overall trend (across countries) is evident in Figure 4.13, which shows that schools with favorable student:computer ratios tended to spend much more from their own budgets on hardware acquisition than did the other schools.

In the United Kingdom, for the financial year 1997–1998, an average expenditure was reported of £9 per student in primary education and £30 in secondary education (DfEE, 1998). The money was spent on 'computers, robots, software, and other materials' and on 'peripheral equipment, upgrades, and replacements'.

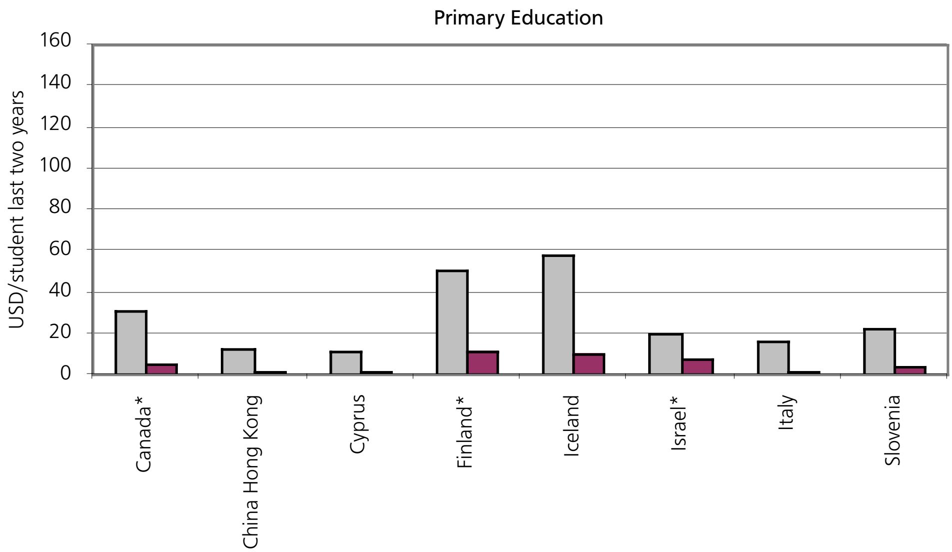
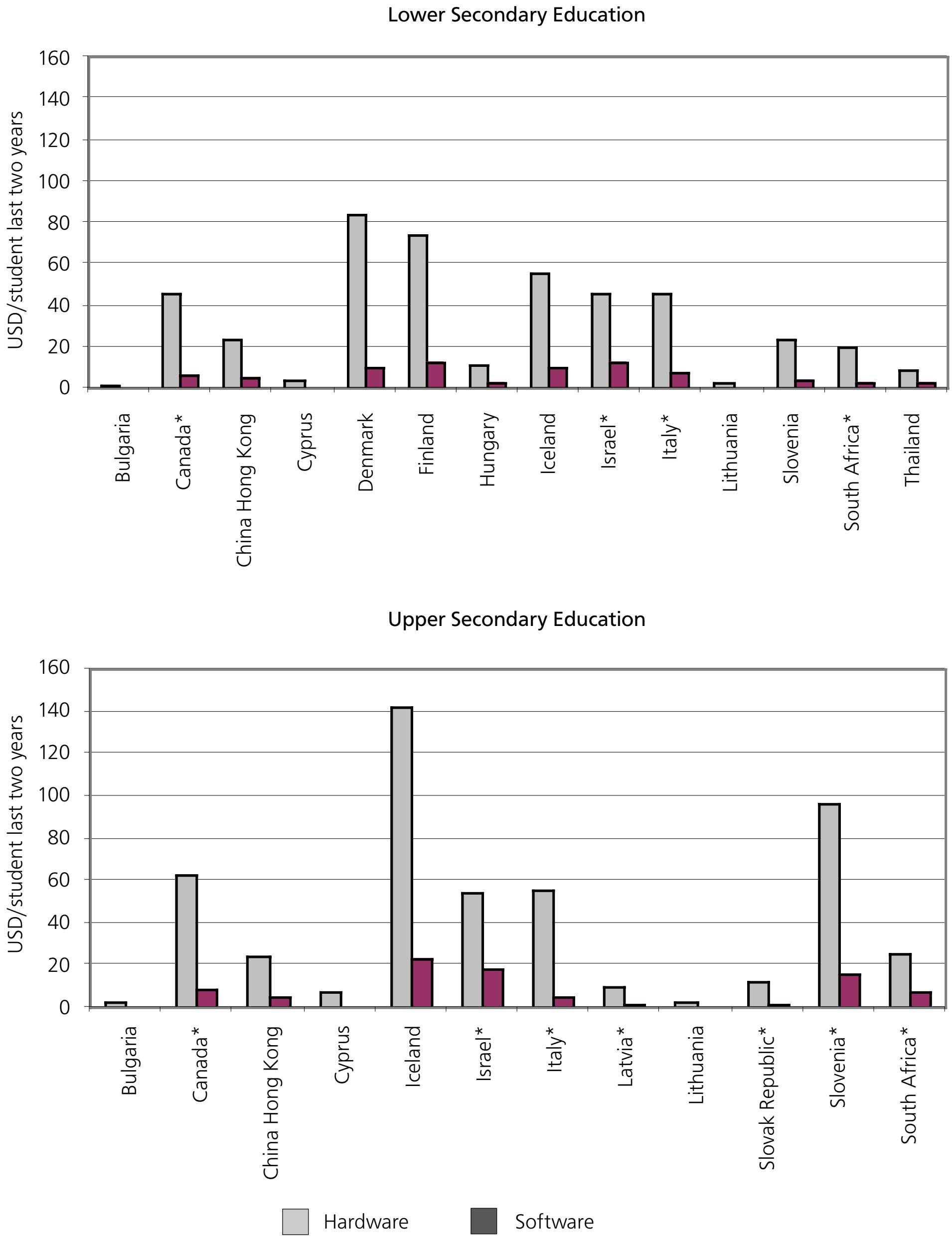


Figure 4.12 (contd. on page 153)



Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2).

Figure 4.12 (contd. from previous page) Average expenditures in the last two school years (in US$ per student) for hardware and software items—primary, lower, and upper secondary education.

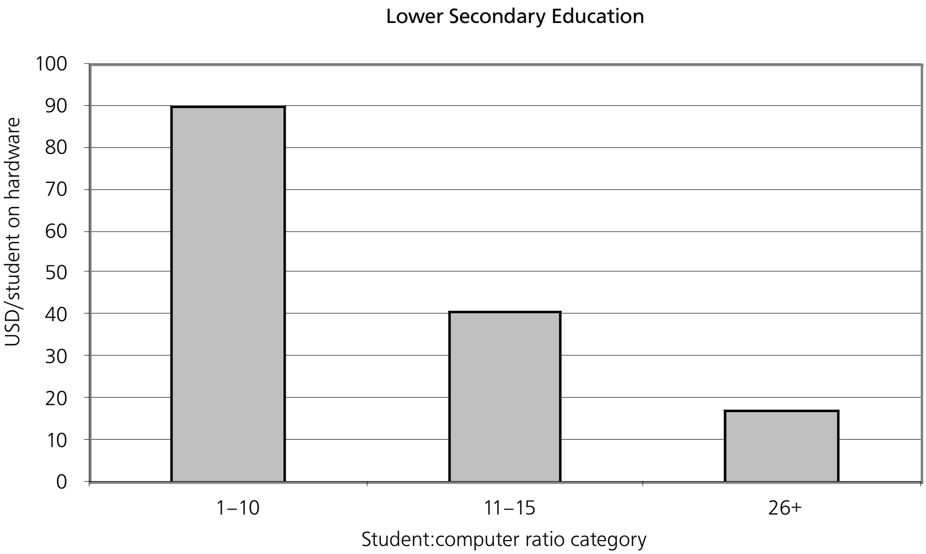


Figure 4.13 Average expenditures on hardware by level of student:computer ratio for lower secondary education (across countries).

SU AR AND REFLECTIONS

This chapter contained a description of a large number of indicators regarding the hardware and software infrastructure in schools. The trend data (that is, a comparison of current student:computer ratios with 1995 data) show that over the four-year period most countries developed rapidly in terms of equipping their schools with computer hardware and software. The overall picture that emerges from this chapter is that huge differences exist between schools in different countries regarding access to ICT equipment and facilities such as the Internet/WWW. It seems plausible to argue that such differences stem mainly from the fact that some governments tend to stimulate the creation of ICT-infrastructure in schools to a much greater extent than do others. However, it may also be the case that differences in the extent to which schools undertake private initiatives contribute to these disparities (refer Figure 4.13).

Despite the fact that student:computer ratios did improve considerably over the four years between 1995 and 1998, one of the major obstacles that schools still saw as hampering the realization of ICT-related goals was the lack of a sufficient number of computers. For political decision-makers this may be a frustrating observation, as it seems that the number of computers actually available 'is never enough'. However, a closer inspection of the data shows that the frequency of complaints about lack of equipment tended to decrease markedly in those schools that had increased their student:computer ratios. Figure 4.14 illustrates that in schools where the student:computer ratios were 25 or higher, approximately 80% of the respondents complained about a lack of equipment. However, this percentage dropped to 50 in those schools with student:computer ratios of 10 or lower.

Given the over-arching research theme of SITES Module-1, namely the potential that ICT has to facilitate the adoption and implementation of the emerging pedagogical paradigm, it is of considerable interest to analyze the relationship between indicators of ICT infrastructure and the paradigm indicators described in Chapter 3. Figure 3.9 in that chapter reveals a considerable co-variation between student:computer ratios and the emerging pedagogical paradigm. However, at this stage of SITES, it cannot yet be ascertained if this co-variation denotes a causal relationship.

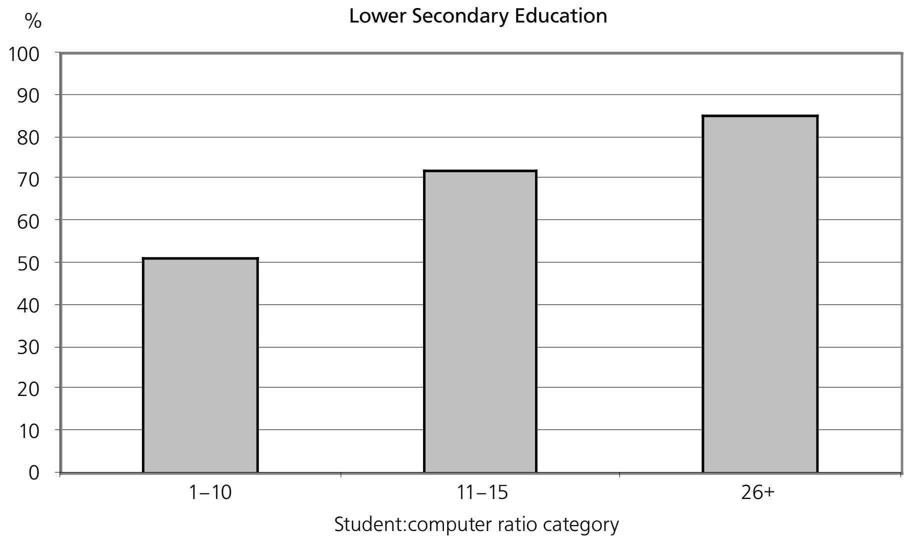


Figure 4.14 Breakdown for lower secondary education of percentages of school principals who indicated that a shortage of hardware was a main obstacle (at the grade range) by levels of student:computer ratios.

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Cha ter

STAFF DE ELOP ENT

W. J. Pelgrum (University of Twente)

This chapter contains a description of indicators on staff development. The question of whether schools have adopted objectives with regard to staff development is addressed, as is the question of the extent to which facilities for training teachers are available inside and/or outside the school. Other questions deal with the perceived problems, priorities, and financial investments of schools in the area of ICT-related staff development.

INTRODUCTION

An important (and maybe, *the* crucial) factor determining the extent to which technological innovations are adopted and implemented in educational practice is the teacher. The training of teachers (and regular updating of their knowledge and skills regarding ICT) is hypothesized to be especially important for the integration of technology in daily educational practice. The authors of the report documenting the results of CompEd 1992 had this to say:

> ...a look into the wishes of teachers concerning teacher training showed that many teachers still indicated a lack of knowledge and a need for further training. This is in line with the innovation literature, which indicates that the introduction of computers is a complex innovation with considerable changes for the teachers. One-shot training is not enough to make this innovation successful. Although most (computer education) teachers had received some form of teacher training in the field of computer use it was obvious that continuing attention for teacher training is important for all teachers. Furthermore, analyses of the support for teacher training at the school level revealed that the most available types of training at school dealt with introductory courses and those directed towards the use of application programs. Whereas the expectation was that the computer coordinator could be an important person within the school setting to provide teachers with some kind of training, analyses showed that the persons selected for computer coordination were mostly regular teachers. The time they had available for coordination tasks was primarily directed towards helping students. Helping teachers (and thus for instance training them informally about computer use) was a second coordination task, but not much of the available time was devoted to this. (Pelgrum, Janssen Reinen, & Plomp, 1993, p120)

In order to describe the situation in 1998, this chapter presents a number of indicators of staff development. First, the following question is addressed: to what extent did school principals and technology coordinators experience the level of staff qualification in ICT as problematic? This section is followed by a description of the practices that schools undertook to train teachers in ICT. The final section of the chapter presents the ratings that the technical questionnaire respondents gave of their own ICT-related skills. These people were the staff members who acted (formally or informally) in the majority of schools as technology coordinators, and they were seen as being potentially important for disseminating information about ICT among teachers. Their self-ratings, it was hoped, would provide an estimate of their ICT competencies.

All reported statistics in this chapter are student based. This means that sentences such as 'The percentage of principals answering affirmatively...' should be read as 'The percentage of students whose principals answered affirmatively...'.

PROBLE S WIT REGARD TO STAFF UALIFICATIONS

Reference has already been made in previous chapters of this book to the responses that school principals and technology coordinators gave to a question asking them to identify major obstacles affecting their schools' ICT-related goals. Appendix G (Tables G.7.1–G.7.3 and G.8.1–G.8.3) provides the percentages of affirmative responses for the full list of items for that question. The following items dealt directly or indirectly with staff development (the numbers refer to the numbers used in the columns of Tables G.7.1–G.8.3):

Principal questionnaire (Tables G.7.1–G.7.3):

- 13. Teachers lack knowledge of/skills in using computers for instructional purposes
- 14. Not enough training opportunities for teachers

Technical questionnaire (Tables G.8.1–G.8.3):

- 22. Teachers feel uncomfortable because some students are more competent with ICT than they are
- 23. The quality of available teacher training courses is insufficient

The tables show that a substantial group of school principals in many countries at the *primary level* saw 'teachers' lack of knowledge' as a major obstacle. Although this problem was not reported as frequently as, for example, the lack of hardware, it was in all countries (except Iceland, Italy, and Singapore) reported by more than 50% of the principals. 'Lack of training opportunities' was also an important problem in a considerable number of countries, except Cyprus, Israel, Singapore, and Slovenia.

At the *lower secondary level*, it seems that the 'teachers' lack of knowledge' was seen most frequently as a major obstacle in France and Luxembourg. 'Lack of training opportunities' was mentioned less frequently, but it was still mentioned by substantial groups of respondents in most countries.

From Tables G.8.1–G.8.3 it appears that in some countries (especially at the lower and upper secondary levels) quite substantial groups of computer coordinators reported that teachers felt uncomfortable because their students were more competent than they were with ICT. In *primary education* this was the case especially in Canada, Cyprus, and Slovenia. In *lower secondary education* it was the case in Canada, New Zealand, Slovenia, and South

Africa. At the *upper secondary level* this problem was mentioned especially in Canada, Israel, Italy, Luxembourg, and Slovenia. The lack of quality of available teacher training courses also was seen quite often as a major obstacle.

POLICIES WIT REGARD TO STAFF DE ELOP ENT AND ITS REALI ATION

Staff development is an expensive activity, and it was therefore reasonable to expect that schools would set priorities with regard to training all (or at least some) staff members. The SITES researchers were also interested in finding out how (for example, basic courses, regular updates, and so on) and to what extent schools had achieved these training goals. School principals therefore were asked if it was the policy of the school to train all staff or only some staff members and to what extent their schools had realized this policy. The percentages of students whose principals indicated that there was a policy and the percentages reflecting that this was almost completely or fully realized are shown in Table 5.1. The percentages for realization were not confined to the existence of a policy, as it was assumed that realization could also happen in the absence of explicit policies.

The overall observation from Table 5.1 is that, at all three educational levels, training all teachers to use ICT was a policy goal of the majority of schools. However, in lower secondary education in Cyprus and the Russian Federation and upper secondary education in the Russian Federation and the Slovak Republic this was much less the case. The goal of training a few teachers to become an ICT specialist had also been adopted by a majority of schools, except for those in Cyprus (lower secondary education), Japan, the Russian Federation, and the Slovak Republic. In most countries at all three educational levels few schools had realized these goals for staff development. The exception was in Singapore, where the realization of the goal of training all teachers to use ICT was very high for primary and lower secondary education.

For primary education in the Netherlands (ten Brummelhuis, 1998), the training of all teachers was a policy goal at 73% of the schools, and this goal had been almost or fully realized at 37% of the schools. These percentages were respectively 94% and 53% for lower secondary education.

In addition to the data given in Table 5.1, information was solicited from school principals regarding the extent to which training was obligatory for teachers at the targeted grade range and for which types of courses. Moreover, the principals were requested to indicate if a substantial number of teachers from the targeted grade range actually had taken particular types of courses. The questionnaire item addressing these issues was worded as follows:

Table 5.1 Percentages of students whose principals indicated that the school had adopted goals regarding the training of teachers and percentages reflecting whether these goals were realized almost or fully—primary, lower secondary, and upper secondary education

	Primary Education				Lower Secondary Education				Upper Secondary Education			
	Goal train all teachers to use ICT	Goal train few teach. ICT specialist	Real. train. all teachers to use ICT	Real. train. few teach. ICT spec.	Goal train all teachers to use ICT	Goal train few teach. ICT specialist	Real. train. all teachers to use ICT	Real. train. few teach. ICT spec.	Goal train all teachers to use ICT	Goal train few teach. ICT specialist	Real. train. all teachers to use ICT	Real. train. all teachers to use ICT
Belgium-French*	~	~	~	~	81	95	10	42	78	95	11	43
Bulgaria	~	~	~	~	71	83	2	16	72	88	1	15
Canada*	85	76	23	34	80	74	17	29	81	73	16	35
China Hong Kong	95	93	4	10	95	88	2	13	95	88	2	13
Chinese Taipei	91	88	23	40	97	90	15	34	97	87	31	41
Cyprus	85	62	3	10	38	49	0	8	92	89	4	12
Czech Republic	~	~	~	~	83	78	12	31	84	89	17	45
Denmark	~	~	~	~	85	88	19	60	~	~	~	~
Finland*	97	87	32	35	98	94	31	38	~	~	~	~
France	73	57	3	5	82	87	5	20	85	88	4	30
Hungary	~	~	~	~	97	68	7	15	~	~	~	~
Iceland	80	78	10	21	78	77	8	25	79	69	7	25
Israel*	89	83	30	34	95	84	31	25	95	89	28	32
Italy*	86	72	23	32	90	75	14	22	91	80	17	33
Japan	74	41	16	7	67	47	12	11	45	48	7	10
Latvia*	~	~	~	~	~	~	~	~	91	83	18	20
Lithuania	~	~	~	~	88	74	15	15	91	76	14	13
Luxembourg	~	~	~	~	71	100	5	51	71	98	5	49
New Zealand*	95	73	30	39	93	77	22	37	~	~	~	~
Norway	95	86	20	38	97	88	24	47	97	85	24	46
Russian Federation*					51	44	6	13	51	44	6	13
Singapore	99	85	80	36	99	87	74	36	100	93	58	46
Slovak Republic*	~	~	~	~	~	~	~	~	18	21	17	29
Slovenia	98	92	21	46	98	93	17	53	99	94	23	42
South Africa*	~	~	~	~	64	65	6	24	60	67	7	21
Thailand	~	~	~	~	90	91	48	48	~	~	~	~

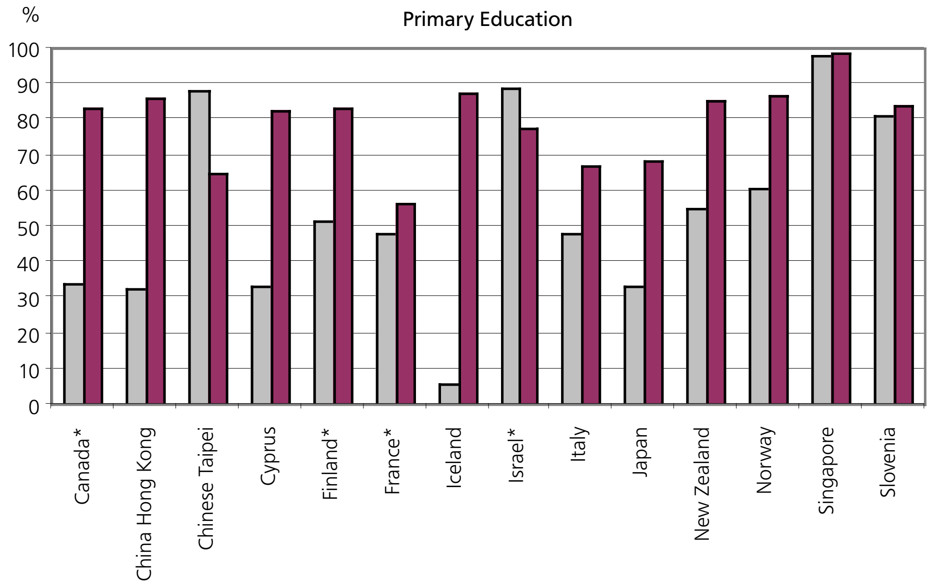
Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). ~: data not collected. See Appendix D for rules of thumb for estimating the standard error for percentages.

16. The following contains some questions about the ICT-related training for teachers of grades *-*.

☑ Tick 'no' or 'yes' for each question.

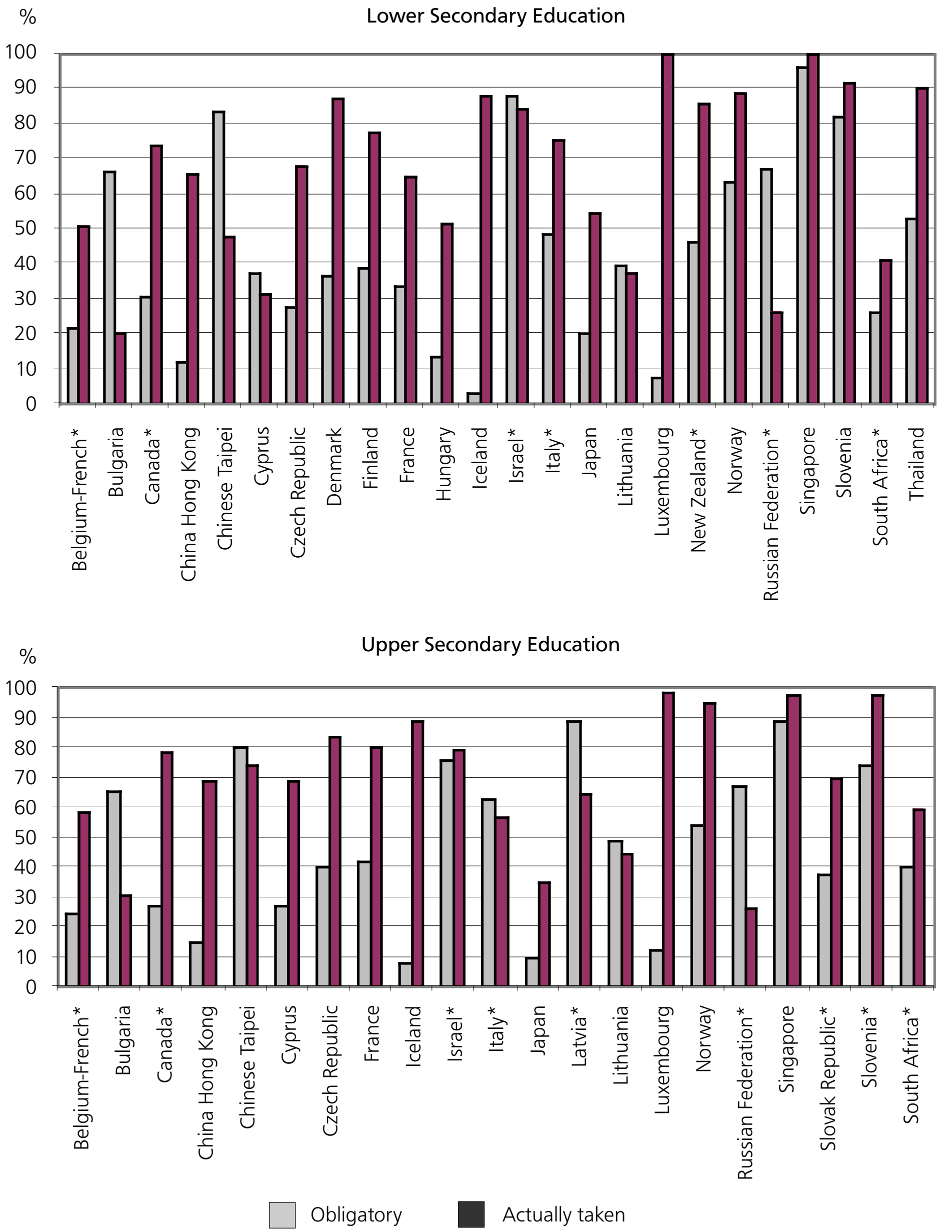
A)	No	Yes
Is it obligatory for:		
1. All grades *-* teachers to take at least some basic computer courses?	☐	☐
2. All grades *-* teachers to regularly take courses to update their ICT-knowledge and skills?	☐	☐
B)		
Have a substantial number of teachers from grades *-*.		
1. Attended at least some basic computer courses?	☐	☐
2. Regularly attended courses to update their ICT-knowledge and skills?	☐	☐

Figures 5.1 and 5.2 contain respectively the percentages of students whose principals answered questions A1/B1 and A2/B2 affirmatively. The percentages for the items in part B of the question were not dependent on part A, because it was assumed that part B could occur in the absence of obligatory prescriptions.



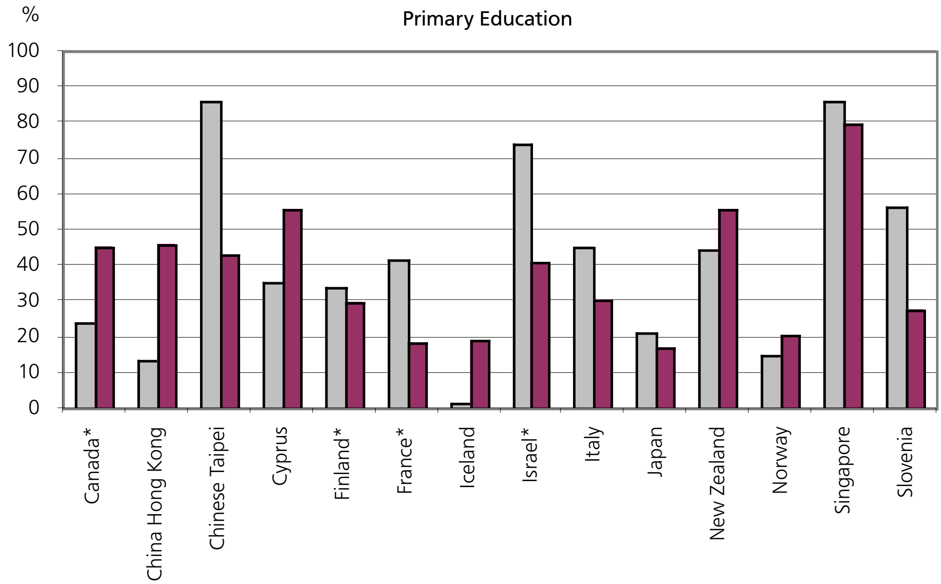
Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages.

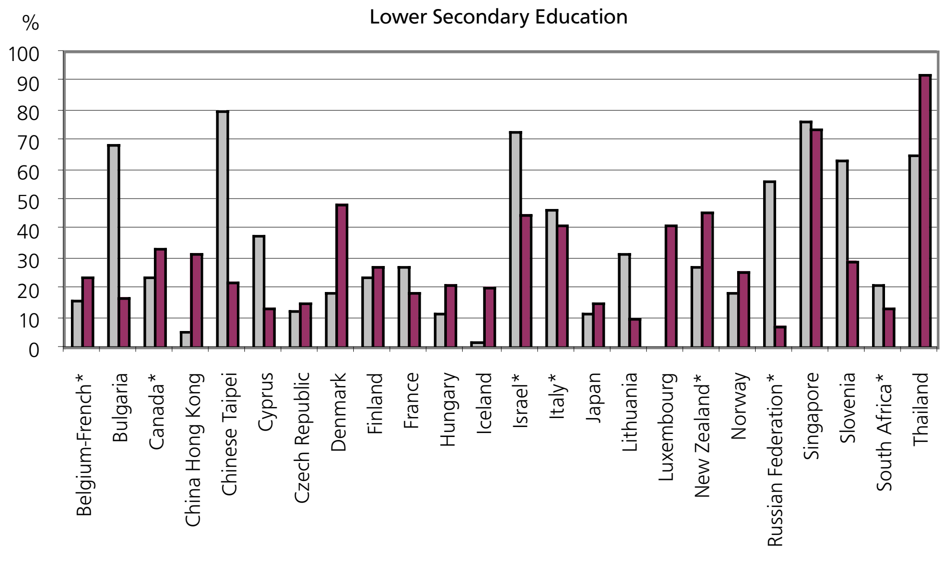
Figure 5.1 Percentages of students at schools where it was obligatory that all teachers from the targeted grade range had taken some basic ICT courses and percentages reflecting if a substantial number of teachers actually had taken such courses–primary, lower, and upper secondary education. *(contd. on page 162)*



Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages.

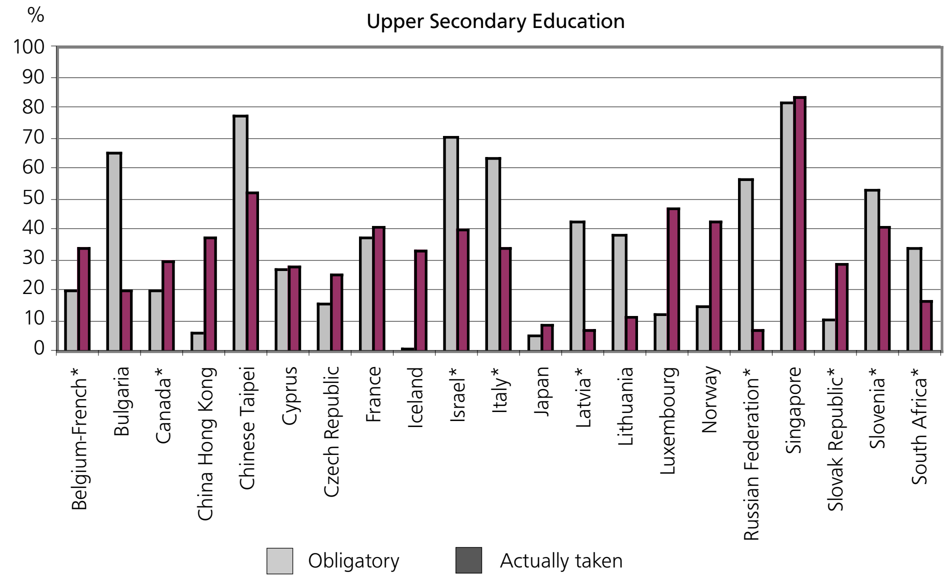
Figure 5.1 (contd. from previous page) Percentages of students at schools where it was obligatory that all teachers from the targeted grade range had taken some basic ICT courses and percentages reflecting if a substantial number of teachers actually had taken such courses—primary, lower, and upper secondary education.





Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages.

Figure 5.2 Percentages of students whose principals indicated that it was obligatory that all teachers from the targeted grade range take courses to regularly update their ICT knowledge and percentages reflecting if a substantial number of teachers actually had taken such courses—primary, lower, and upper secondary education. *(contd. on page 164)*



Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages.

Figure 5.2 (contd. from previous page) Percentages of students whose principals indicated that it was obligatory that all teachers from the targeted grade range take courses to regularly update their ICT knowledge and percentages reflecting if a substantial number of teachers actually had taken such courses—primary, lower, and upper secondary education.

In *primary education*, it was obligatory for all teachers from the targeted grade range to take basic ICT courses in a majority of schools in Chinese Taipei, Finland, Israel, New Zealand, Norway, Singapore, and Slovenia. It is interesting to note that, although in many countries this requirement did not exist, a majority of schools indicated that a substantial number of teachers actually had received basic ICT courses. The requirement for all teachers to regularly update their ICT knowledge and skills (Figure 5.2) occurred less frequently than the requirement to attend basic ICT courses. This requirement existed in most schools in Chinese Taipei, Israel, Singapore, and Slovenia, but in a minority of schools in the other countries. The percentage of students from schools where it was reported that a substantial number of teachers actually regularly attended courses for updating their ICT knowledge and skills was relatively high in Cyprus and New Zealand and especially in Singapore.

For *lower secondary education*, it appears from Figure 5.1 that especially in Chinese Taipei, Israel, Singapore, and Slovenia all teachers from the targeted grade range were obligated to attend a basic course in ICT. In these countries it was also claimed that it was obligatory for teachers to regularly update their ICT knowledge, although this was the case to a lesser extent in Slovenia. It is quite interesting to compare these figures with the percentage of students whose principals indicated that a substantial number of teachers had attended basic courses or were regularly updating their ICT knowledge. The percentage of schools where a substantial number of teachers had attended basic ICT courses was especially high in Denmark, Iceland, Israel, Luxembourg, New Zealand, Norway, Singapore, Slovenia, and Thailand. This attendance happened to a much lesser extent in Bulgaria and the Russian Federation. With regard to the regular updating of knowledge, relatively high percentages were evident for lower secondary education in Singapore and Thailand.

For *upper secondary education*, the same type of observations can be made as for lower secondary education for those countries that sampled schools at both educational levels. In addition, there was a large number of schools in Luxembourg and Norway where it was not obligatory for all teachers from the targeted grade range to attend basic ICT courses, but a substantial number of teachers had, in fact, done so.

ET ODS OF TRANSFERRING ICT-RELATED NOWLEDGE

It is known from innovation theories that continuous staff development is an important prerequisite for sustained implementation of change. Therefore, it seemed relevant to investigate to what extent schools had set up mechanisms for facilitating the transfer of ICT-related knowledge among teachers in the schools. Transfer may, for example, occur via working groups, the computer coordinator, newsletters, a cascade approach (trained teachers who further disseminate information within the school) and courses within the school. Alternatively, it may be left to individual initiatives within the school's informal communication network. Tables 5.2.1–5.2.3 contain the percentages of school principals who indicated that each of these arrangements existed.

From these tables it appears that, overall, the most prevalent arrangements involved informal contacts, computer coordinators, courses run by external agencies, and in-school courses. However, large differences existed between countries. For example, whereas 90% of the technical respondents in Singapore (primary education) indicated that transfer took place via courses conducted by an external agency, this was the case in only 4% of the schools in France. Furthermore, it is noteworthy that across all three educational levels Singapore apparently had the most arrangements. The percentages of students at schools whose technical respondents indicated that no organized structure for internal ICT-information exchange existed were below 50% in all countries (except for lower secondary education in Denmark and lower and upper secondary education in Luxembourg).

Table 5.2.1 Percentages of students at schools where certain arrangements were available regarding the transfer of ICT knowledge among teachers—primary education

	1. Via informal contacts/communic.	2. Via school's ICT working group	3. Regular item on staff meetings	4. Via a regular newsletter	5. Teacher repeats external course	6. Courses by an external agency	7. Via in-school courses	8. Via computer coordinator	9. No organised structure	10. Transfer ICT knowledge, other
Canada*	89	46	31	11	49	35	46	68	15	6
China Hong Kong	75	43	27	18	37	66	40	44	20	3
Chinese Taipei	67	18	3	3	44	36	64	54	9	3
Cyprus	91	41	6	0	7	34	20	92	19	6
Finland*	57	9	12	5	29	38	50	73	12	5
France*	76	2	8	0	12	4	7	26	42	3
Iceland	83	4	6	1	13	41	36	78	34	14
Israel*	48	29	14	8	20	45	56	60	23	5
Italy	52	40	10	1	19	42	57	38	18	2
Japan	52	19	15	8	26	42	51	40	16	3
New Zealand	78	42	17	3	44	44	59	80	14	~
Norway	86	15	3	2	16	41	47	69	28	3
Singapore	96	84	48	16	48	90	95	92	11	11
Slovenia	92	6	14	45	16	57	37	83	1	7

Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). ~: data not collected. See Appendix D for rules of thumb for estimating the standard error for percentages.

Table 5.2.2 Percentages of students at schools where certain arrangements were available regarding the transfer of ICT knowledge among teachers—lower secondary education

	1. Via informal contacts/communic.	2. Via school's ICT working group	3. Regular item on staff meetings	4. Via a regular newsletter	5. Teacher repeats external course	6. Courses by an external agency	7. Via in-school courses	8. Via computer coordinator	9. No organised structure	10. Transfer ICT knowledge, other
Belgium-French*	75	15	7	4	60	21	28	56	23	0
Bulgaria	71	5	4	5	10	28	16	19	38	5
Canada*	90	45	16	12	36	32	44	65	22	6
China Hong Kong	88	44	17	12	33	44	57	45	12	3
Chinese Taipei	79	14	5	2	46	38	59	58	6	1
Cyprus	74	14	0	0	0	0	1	1	49	2
Czech Republic	85	6	11	0	17	10	32	35	17	2
Denmark	92	23	5	14	33	50	63	78	50	6
Finland	67	7	3	2	19	33	45	72	14	9
France	86	7	7	1	12	11	18	43	44	2
Hungary	30	21	7	14	25	17	25	29	36	4
Iceland	85	3	6	2	9	33	30	79	45	13
Israel*	49	34	11	5	46	53	57	65	17	6
Italy*	74	32	13	5	29	45	72	44	18	4
Japan	72	18	8	3	14	41	38	41	18	1
Lithuania	74	7	2	5	31	52	23	42	30	9
Luxembourg	89	6	0	0	24	52	43	74	52	0
New Zealand*	90	61	13	12	31	38	61	74	20	1
Norway	87	16	4	1	16	38	61	73	22	3
Russian Federation*	68	9	9	2	22	45	8	8	22	6
Singapore	96	79	59	15	57	87	92	87	8	14
Slovenia	91	6	14	45	16	57	37	83	1	6
South Africa*	74	12	7	2	14	14	26	41	38	2
Thailand	59	26	15	5	50	41	72	29	5	3

Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages.

Table 5.2.3 Percentages of students at schools where certain arrangements were available regarding the transfer of ICT knowledge among teachers—upper secondary education

	1. Via informal contacts/communic.	2. Via school's ICT working group	3. Regular item on staff meetings	4. Via a regular newsletter	5. Teacher repeats external course	6. Courses by an external agency	7. Via in-school courses	8. Via computer coordinator	9. No organised structure	10. Transfer ICT knowledge, other
Belgium-French*	77	15	7	4	59	22	27	58	23	0
Bulgaria	72	5	1	4	8	25	15	17	40	7
Canada*	92	50	14	12	33	33	46	68	22	5
China Hong Kong	88	44	17	12	33	44	57	45	12	3
Chinese Taipei	76	29	16	11	39	43	80	75	4	0
Cyprus	88	0	0	0	4	9	7	15	36	10
Czech Republic	89	37	10	3	25	14	38	49	11	6
France	90	12	9	7	18	22	27	57	35	4
Iceland	100	20	13	9	12	37	41	85	29	4
Israel*	60	29	8	9	43	45	52	58	24	4
Italy*	71	35	11	3	26	30	77	49	22	3
Japan	72	42	6	2	19	39	33	48	29	2
Latvia*	84	12	9	5	29	11	59	33	22	10
Lithuania	72	7	1	7	30	51	23	40	32	11
Luxembourg	90	6	0	0	22	50	39	75	53	5
Norway	90	16	5	6	18	36	79	69	26	4
Russian Federation*	68	9	8	2	20	44	8	8	22	6
Singapore	83	76	57	37	64	96	99	93	19	15
Slovak Republic*	79	12	12	2	25	12	35	43	29	5
Slovenia*	97	16	15	30	16	53	20	48	16	16
South Africa*	64	9	2	2	22	12	21	37	38	2

Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages.

A AILABILIT OF ICT TRAINING COURSES

The availability of training courses is a crucial condition for raising the ICT qualifications of staff. Therefore, a question about this topic was included in the questionnaires as an international option, which means that countries were allowed to exclude the question from the national version of the questionnaire.

The respondents answering the technical questionnaire were asked if each of the following courses was available in-house or via external agencies for teachers from the targeted grade range:

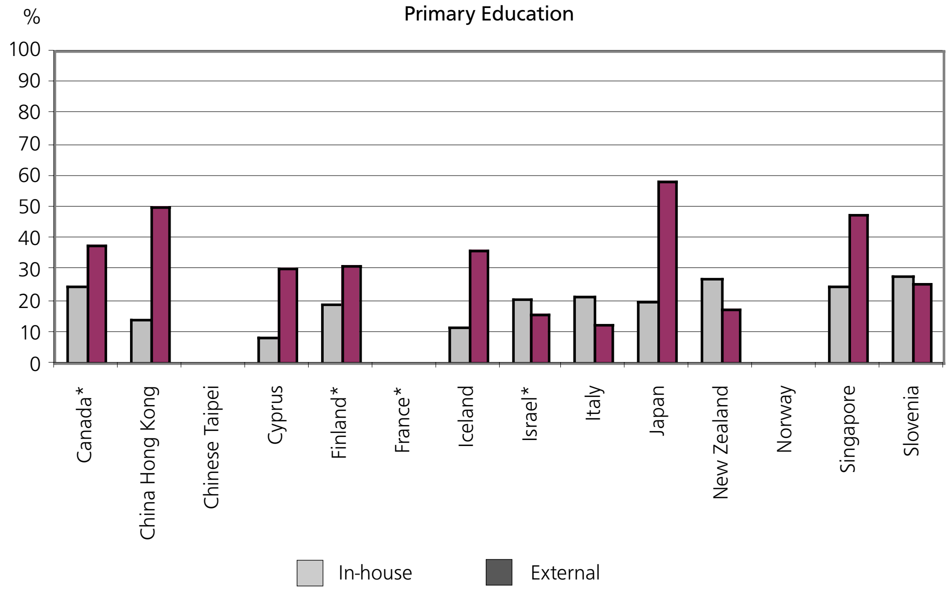
1. General introductory course (how to use a computer, principles of software and hardware, functions of mouse, printer)
2. General introductory course (history of ICT, relevance, consequences of computer use, etc.)
3. Introductory course for applications/standard tools (basic word-processing, spreadsheets, databases, etc.)
4. Introductory course for Internet use (retrieve information, send/receive emails, etc.)
5. Introductory technical course for operating and maintaining computer systems
6. Advanced course for applications/standard tools (e.g. advanced word-processing, complex relational databases)
7. Advanced course for Internet use (e.g. creating websites/developing a home page, advanced use of Internet, video-conferencing)
8. Advanced technical course for operating and maintaining computer systems (e.g. networks, special equipment)
9. General course about didactical/pedagogical principles of computer use
10. Subject-specific training (with subject-specific learning software, e.g. tutorials or drill and practice software)
11. Programming course, where teachers can learn how to create their own software (also with authorware)
12. Special course with digital video- and audio-equipment

The percentages of respondents who checked the in-house availability of each possible course are shown in Appendix H, Tables H.2.1–H.2.3. Tables H.3.1–H.3.3 contain the percentages for the externally available courses.

Not surprisingly, with regard to the in-house training facilities, the largest percentages were observed for courses relating to basic computer-handling skills and the use of basic applications (word-processing, spreadsheets, databases). It should be noted, however, that in some countries only a small group of students were at schools where this introductory training could be handled inside the school (for example, lower secondary schools in Bulgaria, Cyprus, and the Russian Federation).

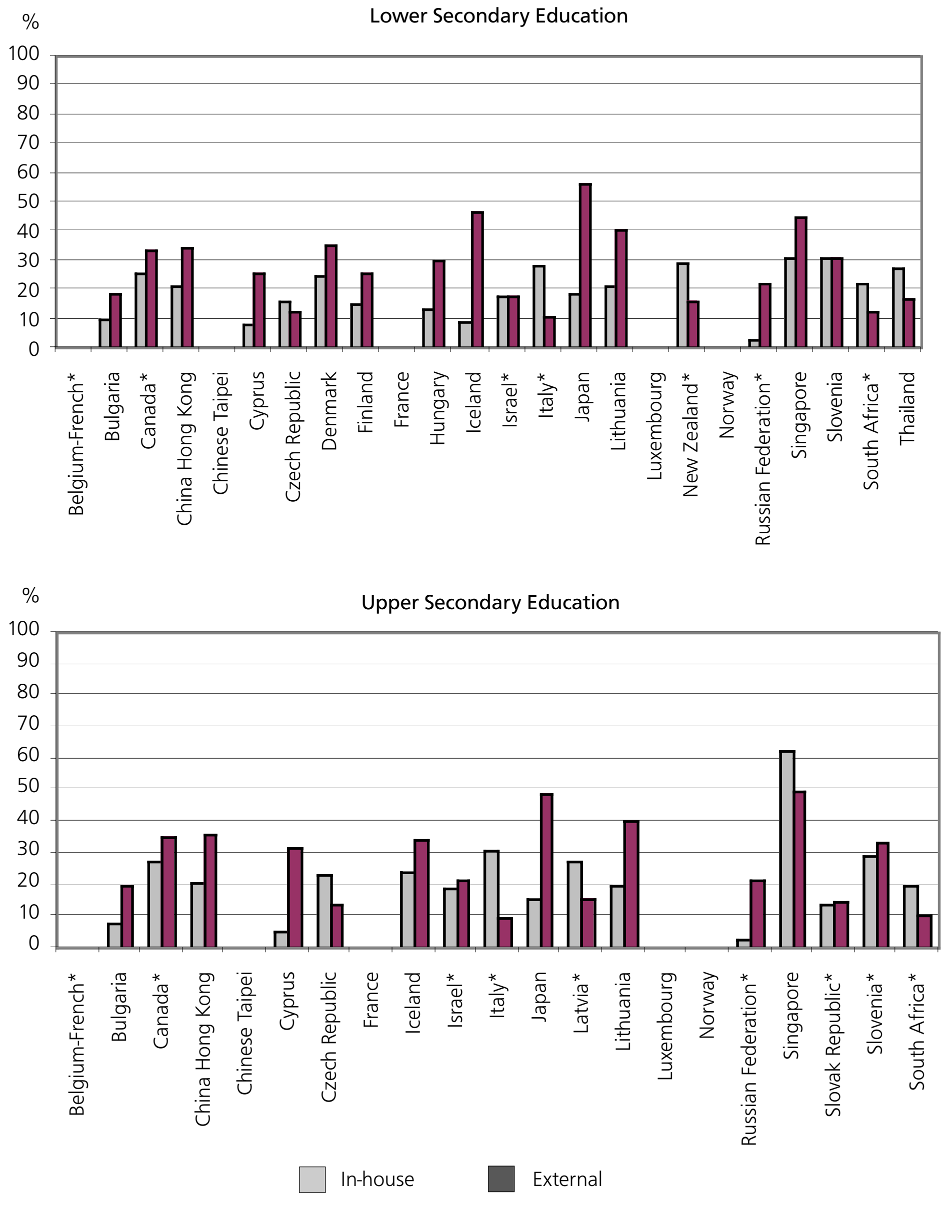
In relation to the external courses, it seems reasonable to expect that training facilities would be available for most of the above-mentioned topics. However, as the data in Tables H.3.1–H.3.3 reveal, this was, according to the perceptions of the technical respondents, clearly not the case. Another finding of relevance was that relatively small groups of the questionnaire respondents indicated that external courses were available that dealt with the didactical/pedagogical principles of computer use and with subject-specific training. The availability of such courses may be hypothesized as an important factor affecting the use of ICT in daily classroom practices.

A more condensed impression of the extent of availability of in-house and external courses can be gained from Figure 5.3. In-house availability in this figure reflects the average percentage of courses that were checked. External availability was calculated in the same way. In general, and not surprisingly, more external than in-house courses were available to teachers. Relatively high availability of external courses existed, for instance, at the primary level in China Hong Kong, Japan, and Singapore, while it was relatively low in, for example, Italy.



Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages. Missing bars: data not available.

Figure 5.3 *(contd. on page 171)*



Notes: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2). See Appendix D for rules of thumb for estimating the standard error for percentages. Missing bars: data not available.

Figure 5.3 (contd. from previous page) Average percentages across schools of available in-house and external courses from a list of 12—primary, lower, and upper secondary education.

RESPONDENTS SELF-RATINGS

If one assumes that the person who answered the technical questionnaire also plays an important role in transferring knowledge within the school, then it is interesting to know to what extent these persons were adequately prepared for their work in supporting ICT activities within the school. In order to acquire an estimate of such an indicator, the questionnaire respondents were asked to rate how well prepared they thought they were in each of the following areas:

General

1. MS-Windows
2. MacOs
3. MS-DOS
4. Word-processing
5. Databases
6. Spreadsheets

Instructional processes

7. Subject-specific applications
8. Application of software to track student progress
9. Didactical and organizational integration of computers in subjects
10. The use of specific programs for subjects
11. Evaluation and selection of instructional software
12. Use of computers for individualized learning programs
13. The use of multimedia applications
14. Adaptation of software to fit school purposes

Email, Internet, WWW

15. The use of email for educational purposes
16. The use of the Internet/WWW for educational purposes

Presentation

17. The use of software for making presentations

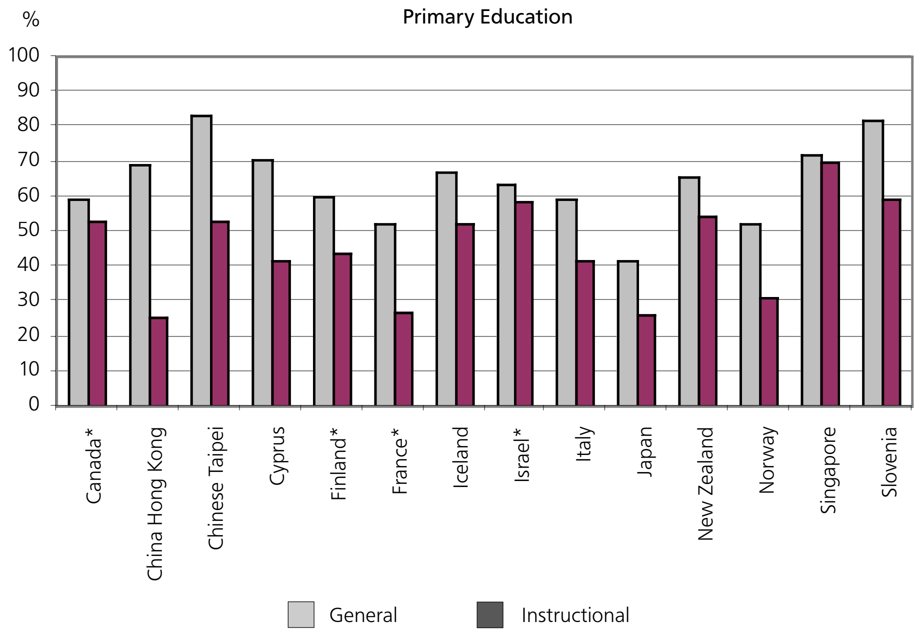
If the area was not relevant, respondents were allowed to check a box titled not applicable.

Tables H.1.1–H.1.3 (in Appendix H) contain (per country) the percentages of respondents who answered each item affirmatively.[1] Some general observations can be made on the

1 The percentages were calculated by treating 'not applicable' and 'not answered' as if the answer had been 'no'. It could be argued that doing this could lead to downward-biased estimates for schools where other persons were responsible for certain areas. However, there were no indications in the data that the number of persons responsible for technology coordination was correlated with the occurrence of checking 'not applicable' and/or not answering particular items.

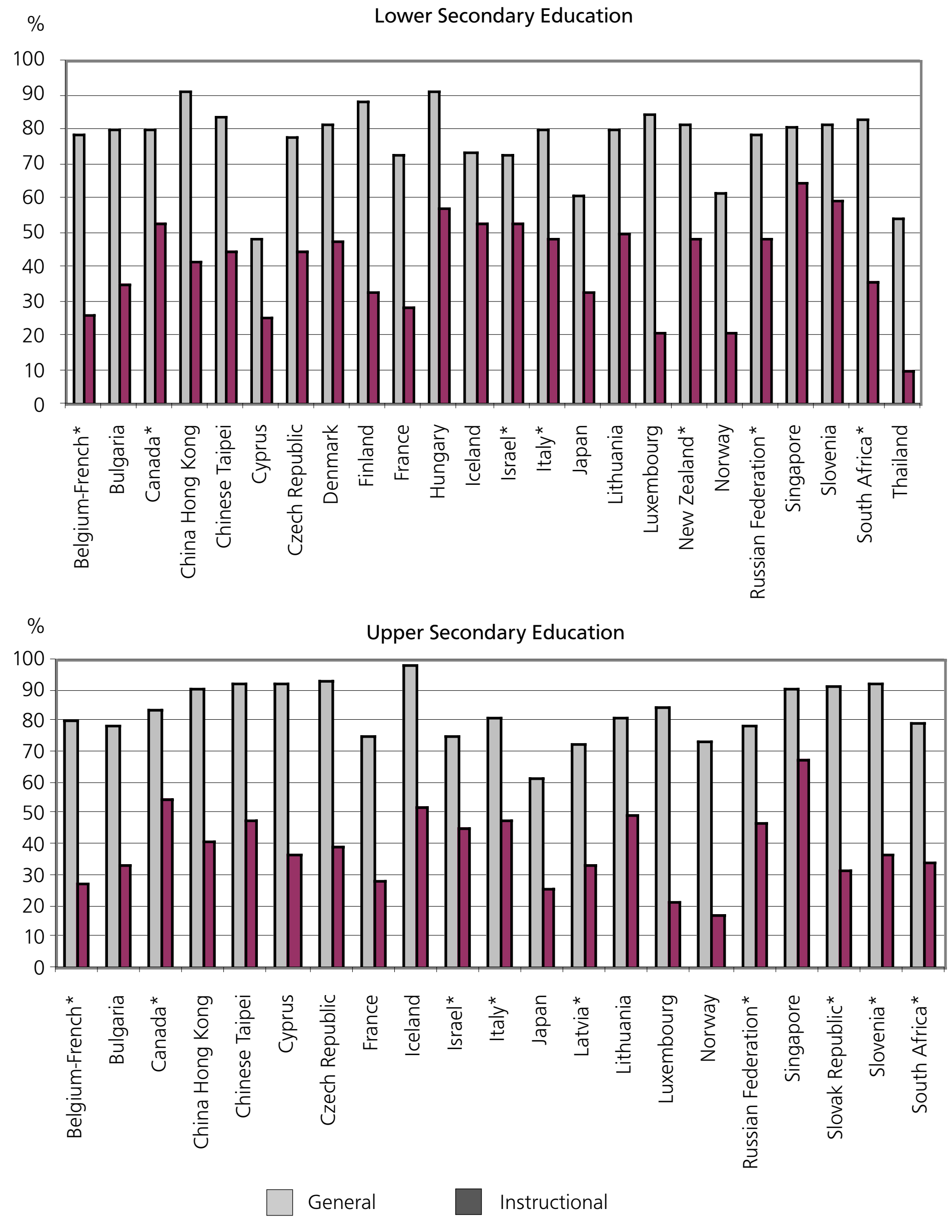
basis of the data in these tables. Overall, it seems that the highest self-assessment of adequacy of preparation occurred for word-processing. It is not surprising to find that these self-assessments were low for the Mac operating system because the majority of schools did not use these operating systems. In some countries (for example, Canada, Singapore, and Slovenia, at the lower secondary level) 85% or more of the respondents indicated that they felt adequately prepared for use of the Internet for instructional purposes. However, this was barely the case in other countries (for example, Bulgaria, Cyprus, the Czech Republic, Japan, the Russian Federation, and Thailand).

Factor analyses revealed two clear dimensions in the self-ratings, namely a factor containing the general topics (exclusive item 2, Mac-OS, which was answered with 'no' by most respondents) and a factor related to the instructionally related topics (items 7 to 14 from the above list). Figure 5.4 contains the average percentages for each of these scales in each country and at each educational level.



Note: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2).

Figure 5.4 Average values of self-ratings from technical respondents regarding the adequacy of preparation for supporting general ICT-related activities and pedagogical ICT-related activities—primary, lower, and upper secondary education. *(contd. on page 174)*



Note: *: country did not satisfy all sampling criteria (see Chapter 1, Table 1.2).

Figure 5.4 (contd. from previous page) Average values of self-ratings from technical respondents regarding the adequacy of preparation for supporting general ICT-related activities and pedagogical ICT-related activities—primary, lower, and upper secondary education.

A first observation from this figure is that at all three educational levels the self-ratings for the general (or alternatively more technical) ICT-related activities were much higher than for the instructionally related activities. With regard to the latter activities, the ratings were relatively high in, for example:

- primary education in Israel, Singapore, and Slovenia;
- lower secondary education in Hungary, Singapore, and Slovenia;
- upper secondary education in Singapore.

However, the instructionally related ratings were comparatively low in, for example:

- primary education in China Hong Kong, France, and Japan;
- lower secondary education in Belgium-French, Cyprus, France, Luxembourg, Norway, and Thailand;
- upper secondary education in Belgium-French, France, Japan, Luxembourg, and Norway.

SU AR AND REFLECTIONS

This chapter described a number of indicators relating to staff development. The results presented here revealed that the questionnaire respondents saw a lack of ICT-related knowledge among teachers as a major obstacle to realizing the ICT-related objectives of the schools. In this context it was not surprising to observe that most schools had adopted a policy that all teachers should receive training for using ICT in their instructional practice. However, it appeared that in most schools this policy had not yet been satisfactorily realized. Nevertheless, even in the absence of ICT-training requirements a substantial number of teachers had attended basic ICT courses. It seems that for most of the schools that participated in SITES Module-1 there is a need for additional continuous staff development regarding ICT.

However, realization even of this goal is likely not to be easy given the finding that the existence of training courses was, according to the perceptions of the technical respondents, generally rather low in most participating countries. A notable exception was Singapore, where the ICT-related training facilities for teachers were quite favorable. This finding is not unexpected, given Singapore's ICT-related policies (refer Chapter 2). For most participating countries over the next few years, the challenge will be that of determining how teachers' abilities to use ICT for instructional purposes can be improved within the context of limited educational budgets.

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Cha ter

ATTITUDES, POLICIES, AND USAGE AT ANAGERIAL LE EL

K. T. Bos and A. J. Visscher (University of Twente)

This chapter reports on principals' attitudes to ICT and the degree to which schools have developed and realized an ICT-related vision and policy. Findings relating to the extent to which ICT is used to monitor students for school administration are also presented, as are findings relating to the problems that schools face when implementing ICT.

INTRODUCTION

The relationship between school leadership and the use of ICT is twofold. First, school managers can use ICT as a tool to support the execution of their administrative and managerial tasks (this usage happens daily in many countries around the globe; see Visscher, 1995; Visscher & Wild, 1997; Visscher, Fung, & Wild, 1999). Second, school managers, as leaders of their schools, often can take the important role of encouraging and facilitating the use of ICT within their schools for administrative and managerial work (Visscher, 1996) as well as for instructional activities (Akker, Keursten, & Plomp, 1992). The second consideration refers to the concept of educational leadership (Creemers, 1994; Levine & Lezotte, 1990), whereby school managers can influence and improve what happens in the teaching/learning process. The extent to which school principals promote the use of ICT in their schools probably depends on the degree to which they consider ICT useful. Their views on this matter can be evident in a number of ways, such as how they incorporate ICT into their own school tasks and the school policy measures that they effect to promote the incorporation of ICT into their schools.

This chapter addresses questions related to the following: principals' attitudes towards ICT; the extent to which their schools had adopted explicit ICT policies; the extent to which ICT was being used to monitor students' learning progress and for school administrative work; and organizational problems associated with the introduction of ICT into their schools. As stated in Chapter 1, an important implication of the chosen sample design is that all statistics reported in this report are proportionate to the distribution of students in each population. Even if the text below refers to 'the percentage of school principals that gave a particular answer', this should be read as 'the percentage of students in ICT-using schools whose principals gave a particular answer'.

ATTITUDES AND BELIEFS OF SC OOL PRINCIPALS TOWARD ICT

School principals, because of their position in schools, can be important agents of change. With this in mind, and as observed in Chapter 5, principals' attitudes toward computers can play an important role in the successful implementation of ICT in education (Pelgrum & Plomp, 1991). The SITES researchers therefore considered it important to ascertain principals' attitudes toward the use of computers in schools.

Tables 6.1.1–6.1.3 present the outcomes for the scales used to measure the principals' attitudes. The final column of each table shows the results for the whole attitude scale (24 items; see question 15 of the Principal Questionnaire in Appendix C). The other columns contain the results of four sub-scales and two singletons (single-item scales):

1. the impact of ICT on achievement (five items: questions 15-1, 10, 16, 18, 23);
2. the relevance of Internet (six items: questions 15-5, 6, 7, 9, 19, 24);
3. the impact of ICT on school management (five items: questions 15-2, 3, 4, 15, 21);
4. the contribution of ICT to life-long learning (six items: questions 15-8, 11, 12, 13, 14, 20);
5. the importance of in-service training courses on computers (single item: question 17);
6. the importance of all teachers acquiring ICT certification (single item: question 22).

Table 6.1.1 Average values and standard errors (in brackets) of principals' attitudes toward ICT—primary education

	1. ICT impact on achievement	2. Relevance of Internet	3. ICT impact school management	4. ICT contribution life-long learning	5. Make in-serv. ICT train. compuls.	6. Teach. must acquire ICT certific.	Attitude toward ICT in the school
Canada*	74 (0.5)	85 (0.4)	75(0.4)	81 (0.4)	83 (0.6)	69 (0.7)	79 (0.4)
China Hong Kong	70 (1.1)	75 (1.1)	75 (1.1)	75 (1.0)	77 (1.6)	66 (1.7)	74 (0.9)
Chinese Taipei	82 (1.2)	87 (1.1)	83 (1.2)	84 (1.2)	88 (1.3)	79 (1.6)	84 (1.2)
Cyprus	81 (2.3)	77 (2.8)	74 (2.8)	78 (2.2)	78 (3.4)	80 (3.2)	77 (1.7)
Finland*	60 (1.2)	80 (0.9)	64(1.0)	70 (0.9)	73 (2.0)	50 (1.8)	68 (0.8)
France*	67 (0.8)	72 (1.0)	71(0.9)	72 (0.7)	75 (1.7)	68 (1.5)	71 (0.7)
Iceland	72 (1.3)	85 (1.1)	78 (1.4)	80 (1.4)	84 (1.7)	67 (1.9)	79 (1.2)
Israel*	87 (1.2)	86 (1.3)	85(1.3)	90 (1.1)	95 (1.2)	71 (3.7)	87 (1.0)
Italy	88 (1.1)	84 (1.2)	88(0.9)	87 (1.1)	85 (1.9)	82 (1.7)	86 (1.0)
Japan	75 (1.5)	69 (1.9)	65(1.7)	77 (1.4)	80 (2.1)	56 (2.8)	72 (1.4)
New Zealand	71 (1.3)	80 (1.2)	81 (1.1)	81 (1.1)	79 (2.1)	71 (1.9)	79 (1.0)
Norway	69 (0.4)	76 (0.4)	72(0.4)	75 (0.4)	92 (0.5)	73 (0.8)	74 (0.3)
Singapore	92 (0.7)	94 (0.5)	91(0.7)	95 (0.5)	94 (0.8)	91 (1.1)	93 (0.5)
Slovenia	70 (1.3)	78 (1.0)	79 (1.1)	73 (1.0)	66 (2.0)	72 (1.9)	75 (0.9)

Notes: *: country did not satisfy all sampling criteria. Standard error: value ± 2* se = 95% confid. interval population.

Table 6.1.2 Average values and standard errors (in brackets) of principals' attitudes toward ICT—lower secondary education

	1. ICT impact on achievement	2. Relevance of Internet	3. ICT impact school management	4. ICT contribution life-long learning	5. Make in-serv. ICT train. compuls.	6. Teach. must acquire ICT certific.	Attitude toward ICT in the school
Belgium-French*	67 (1.2)	75 (0.9)	73 (1.1)	76 (0.9)	79 (1.7)	60 (2.1)	73 (0.8)
Bulgaria	85 (0.5)	84 (0.5)	86(0.5)	82 (0.5)	79 (0.9)	79 (0.8)	84 (0.5)
Canada*	76 (0.5)	86 (0.4)	81(0.5)	81 (0.5)	82 (0.7)	67 (0.9)	81 (0.4)
China Hong Kong	65 (0.5)	79 (0.5)	73 (0.5)	74 (0.5)	71 (0.8)	61 (0.8)	73 (0.4)
Chinese Taipei	78 (1.0)	86 (0.9)	81 (0.9)	82 (1.0)	84 (1.4)	80 (1.4)	82 (0.9)
Cyprus	83 (1.2)	84 (1.0)	86 (1.0)	83 (0.9)	92 (1.0)	93 (1.3)	86 (0.7)
Czech Republic	73 (0.9)	75 (0.9)	81 (0.7)	75 (0.8)	76 (1.7)	81 (1.2)	76 (0.6)
Denmark	64 (1.0)	81 (0.9)	70 (0.9)	69 (0.9)	89 (1.1)	87 (1.3)	73 (0.8)
Finland	57 (1.1)	82 (0.6)	70 (0.8)	69 (0.8)	66 (1.7)	47 (1.7)	69 (0.7)
France	67 (0.8)	72 (0.9)	71(0.9)	74 (0.7)	78 (1.3)	73 (1.3)	71 (0.7)
Hungary	69 (1.0)	72 (0.8)	70(0.8)	69 (0.8)	59 (1.6)	58 (1.6)	70 (0.7)
Iceland	73 (0.7)	88 (0.5)	80(0.7)	80 (0.7)	84 (0.9)	69 (1.1)	81 (0.5)
Israel*	86 (1.2)	88 (1.1)	88 (1.1)	89 (1.0)	94 (1.3)	82 (3.0)	88 (0.9)
Italy*	84 (1.3)	86 (1.1)	88(1.0)	82 (1.2)	88 (1.6)	79 (2.1)	85 (1.0)
Japan	68 (1.2)	68 (1.3)	62 (1.3)	68 (1.3)	72 (2.0)	46 (2.8)	66 (1.0)
Lithuania	86 (0.7)	86 (0.6)	84(0.7)	82 (0.8)	86 (1.2)	76 (1.4)	84 (0.6)
Luxembourg	63 (3.2)	84 (2.5)	76(1.9)	73 (2.3)	74 (4.2)	67 (4.1)	74 (2.3)
New Zealand*	74 (0.9)	82 (0.7)	83(0.7)	81 (0.8)	79 (1.4)	75 (1.3)	80 (0.7)
Norway	67 (0.3)	79 (0.3)	71(0.3)	73 (0.3)	91 (0.3)	70 (0.6)	73 (0.2)
Russian Federation*	87 (1.3)	~	86 (1.4)	80 (1.4)	90 (1.7)	74 (2.5)	~
Singapore	89 (0.2)	94 (0.1)	89(0.1)	92 (0.1)	92 (0.2)	85 (0.3)	91 (0.1)
Slovenia	70 (1.1)	79 (0.9)	77(1.0)	73 (0.9)	66 (1.7)	72 (1.6)	75 (0.8)
South Africa*	78 (1.6)	77 (1.7)	84(1.3)	81 (1.7)	86 (1.8)	70 (2.8)	80 (1.3)
Thailand	86 (0.6)	81 (0.7)	89 (0.6)	84 (0.7)	88 (0.8)	76 (1.0)	85 (0.6)

Notes: ~ : no data collected. *: country did not satisfy all sampling criteria. Standard error: value ± 2* se = 95% confid. interval population.

Table 6.1.3 Average values and standard errors (in brackets) of principals' attitudes toward ICT—upper secondary education

	1. ICT impact on achievement	2. Relevance of Internet	3. ICT impact school management	4. ICT contribution life-long learning	5. Make in-serv. ICT train. compuls.	6. Teach. must acquire ICT certific.	Attitude toward ICT in the school
Belgium-French*	66 (1.2)	75 (0.9)	74 (1.0)	76 (0.9)	78 (1.6)	60 (2.0)	73 (0.8)
Bulgaria	85 (0.8)	85 (0.7)	87 (0.7)	81 (0.8)	80 (1.3)	80 (1.2)	84 (0.6)
Canada*	77 (0.5)	87 (0.3)	84 (0.4)	83 (0.4)	85 (0.7)	68 (0.9)	83 (0.3)
China Hong Kong	65 (0.5)	79 (0.5)	73 (0.5)	74 (0.5)	71 (0.8)	61 (0.8)	73 (0.4)
Chinese Taipei	79 (0.8)	91 (0.5)	86 (0.6)	84 (0.7)	86 (1.2)	76 (1.2)	85 (0.6)
Cyprus	84 (0.8)	90 (0.6)	90 (0.8)	84 (0.8)	94 (0.7)	96 (0.7)	88 (0.8)
Czech Republic	74 (0.9)	81 (0.8)	84 (0.7)	74 (0.8)	79 (1.6)	80 (1.4)	78 (0.6)
France	66 (1.0)	74 (0.8)	70 (1.0)	72 (0.8)	77 (1.3)	69 (1.4)	71 (0.7)
Iceland	73 (1.3)	91 (0.3)	84 (0.6)	74 (0.7)	80 (0.9)	53 (2.0)	78 (0.7)
Israel*	84 (1.2)	86 (1.1)	88 (1.0)	86 (1.0)	94 (1.0)	86 (2.3)	86 (0.8)
Italy*	66 (2.4)	72 (2.1)	73 (2.3)	67 (2.1)	69 (2.8)	69 (2.7)	70 (2.1)
Japan	67 (1.5)	70 (1.6)	67 (1.3)	67 (1.4)	69 (2.6)	50 (2.8)	67 (1.3)
Latvia*	79 (1.2)	83 (1.0)	85 (1.1)	77 (1.1)	91 (1.4)	74 (2.1)	81 (0.9)
Lithuania	86 (0.2)	85 (0.2)	83 (0.3)	83 (0.2)	87 (0.3)	74 (0.4)	84 (0.2)
Luxembourg	62 (2.9)	84 (2.2)	76 (1.7)	72 (2.0)	76 (3.7)	65 (3.8)	74 (2.1)
Norway	63 (0.5)	80 (0.4)	73 (0.4)	72 (0.4)	89 (0.5)	58 (0.9)	72 (0.4)
Russian Federation*	87 (1.3)	~	86 (1.4)	80 (1.4)	90 (1.7)	74 (2.5)	~
Singapore	87 (0.4)	95 (0.0)	92 (0.3)	95 (0.3)	96 (0.0)	76 (0.0)	92 (0.3)
Slovak Republic*	81 (1.0)	89 (0.8)	88 (0.8)	79 (1.1)	91 (1.2)	73 (1.6)	84 (0.9)
Slovenia*	74 (1.1)	83 (0.8)	80 (0.9)	74 (1.0)	71 (1.9)	70 (1.5)	78 (0.9)
South Africa*	80 (1.7)	79 (1.7)	87 (1.4)	83 (1.6)	82 (2.5)	72 (2.5)	82 (1.5)

Notes: ~ : no data collected. *: country did not satisfy all sampling criteria. Standard error: value ± 2* se = 95% confid. interval population.

The results for the entire attitude scale reflect the results on the four sub-scales for each country in each population. The analyses revealed relatively strong inter-correlations. Factor analysis showed that the separate items represented one dimension. The sub-scale scores and the scores of the complete list of 24 attitude items were calculated per country as follows: 100% * (mean-1)/4 = 25 * (mean-1). The internal consistency coefficient 'Cronbach's alpha' showed that the psychometric quality of the four sub-scales as well as of the complete scale was satisfactory. The reliability coefficients of the four sub-scales varied between .73 and .84. Cronbach's alpha coefficient for the whole scale was higher than .85 for each country.

When interpreting the scores of the sub-scales in each country, one should keep in mind the theoretical range of the scores (from 0 to 100). The original scale in the questionnaire comprised five points (strongly disagree/slightly disagree/uncertain/slightly agree/strongly agree). Scale scores between 50 and 75 must be interpreted thus: on average, the majority of principals in the country were 'uncertain' (scale score 50) or 'slightly agreed' (scale score 75) with each of the statements on the sub-scale.

In each country the mean score for each sub-scale and the entire scale in each population was higher than 60, meaning that principals tended to have a positive attitude toward ICT usage in their respective schools. Nevertheless, countries differed in the extent to which principals were positive. For example, taking a score of 75 as the lower boundary, relatively high scores (above 75, meaning very positive attitudes) on the entire scale were found for *primary schools*[1] in Canada, Chinese Taipei, Cyprus, Iceland, Israel, Italy, New Zealand, and Singapore. Lower (but still positive) attitude scores were found for Finland, France, and Japan. Differences within countries among the sub-scale scores appeared in primary education (columns 2 through 5 of Table 6.1.1). These differences were especially evident in Canada, Chinese Taipei, Finland, and Iceland, where principals exhibited more positive attitudes toward the relevance of Internet than toward the other three aspects of ICT usage in schools. Differences among the various sub-scale scores were not so apparent in the other countries.

In all countries the principals of *lower secondary schools*[2] held positive attitudes toward ICT. Countries in which principals had a very positive attitude (a score higher than 80) were Bulgaria, Canada, Chinese Taipei, Cyprus, Iceland, Israel, Italy, Lithuania, New Zealand, Singapore, South Africa, and Thailand. Less positive attitudes (scores between 65 and 70) were found for Finland, Hungary, and Japan. In relation to the different sub-scales, the scores on the sub-scale 'relevance of Internet' were in some countries higher (at least five points) than the scores on the other three sub-scales. (The differences between the scores on these three sub-scales were small.) This pattern was observed in Canada, China Hong Kong, Denmark, Finland, Iceland, Luxembourg, and Norway.

Countries in which principals in *upper secondary education* had a relatively strong positive attitude toward ICT usage in schools (scores higher than 80) were Bulgaria, Canada, Chinese Taipei, Cyprus, Israel, Latvia, Lithuania, Singapore, the Slovak Republic, and South Africa. Relatively low (but still positive) attitudes (scores between 65 and 70) were found in Japan. As with the other two educational levels, scores on the sub-scale 'relevance of Internet' were in some countries (China Hong Kong, Iceland, Italy, Luxembourg, and Norway) higher (five points or more) than the scores on the other sub-scales.

1 The national survey instrument used in the Netherlands contained a limited number (nine) of the attitude items from the SITES questionnaire. Six out of nine items could be used to calculate one sub-scale and two singletons, on the basis of the ICT-monitor 1997/1998 database (ICT-monitor, 1998). These were 'relevance of Internet' (scale of four items), 'make in-service training compulsory' (single item), and 'all teachers must acquire ICT certification' (single item). In primary schools, the only score above 75% was on the singleton 'all teachers must acquire ICT certification' (77%).

2 In Dutch lower secondary schools, the scores on the singletons related to ICT training and ICT certification were above 75% (77% and 80% respectively).

E PLICIT SC OOL POLICIES

A aila ility of a Written Statement or Policy for the Grade Range

Schools can express their interest in ICT through their school policies and, as such, develop a framework for action concerning the use of computers in their institutions (Pelgrum & Plomp, 1991). Tables 6.2.1–6.2.3 show the percentages of schools with a written ICT policy or statement for the targeted grade range (second column in each of the tables).

Table 6.2.1 Percentages of students whose principals indicated that their school had a written policy or statement with regard to the use of computers for educational purposes by students in the grade range, and the issues included in the school's policy—primary education

	Written policy available	1. Use of comp. current school year	2. Use of comp. forthc. school years	3. Plans hardware replacem./upgrade.	4. Plans staff developm./ICT training	5. Specif. comp.-related tasks/pers.	6. Plans for software acquisition	7. Equity of access	8. Internet policy	Mean number of policies (max. 8)
Canada*	55	93	68	64	77	57	63	59	78	5.6 (0.1)
China Hong Kong	38	85	49	26	97	37	64	34	43	4.4 (0.2)
Chinese Taipei	~	~	~	~	~	~	~	~	~	~
Cyprus	39	89	27	43	51	51	26	31	38	3.6 (0.8)
Finland*	49	90	64	26	36	68	20	37	57	4.0 (0.2)
France*	62	92	73	57	59	10	71	60	63	4.8 (0.1)
Iceland	46	100	91	70	72	53	37	76	56	5.5 (0.2)
Israel*	~	~	~	~	~	~	~	~	~	~
Italy	36	80	66	24	85	35	58	3	30	3.8 (0.2)
Japan	49	63	25	9	65	53	22	6	18	2.6 (0.2)
New Zealand	61	87	66	60	76	48	50	73	44	5.1 (0.2)
Norway	~	~	~	~	~	~	~	~	~	~
Singapore	80	97	76	62	95	89	91	62	47	6.2 (0.1)
Slovenia	53	91	37	84	78	63	81	69	54	5.6 (0.2)

Notes: *: country did not satisfy all sampling criteria. ~ : no data collected. The final column contains average values and standard errors (in brackets) for the number of policy issues identified. Standard error: value ± 2* se = 95% confid. interval population.

Table 6.2.2 Percentages of students whose principals indicated that their school had a written policy or statement with regard to the use of computers for educational purposes by students in the grade range, and the issues included in the school's policy—lower secondary education

	Written policy available	1. Use of comp. current school year	2. Use of comp. forthc. school years	3. Plans hardware replacem./upgrade.	4. Plans staff developm./ICT training	5. Specif. comp.-related tasks/pers.	6. Plans for software acquisition	7. Equity of access	8. Internet policy	Mean number of policies (max. 8)
Belgium-French*	34	80	91	67	87	57	45	70	76	5.7 (0.3)
Bulgaria	50	79	79	57	58	53	35	45	69	4.8 (0.2)
Canada*	67	84	59	57	62	52	51	52	96	5.1 (0.1)
China Hong Kong	42	78	44	58	86	41	59	33	72	4.7 (0.1)
Chinese Taipei	~	~	~	~	~	~	~	~	~	~
Cyprus	24	100	19	13	28	41	13	26	19	2.6 (0.7)
Czech Republic	26	87	51	75	52	62	40	32	30	4.3 (0.3)
Denmark	49	90	82	78	90	54	68	54	64	5.8 (0.2)
Finland	48	86	42	56	46	80	28	29	67	4.3 (0.2)
France	56	85	62	78	87	32	78	57	89	5.7 (0.1)
Hungary	74	75	69	57	74	44	58	35	51	4.6 (0.2)
Iceland	53	97	89	59	57	51	32	74	57	5.1 (0.2)
Israel*	~	~	~	~	~	~	~	~	~	~
Italy*	41	81	49	44	65	35	48	6	57	3.8 (0.2)
Japan	54	63	34	23	62	61	38	9	29	3.2 (0.2)
Lithuania	24	77	67	56	58	36	52	41	40	4.3 (0.3)
Luxembourg	~	~	~	~	~	~	~	~	~	~
New Zealand*	50	81	59	74	71	55	55	51	80	5.3 (0.2)
Norway	~	~	~	~	~	~	~	~	~	~
Russian Federation*	55	43	38	26	32	24	22	19	11	2.2 (0.3)
Singapore	78	92	87	82	95	91	91	66	73	6.8 (0.1)
Slovenia	54	90	36	84	77	63	82	69	54	5.6 (0.2)
South Africa*	22	80	85	85	60	50	65	35	55	5.2 (0.5)
Thailand	75	79	58	67	84	52	58	56	69	5.2 (0.1)

Notes: *: country did not satisfy all sampling criteria. ~ : no data collected. The final column contains average values and standard errors (in brackets) for the number of policy issues identified. Standard error: value ± 2* se = 95% confid. interval population.

Table 6.2.3 Percentages of students whose principals indicated that their school had a written policy or statement with regard to the use of computers for educational purposes by students in the grade range, and the issues included in the school's policy—upper secondary education

	Written policy available	1. Use of comp. current school year	2. Use of comp. forthc. school years	3. Plans hardware replacem./upgrade.	4. Plans staff developm./ICT training	5. Specif. comp.-related tasks/pers.	6. Plans for software acquisition	7. Equity of access	8. Internet policy	Mean number of policies (max. 8)
Belgium-French*	45	79	72	66	90	57	42	64	89	5.6 (0.2)
Bulgaria	48	84	72	52	49	43	38	28	48	4.1 (0.2)
Canada*	63	89	59	66	64	59	58	57	94	5.5 (0.1)
China Hong Kong	42	78	44	58	86	41	59	33	72	4.7 (0.1)
Chinese Taipei	~	~	~	~	~	~	~	~	~	~
Cyprus	31	100	88	51	31	53	11	3	70	4.1 (0.6)
Czech Republic	38	80	42	77	49	65	49	41	65	4.7 (0.2)
France	56	95	66	86	86	41	79	64	90	6.1 (0.1)
Iceland	68	87	85	64	59	41	34	82	70	5.2 (0.2)
Israel*	~	~	~	~	~	~	~	~	~	~
Italy*	50	81	51	48	70	36	53	2	55	4.0 (0.2)
Japan	53	69	40	50	43	63	36	15	34	3.5 (0.2)
Latvia*	59	86	65	81	76	44	45	45	64	5.1 (0.2)
Lithuania	29	73	52	65	65	32	55	44	55	4.4 (0.2)
Luxembourg	–	–	–	–	–	–	–	–	–	–
Norway	~	~	~	~	~	~	~	~	~	~
Russian Federation*	52	72	59	57	57	47	48	31	19	3.9 (0.3)
Singapore	92	97	82	97	91	76	90	65	90	6.9 (0.1)
Slovak Republic*	68	92	45	60	48	47	42	15	60	4.1 (0.2)
Slovenia*	43	88	36	87	78	57	76	58	68	5.5 (0.2)
South Africa*	25	87	70	73	61	68	55	50	50	5.1 (0.5)

Notes: *: country did not satisfy all sampling criteria. ~ : no data collected. The final column contains average values and standard errors (in brackets) for the number of policy issues identified. Standard error: value ± 2* se = 95% confid. interval population.

Fifty per cent or more of the schools in many countries had a written ICT policy on the use of computers for educational purposes by students in the grade range. Countries where less than 50% of the *primary schools*[3] had a written policy available were Cyprus, China Hong Kong, Iceland, and Italy. Less than 50% of the *lower secondary schools*[4] of Belgium-French, China Hong Kong, Cyprus, the Czech Republic, Italy, Lithuania, and South Africa had a written ICT policy. In *upper secondary education* in the same countries (except Italy) and in Bulgaria and Slovenia, less than 50% of the schools had a written ICT policy. Countries with high percentages of schools with a written policy document were Singapore (all three levels of education) and Hungary and Thailand (lower secondary education).

Tables 6.2.1–6.2.3[5] also show (in relation to the total number of schools with a written policy) the percentages of schools with a policy regarding each of the following issues:

1. use of computers in the current school year;
2. use of computers in the forthcoming school years;
3. plans for hardware replacement;
4. plans for staff development with regard to ICT training;
5. specifications for computer-related tasks and persons in charge;
6. plans for software acquisition;
7. equity of access;
8. Internet policy.

The last column of these three tables shows the mean number of topics (and its standard error) included in the written ICT policy. The mean was calculated on the basis of the maximum eight topics listed above. A comparison of the three populations revealed that within each country the figures for respectively *primary, lower, and upper secondary schools* were about the same. France proved an exception to this trend (a mean of 4.8 in primary education and 5.7 and 6.1 respectively in lower and upper secondary education). In the majority of the countries, the mean number of issues included in the written policy varied between 3 and 5. In Cyprus, where only about one-third of the schools in each of the three populations had a written ICT policy, the mean number of topics included was relatively low in one or more of the populations. The same was the case in Italy, Japan, and the Russian Federation, although in these countries more schools reported having a written policy.

The policy issue 'use of computers in the current school year' was included in the written policy of about 75% or more of the schools in almost all countries at *all three educational levels.* The topics that were not included in the written policy of more than 50% of the schools with such a policy were: Internet (*primary education*); use of computers in the

3 The results of the national survey in the Netherlands (ten Brummelhuis, 1998a, 1998b) indicated that 20% of the primary schools had a written document.

4 The results of the national survey in the Netherlands (ten Brummelhuis, 1998a, 1998b) indicated that 40% of the lower secondary schools had a written document.

5 In the Netherlands (ten Brummelhuis, 1998a, 1998b), of the eight issues listed, only five (issues 1, 2, 4, 5, and 8) were included in the national survey. For primary education, the mean number of these five issues included in the written ICT-policy document was 2.1; for lower secondary education, it was 3.9.

forthcoming school years (*lower secondary education*); specifications for computer-related tasks and persons in charge, plans for software acquisition, and equity of access (*lower and upper secondary education*).

De elo ment of an ICT-Related ision

The use of ICT in schools to a certain extent can be coordinated by developing a common vision regarding the use of computers within schools, and by paying attention to norms and values associated with the use of Internet and the WWW. Tables 6.3.1–6.3.3 show the data relating to these two matters for each of the three educational levels.

Table 6.3.1 Percentages of students whose principals indicated (i) that their school had developed a common vision on the use of computers and had in place the policy of 'paying attention to norms and values in using the Internet/WWW' and (ii) that these goals had not been realized or only partially been realized—primary education

	Development of a common vision			Paying attention to norms/values using Internet/WWW		
	Goal	Realized		Goal	Realized	
	Yes	Not	Partially	Yes	Not	Partially
Canada*	83	18	55	86	17	27
China Hong Kong	94	15	75	71	71	23
Chinese Taipei	93	7	59	73	27	46
Cyprus	50	31	53	52	51	27
Finland*	91	26	67	95	13	51
France*	77	55	41	54	82	5
Iceland	88	41	44	76	50	39
Israel*	73	39	43	57	68	18
Italy	75	36	50	46	55	16
Japan	72	37	54	41	82	12
New Zealand	92	14	56	73	21	43
Norway	69	60	31	57	74	19
Singapore	99	5	49	80	30	36
Slovenia	92	13	72	91	18	40

Note: *: country did not satisfy all sampling criteria.

Table 6.3.2 Percentages of students whose principals indicated (i) that their school had developed a common vision on the use of computers and had in place the policy of 'paying attention to norms and values in using the Internet/WWW' and (ii) that these goals had not been realized or only partially been realized—lower secondary education

	Development of a common vision			Paying attention to norms/values using Internet/WWW		
	Goal	Realized		Goal	Realized	
	Yes	Not	Partially	Yes	Not	Partially
Belgium-French*	79	46	49	82	26	36
Bulgaria	93	34	55	68	63	19
Canada*	84	17	57	93	5	32
China Hong Kong	94	22	72	86	38	52
Chinese Taipei	95	12	64	81	25	46
Cyprus	53	90	10	37	82	14
Czech Republic	84	29	59	48	65	17
Denmark	58	34	60	73	21	44
Finland	89	32	63	98	6	67
France	79	57	40	78	51	23
Hungary	94	41	54	91	40	30
Iceland	86	44	47	81	44	39
Israel*	75	36	50	74	49	20
Italy*	69	41	50	72	34	34
Japan	71	46	46	47	68	21
Lithuania	81	56	41	64	57	28
Luxembourg	92	22	61	86	31	24
New Zealand*	89	11	62	88	9	45
Norway	69	58	35	74	51	40
Russian Federation*	34	39	48	~	~	~
Singapore	94	7	56	83	29	48
Slovenia	93	15	67	91	16	40
South Africa*	69	50	42	69	41	34
Thailand	91	5	45	66	24	41

Notes: *: country did not satisfy all sampling criteria. ~ : no data collected.

Table 6.3.3 Percentages of students whose principals indicated (i) that their school had developed a common vision on the use of computers and had in place the policy of 'paying attention to norms and values in using the Internet/WWW' and (ii) that these goals had not been realized or only partially been realized—upper secondary education

	Development of a common vision			Paying attention to norms/values using Internet/WWW		
	Goal	Realized		Goal	Realized	
	Yes	Not	Partially	Yes	Not	Partially
Belgium-French*	81	44	50	80	25	35
Bulgaria	90	46	47	59	81	11
Canada*	85	12	62	93	5	30
China Hong Kong	94	22	72	86	38	52
Chinese Taipei	98	1	60	86	10	49
Cyprus	82	41	56	79	37	41
Czech Republic	90	16	61	73	34	36
France	76	43	48	82	39	26
Iceland	83	29	61	77	31	43
Israel*	73	34	55	88	32	35
Italy*	82	36	54	76	33	25
Japan	70	40	54	52	59	29
Latvia*	90	27	58	76	52	26
Lithuania	82	53	45	65	57	28
Luxembourg	90	21	63	85	34	23
Norway	64	47	47	79	32	56
Russian Federation*	34	39	48	~	~	~
Singapore	96	3	43	96	3	35
Slovak Republic*	16	24	59	40	40	31
Slovenia*	80	23	61	83	25	53
South Africa*	64	46	44	64	42	27

Notes: *: country did not satisfy all sampling criteria. ~ : no data collected.

Columns 2 and 5 of these tables contain the percentages of principals who said that 'developing a common vision' and 'paying attention to norms and values when using the Internet/WWW' was a policy goal of their schools. In almost all countries, at *all three educational levels*, at least two-thirds of the schools had developed a common vision on ICT as a policy goal. The only exception for *primary education* was Cyprus (50%). Cyprus (53%) was also an exception at the *lower secondary level*. Denmark (58%) and the Russian Federation (34%) were likewise exceptions at this level. The exceptions at the *upper secondary level* were the Russian Federation (34%) and the Slovak Republic (16%). 'Paying attention to norms and values when using the Internet/WWW' was a policy goal in at least 40% of the schools in all countries at all levels. In most of the countries this percentage was higher than 60%.

As far as the realization of these goals is concerned, the following picture emerges. At *all three educational levels*, the majority of principals answered that the two goals had not been realized or had been only partially realized (the percentage of schools in which the goals had been realized fully is not shown in the tables). 'A common vision' was partially or fully realized by 50% or more of the schools at all three levels in almost all countries. There were a few exceptions to this general trend. In *primary education*, the countries that went against the trend were France (41% partially realized and 4% fully realized) and Norway (31% and 9%). The exceptions in *lower secondary education* were Cyprus (10% and 0%), France (40% and 3%), Lithuania (41% and 3%), and Norway (35% and 7%). In *upper secondary education*, Lithuania (45% and 2%) was the only country where 'a common vision' had been realized partially or fully in less than 50% of the schools.

In *primary education*,[6] realization of the goal 'paying attention to norms and values when using the Internet/WWW' was lower than in *lower*[7] *and upper secondary education*. The less frequent use of the Internet/WWW by students in primary education may be an explanation here.

Regulation of Com uter-Related Acti ities

Tables 6.4.1–6.4.3 show the outcomes for six particular measures that schools could take to regulate (to a certain degree) computer-related activities:

1. preventing unauthorized system access or entry;
2. honoring intellectual property rights (e.g. software copyrights);
3. prohibiting access to adults only material;
4. restricting game-playing on school computers;
5. specifying compulsory student computer-related knowledge and skills;
6. stimulating local community (parents and/or others) access to school computers or the Internet.

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6 'Paying attention to norms and values when using the Internet/WWW' was a policy goal in 51% of primary schools in the Netherlands.

7 'Paying attention to norms and values when using the Internet/WWW' was a policy goal in 75% of the lower secondary schools. In lower secondary education, the percentage of schools where this goal had been partially or fully realized was higher than in primary education (38% versus 10%).

Columns 2 through 7 in the tables contain the percentages of principals who answered that these measures had been taken in their schools.

The final column in each of the three tables presents the mean number of measures (and its standard error) mentioned by principals in each country. A score of 3.6 (0.0) means here that, on average, a principal checked 3.6 out of the six measures with a standard error of 0.0.

In *primary education*, principals set up fewer measures than at other educational levels, and the mean number of measures taken was more than three in only two countries (Canada and Singapore). In *lower and upper secondary schools* in almost half of the countries, three measures or more were taken on average. In many countries, more than 50% of the schools at the lower and upper secondary levels had taken the first five measures. Many schools had 'restricted game-playing on school computers'.

Table 6.4.1 Percentages of students whose principals indicated that particular measures to regulate computer-related activities had been set up in their school—primary education

	1. Prevention unauthor. system acc.	2. Honoring intellect. property rights	3. Prohibition acc. adults only mater.	4. Restrict/game play. school comp.	5. Spec. compuls. stud. comp. knowl.	6. Local community acc. to Internet	Mean number of measures (max. 6)
Canada*	75	75	76	77	47	20	3.7 (0.0)
China Hong Kong	63	69	31	29	47	12	2.5 (0.1)
Chinese Taipei	26	73	57	25	48	36	2.6 (0.1)
Cyprus	38	28	40	56	56	6	2.2 (0.4)
Finland*	32	80	38	82	31	16	2.8 (0.1)
France*	17	28	18	35	23	8	1.3 (0.1)
Iceland	63	49	64	76	18	11	2.8 (0.1)
Israel*	41	47	28	47	31	21	2.1 (0.2)
Italy	17	23	16	11	5	5	0.8 (0.1)
Japan	2	7	5	7	16	3	0.4 (0.1)
New Zealand	61	56	52	70	33	14	2.9 (0.1)
Norway	39	33	23	43	19	6	1.6 (0.0)
Singapore	78	77	41	76	56	15	3.4 (0.1)
Slovenia	55	72	44	66	23	18	2.8 (0.1)

Notes: *: country did not satisfy all sampling criteria. The final column contains average values and standard errors (in brackets) for the number of measures indicated. Standard error: value ± 2* se = 95% confid. interval population.

Table 6.4.2 Percentages of students whose principals indicated that particular measures to regulate computer-related activities had been set up in their school—lower secondary education

	1. Prevention unauthor. system acc.	2. Honoring intellect. property rights	3. Prohibition acc. adults only mater.	4. Restrict/game play. school comp.	5. Spec. compuls. stud. comp. knowl.	6. Local community acc. to Internet	Mean number of measures (max. 6)
Belgium-French*	63	48	53	70	25	24	2.8 (0.1)
Bulgaria	67	31	38	62	63	15	2.8 (0.1)
Canada*	90	79	87	89	42	26	4.1 (0.0)
China Hong Kong	73	80	59	62	50	6	3.3 (0.0)
Chinese Taipei	39	83	70	46	60	28	3.3 (0.1)
Cyprus	36	18	32	51	46	12	1.9 (0.2)
Czech Republic	63	64	53	21	40	12	2.6 (0.1)
Denmark	68	98	40	75	37	16	3.3 (0.1)
Finland	58	88	40	84	47	21	3.4 (0.1)
France	50	58	46	60	38	15	2.7 (0.1)
Hungary	55	43	46	46	72	29	2.9 (0.1)
Iceland	67	57	73	81	20	11	3.1 (0.1)
Israel*	64	55	46	62	42	22	2.9 (0.2)
Italy*	52	53	43	57	18	12	2.3 (0.1)
Japan	8	17	16	19	34	7	1.0 (0.1)
Lithuania	12	20	36	51	50	22	1.9 (0.1)
Luxembourg	83	77	73	97	75	47	4.5 (0.2)
New Zealand*	91	73	76	88	42	41	4.1 (0.1)
Norway	59	44	36	59	23	15	2.4 (0.0)
Russian Federation*	33	16	39	26	57	7	1.8 (0.2)
Singapore	73	66	56	77	68	16	3.6 (0.0)
Slovenia	68	85	52	72	28	22	3.3 (0.1)
South Africa*	55	58	45	66	23	22	2.7 (0.2)
Thailand	27	32	32	42	29	19	1.8 (0.1)

Notes: *: country did not satisfy all sampling criteria. The final column contains average values and standard errors (in brackets) for the number of measures indicated. Standard error: value ± 2* se = 95% confid. interval population.

Table 6.4.3 Percentages of students whose principals indicated that particular measures to regulate computer-related activities had been set up in their school—upper secondary education

	1. Prevention unauthor. system acc.	2. Honoring intellect. property rights	3. Prohibition acc. adults only mater.	4. Restrict/game play. school comp.	5. Spec. compuls. stud. comp. knowl.	6. Local community acc. to Internet	Mean number of measures (max. 6)
Belgium-French*	60	49	50	69	24	25	2.8 (0.1)
Bulgaria	69	22	32	63	75	13	2.7 (0.1)
Canada*	95	84	88	87	38	26	4.2 (0.0)
China Hong Kong	73	80	59	62	50	6	3.3 (0.0)
Chinese Taipei	60	86	78	69	83	37	4.1 (0.1)
Cyprus	70	45	64	88	62	11	3.4 (0.1)
Czech Republic	77	81	68	42	65	13	3.5 (0.1)
France	65	68	56	69	43	14	3.2 (0.1)
Iceland	93	53	58	96	57	10	3.7 (0.0)
Israel*	81	68	60	68	60	28	3.7 (0.1)
Italy*	52	51	47	60	31	19	2.6 (0.1)
Japan	18	16	14	20	27	9	1.0 (0.1)
Latvia*	47	26	34	26	61	36	2.3 (0.1)
Lithuania	16	17	41	54	63	24	2.1 (0.0)
Luxembourg	79	75	72	95	71	44	4.4 (0.2)
Norway	83	50	36	72	29	16	2.9 (0.0)
Russian Federation*	33	16	39	26	57	7	1.8 (0.2)
Singapore	95	91	88	83	63	28	4.5 (0.0)
Slovak Republic*	61	41	47	57	45	16	2.7 (0.1)
Slovenia*	74	64	23	45	47	23	2.8 (0.1)
South Africa*	62	66	63	72	32	26	3.2 (0.2)

Notes: *: country did not satisfy all sampling criteria. The final column contains average values and standard errors (in brackets) for the number of measures indicated. Standard error: value ± 2* se = 95% confid. interval population.

USE OF ICT FOR ONITORING STUDENT PROGRESS AND FOR SC OOL AD INISTRATION

Student Progress

Principals were also asked whether their school had 'using computers to keep track of student data' as a policy goal (see the second column of Tables 6.5.1–6.5.3) and to what extent their school computers were being used for this purpose.

In almost all countries, more than 60% of the *primary school*[8] principals mentioned this goal. Although in more than 50% of these schools this goal had been realized partially or fully, it had yet to be realized fully in many countries.

Columns 6 to 9 of Tables 6.5.1–6.5.3 show the percentages of principals who indicated how often they used computers to keep track of students' learning progress ('never', 'a few times', 'monthly', and 'weekly/daily').

Table 6.5.1 Percentages of students whose school principals indicated the extent to which computers were being used to keep track of students' learning progress and to maintain other student data—primary education

	Policy goal: using computers for student data	Using computers for student data			Frequency computer use to keep track of students' learning progress			
	Yes	Not	Partially	Fully	Never	A few times	Monthly	Weekly/daily
Canada*	78	14	32	54	20	43	15	21
China Hong Kong	79	28	54	18	41	43	16	0
Chinese Taipei	70	20	66	14	17	61	20	2
Cyprus	74	42	31	27	50	48	3	0
Finland*	97	11	23	66	26	65	6	3
France*	90	22	33	45	44	43	8	6
Iceland	94	19	51	30	21	42	22	15
Israel*	72	36	40	24	39	43	13	4
Italy	86	18	23	59	64	27	6	3
Japan	41	47	47	6	~	~	~	~
New Zealand	73	11	54	35	22	45	12	21
Norway	95	6	23	71	~	~	~	~
Singapore	98	2	30	68	5	67	20	7
Slovenia	96	6	42	52	39	48	10	3

Notes: *: country did not satisfy all sampling criteria. ~ : no data collected.

8 In the Netherlands (ten Brummelhuis, 1998a, 1998b), 93% and 99% respectively of the principals in primary education indicated that 'using computers to keep track of student data' was a policy goal. In primary education this goal had been partially or fully realized by 83% of the schools. In lower secondary education this percentage was 94.

Table 6.5.2 Percentages of students whose school principals indicated the extent to which computers were being used to keep track of students' learning progress and to maintain other student data—lower secondary education

	Policy goal: using computers for student data	Using computers for student data			Frequency computer use to keep track of students' learning progress			
	Yes	Not	Partially	Fully	Never	A few times	Monthly	Weekly/daily
Belgium-French*	98	1	13	86	51	40	6	2
Bulgaria	83	52	34	14	72	24	2	1
Canada*	92	2	19	79	1	23	18	58
China Hong Kong	78	21	57	23	21	57	15	6
Chinese Taipei	97	2	35	64	11	20	31	38
Cyprus	87	0	4	96	9	57	31	3
Czech Republic	94	5	22	73	26	65	7	2
Denmark	97	1	10	89	8	73	12	6
Finland	100	1	4	95	10	49	23	18
France	97	2	20	78	18	50	25	7
Hungary	93	29	38	32	38	55	5	2
Iceland	98	17	44	39	15	42	26	17
Israel*	90	10	36	54	15	40	32	13
Italy*	97	3	19	78	45	39	10	5
Japan	76	8	50	42	–	–	–	–
Lithuania	81	43	45	13	43	44	10	3
Luxembourg	100	0	21	79	43	57	0	0
New Zealand*	95	2	45	53	3	25	20	52
Norway	95	5	33	62	~	~	~	~
Russian Federation*	41	60	39	1	70	25	5	0
Singapore	97	3	44	53	1	72	20	8
Slovenia	97	4	42	54	34	53	9	3
South Africa*	91	7	22	71	19	37	21	22
Thailand	96	1	37	63	32	40	23	6

Notes: *: country did not satisfy all sampling criteria. ~ : no data collected.

Those countries that used computers for this goal at the *primary level*[9] generally did so on a limited basis only ('never' or 'a few times'). In Canada, Chinese Taipei, Iceland, New Zealand, and Singapore, the percentage of primary schools that used computers on at least a monthly basis for tracking students' learning process was more than 20%. The number of schools that never used the computer for this purpose was surprisingly high in a considerable number of countries. Approximately 40–60% of the schools in China Hong Kong, Cyprus, France, Israel, Italy, and Slovenia fitted this category.

9 In the Netherlands (ten Brummelhuis, 1998a, 1998b), 62% of the primary schools kept track of student data at least once a week.

Table 6.5.3 Percentages of students whose school principals indicated the extent to which computers were being used to keep track of students' learning progress and to maintain other student data—upper secondary education

	Policy goal: using computers for student data	Using computers for student data			Frequency computer use to keep track of students' learning progress			
	Yes	Not	Partially	Fully	Never	A few times	Monthly	Weekly/daily
Belgium-French*	98	1	13	86	52	37	8	2
Bulgaria	83	52	36	12	72	23	3	1
Canada*	94	1	11	88	1	19	16	64
China Hong Kong	78	21	57	23	21	57	15	7
Chinese Taipei	100	0	27	73	8	17	25	50
Cyprus	95	5	4	91	3	56	21	19
Czech Republic	95	0	13	87	10	68	18	4
France	99	2	20	78	27	51	10	11
Iceland	100	0	10	90	1	18	11	70
Israel*	94	8	28	64	8	40	32	20
Italy*	97	2	17	82	39	38	13	10
Japan	84	7	58	35	–	–	–	–
Latvia*	96	12	55	33	30	60	9	1
Lithuania	80	45	40	16	45	41	10	4
Luxembourg	100	0	23	77	43	57	0	0
Norway	100	0	6	94	~	~	~	~
Russian Federation*	41	60	39	1	71	25	5	0
Singapore	100	0	6	94	0	44	20	37
Slovak Republic*	12	3	32	65	16	76	7	2
Slovenia*	100	2	39	59	5	64	28	4
South Africa*	92	6	25	69	20	30	20	30

Notes: *: country did not satisfy all sampling criteria. ~ : no data collected.

In *lower secondary education*[10] in almost all countries, the percentage of schools that had 'using computers to keep track of students' learning progress' as a policy goal was about 90% or higher. Only Bulgaria (83%), China Hong Kong (78%), Japan (76%), Lithuania (81%), and the Russian Federation (41%) had lower scores. In Bulgaria, Lithuania, and the Russian Federation this goal had yet to be realized in 52%, 43%, and 60% respectively of lower secondary schools. In most countries the goal had been realized partially or fully in more than 50% of the schools.

A considerable number of schools in Belgium-French, Bulgaria, Hungary, Italy, Lithuania, Luxembourg, the Russian Federation, Slovenia, and Thailand had never used computers for keeping track of students' learning progress. In the majority of countries, schools that used computers for this purpose did so only a few times each school year. The exceptions

10 In the Netherlands (ten Brummelhuis, 1998a, 1998b), 76% of lower secondary schools kept track of student data at least once a week.

were Canada, Chinese Taipei, Finland, Iceland, Israel, New Zealand, and South Africa. In these countries, 40% or more of lower secondary schools used the computer for monitoring student progress on a monthly or weekly basis.

Similar results were evident for *upper secondary schools* (refer Table 6.5.3). In most countries, the percentages of schools in which the computer was used at least once a month per school year to keep track of students' learning was somewhat higher than for schools at the lower secondary level.

Administrati e Use

Computers can be used for various school administrative activities (Fung, Visscher, Barta, & Teather, 1997; Visscher, 1991; Visscher, 1996; Visscher & Wild, 1997). The questionnaire for school principals listed five ways that the school could benefit from using the computer in the school administrative area. These were:

1. updating the library database;
2. creating and updating the lesson schedule;
3. staff administration;
4. financial administration;
5. communication with parents and others outside school.

Principals were asked to indicate the frequency per school year with which the school carried out each activity. Tables 6.6.1–6.6.3 present the frequencies and mean scores across all five activities. The percentages of principals who indicated that they never used the computer for a particular activity are not shown in the tables. (These percentages are equal to the difference between 100% and the percentage shown.)

From the final column in the three tables, it is evident that in the majority of countries the computer was used, on average, for at least three of the five school administrative activities. In primary education, China Hong Kong (mean 2.5), Cyprus (1.5), France (2.5), and Israel (2.2) were exceptions to this rule.

In *lower and upper secondary education*, the mean number of activities was lower than 3 in three countries: Bulgaria (1.9 and 1.8), Cyprus (1.8 and 2.3), and Lithuania (1.8 and 1.8). In Latvia (which did not participate at the lower secondary level), the mean number of activities in upper secondary education was 2.4.

In *primary schools*, computer technology was used to 'update the library database' in many schools. However, in China Hong Kong, Cyprus, Finland, and Israel relatively few schools used the computer for this activity. The other types of computer support proved, on average, to be utilized more in primary schools. In China Hong Kong, Cyprus, France, Israel, and Italy, less than 50% of the schools used the computer for two or more of the five activities.

The construction and updating of the school schedule was done without a computer in a substantial percentage of primary schools in many countries. The reason for this may be that lesson schedules for primary schools are not as complicated as those for secondary schools.

In *lower*[11] *and upper secondary education*, the computer was used quite widely for all five school administrative activities in most countries (except in those that, on general, did not use the computer much in this area), including Bulgaria, Cyprus, Latvia (upper secondary schools), Lithuania, and the Russian Federation.

Table 6.6.1 Percentages of students whose principals indicated that in their school computers were being used for particular administrative activities a few times or more during a school year—primary education

	1. Updating library data	2. Creating/updating less. sched.	3. Staff administration	4. Financial administration	5. Communication with parents	Mean no. of activities (max. 5)
Canada*	73	62	85	92	89	4.0 (0.0)
China Hong Kong	20	58	73	62	36	2.5 (0.1)
Chinese Taipei	79	80	93	92	71	4.1 (0.1)
Cyprus	13	44	36	18	51	1.5 (0.3)
Finland*	30	45	75	75	77	3.0 (0.1)
France*	50	49	32	43	79	2.5 (0.1)
Iceland	80	92	81	75	87	4.0 (0.1)
Israel*	31	33	49	60	45	2.2 (0.1)
Italy	44	46	95	91	78	3.5 (0.1)
Japan	~	~	~	~	~	~
New Zealand	83	65	92	90	68	4.0 (0.1)
Norway	~	~	~	~	~	~
Singapore	98	81	98	100	87	4.6 (0.0)
Slovenia	93	54	99	98	73	4.2 (0.1)

Notes: *: country did not satisfy all sampling criteria. ~ : no data collected. The final column contains average values and standard errors (in brackets) for the number of activities. Standard error: value ± 2* se = 95% confid. interval population.

11 In the national survey in the Netherlands (ten Brummelhuis, 1998a, 1998b), four out of the five administrative activities were included (the activity numbers 1, 2, 3, and 4). In this country, the computer was used more frequently for school administrative purposes in lower secondary education (mean number of activities 3.3) than in primary education (mean number of activities 2.6). A relatively small number of primary and lower secondary schools used the computer for updating the library database (36% and 55% respectively). About 75% of the schools (primary and lower secondary) used the computer for creating and updating the school schedule.

Table 6.6.2 Percentages of students whose principals indicated that in their school computers were being used for particular administrative activities a few times or more during a school year—lower secondary education

	1. Updating library data	2. Creating/updating less. sched.	3. Staff administration	4. Financial administration	5. Communication with parents	Mean no. of activities (max. 5)
Belgium-French*	73	76	99	96	70	4.1 (0.1)
Bulgaria	20	42	54	50	26	1.9 (0.1)
Canada*	88	79	94	97	87	4.5 (0.0)
China Hong Kong	80	88	87	81	66	4.0 (0.0)
Chinese Taipei	75	94	97	99	66	4.3 (0.1)
Cyprus	20	54	52	17	33	1.8 (0.2)
Czech Republic	30	47	94	83	74	3.2 (0.1)
Denmark	89	88	99	98	90	4.6 (0.0)
Finland	29	90	93	86	79	3.8 (0.1)
France	93	81	100	99	77	4.5 (0.0)
Hungary	49	47	86	82	57	3.2 (0.1)
Iceland	79	95	88	77	90	4.2 (0.1)
Israel*	65	70	74	69	46	3.1 (0.2)
Italy*	69	64	96	95	81	4.1 (0.1)
Japan	~	~	~	~	~	~
Lithuania	14	22	60	47	47	1.8 (0.1)
Luxembourg	93	93	100	100	88	4.7 (0.1)
New Zealand*	99	92	99	99	83	4.7 (0.0)
Norway	~	~	~	~	~	~
Russian Federation*	5	20	29	15	~	~
Singapore	100	89	100	100	81	4.7 (0.0)
Slovenia	94	59	99	98	73	4.2 (0.1)
South Africa*	52	49	84	90	74	3.5 (0.1)
Thailand	48	66	84	92	57	3.5 (0.1)

Notes: *: country did not satisfy all sampling criteria. ~ : no data collected. The final column contains average values and standard errors (in brackets) for the number of activities. Standard error: value ± 2* se = 95% confid. interval population.

Table 6.6.3 Percentages of students whose principals indicated that in their school computers were being used for particular administrative activities a few times or more during a school year—upper secondary education

	1. Updating library data	2. Creating/updating less. sched.	3. Staff administration	4. Financial administration	5. Communication with parents	Mean no. of activities (max. 5)
Belgium-French*	75	75	99	95	69	4.1 (0.1)
Bulgaria	18	38	59	60	15	1.8 (0.1)
Canada*	93	87	98	98	90	4.7 (0.0)
China Hong Kong	80	88	87	81	66	4.0 (0.0)
Chinese Taipei	97	95	97	99	87	4.7 (0.0)
Cyprus	16	80	70	16	47	2.3 (0.2)
Czech Republic	58	72	98	99	91	4.2 (0.1)
France	89	75	99	99	74	4.3 (0.0)
Iceland	98	100	91	100	85	4.7 (0.1)
Israel*	77	84	87	89	60	4.0 (0.1)
Italy*	68	67	94	97	84	4.1 (0.1)
Japan	~	~	~	~	~	~
Lavia*	22	50	68	58	48	2.4 (0.1)
Lithuania	14	23	58	48	43	1.8 (0.0)
Luxembourg	93	90	100	100	85	4.7 (0.1)
Norway	~	~	~	~	~	~
Russian Federation*	5	20	29	15	~	~
Singapore	100	81	99	100	96	4.8 (0.0)
Slovak Republic*	45	83	94	91	53	3.6 (0.1)
Slovenia*	97	90	99	100	89	4.8 (0.0)
South Africa*	49	57	88	94	81	3.7 (0.1)

Notes: *: country did not satisfy all sampling criteria. ~ : no data collected. The final column contains average values and standard errors (in brackets) for the number of activities. Standard error: value ± 2* se = 95% confid. interval population.

PROBLE S REALI ING ICT GOALS

Tables G.7.1–G.7.3 (see Appendix G) contain the percentages of principals indicating that they experienced specific obstacles in realizing their schools' computer-related goals. (The numbers in the following list refer to the numbers in the tables; the 'missing' numbers (items) were discussed in Chapters 3 and 4). The list of obstacles given to principals was as follows:

4. Insufficient time for teachers to prepare lessons in which computers are used.
5. Difficult to integrate computers into classroom instruction practices.
7. Problems in scheduling enough computer time for different classes.
8. Difficult to use Internet/WWW with low-achieving students.
9. No time in the school schedule for using the Internet/WWW.
10. No time in teachers' schedules to explore opportunities for using the Internet/WWW.

Obstacles 4, 5, and 7 in all populations were considered to be the major problems by a substantial percentage of principals in many countries (in most cases by 50% or more of them). The difficulty of integrating computers into instructional practices (obstacle 5) was mentioned by a very large group of principals in some countries (Chinese Taipei, Denmark, Luxembourg). Obstacle 8 was not regarded as a problem in any of the countries. Obstacles 9 and 10 were not regarded as serious problems in many schools across all three educational levels. However, more than 50% of the primary and lower secondary education principals in a limited number of countries mentioned these problems.

SU AR AND REFLECTIONS

The general conclusion that can be drawn from the results presented in this chapter is that, in a considerable number of countries, schools are doing much to develop their ICT-related policies, visions, and attitudes. Much is also being achieved in terms of computer usage for student monitoring and school administration. However, there is still considerable room for progress not only in those countries performing at above-average levels but also in those countries performing at the lower levels.

The attitudes of principals toward the use of ICT in their schools in general tended to be positive, although the depth of that opinion varied considerably. In some countries, school leaders were very positive; in others they were only very slightly positive.

As far as ICT policies are concerned, the results showed that in many countries about 50% or more of the schools had developed school policy measures concerning the use of ICT within their institutions. Many schools had included about half of the policy issues listed in the questionnaire. However, this finding has both optimistic overtones ('a considerable number of schools in a considerable number of countries are quite active in the development of ICT policies') and pessimistic overtones ('although a number of countries are relatively active, in too many countries too little is happening in this area').

A similar picture emerges from the research results concerning the development of an ICT vision and its realization. Although in a good number of countries the development of such a vision was a goal for a fair number of schools, that goal had yet to be realized in many countries.

Many schools were benefiting from using the computer for school administration (on average, schools were using about three of the five types of school administrative activities listed in the questionnaire). This finding again implies that the computer provides much support in routine school administrative work. However, that said, it is evident that more schools need to learn to use computers for all valuable administrative and management activities (although using computers for management purposes tends to be more difficult than for administrative purposes). One would expect that teachers would gain considerable benefit from the possibilities that computers offer for student monitoring, given that this task is very time-consuming. However, the findings revealed that while some schools were using computers for this purpose, many were not.

Some of the problems schools faced in implementing ICT concerned the lack of resources, notably insufficient teacher time for preparing computer lessons, and not enough time to work with computers. Respondents also pointed to the mismatch between available software and instructional practices.

This chapter shows that considerable progress was being made in the participating schools in terms of ICT attitudes and plans and the various ways of using computer technology. However, if all schools around the world are to benefit fully from what modern school information systems can provide, then much still needs to be done. School staff need to be shown how they can 'win' by making greater use of computers. At the same time, solutions have to be found for the problems schools face when trying to implement ICT in their institutions.

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Cha ter

OST SATISF ING E PERIENCES WIT ICT

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This chapter presents a preliminary analysis of the ICT-related learning activities that school principals considered were the most satisfying ICT experiences in their schools. The intention was to gather extra information on how ICT contributes to innovation in education, particularly with respect to realizing aspects of the 'emerging paradigm'. Furthermore, it was expected that the examples could form a bridge between SITES Module-1 and SITES Module-2. (The latter will be a case study of innovative pedagogical practices using technology.) A more extended analysis of the data presented in this chapter will be part of SITES Module-2.

GENERAL O ER IEW

For this part of SITES Module-1, school principals were asked to give, with the help of sub-questions, 'an example of the most satisfying experience of a learning activity in your school in which students use computer-related technology, which gives students the most useful, effective and advanced learning experiences with technology' (refer question 14, Principal Questionnaire, Appendix C). There were two reasons for including this question in the Module-1 survey. The first was to collect additional information on that aspect of Module-1 dealing with the 'emerging paradigm'—the way technology facilitates the realization of new goals for teaching and learning that arise from the demands of an information society. The second reason had to do with the preparation of Module-2, which will be a case study of innovative pedagogical practices using technology. The examples collected in Module-1 will form the bridge between Module-1 and Module-2.

For Module 1, a decision was made that each country would be asked to provide a maximum of 10 examples per educational level for reporting in the international part of the SITES study. However, in nearly all countries the respondents provided more than 10 examples, as is evident in Table 7.1. A manual therefore was developed to guide selection of the examples for the international study. The selection process focused on excluding examples that emphasized only computer programming, ICT basic skills (taught in a separate course), and the use of technology for drill and practice, because they were seen as fitting more into the 'traditionally important paradigm' and less into the 'emerging paradigm'. As such, the selected examples are not a random sample of all the collected examples and represent, as can be seen in Table 7.1, only a fraction of the total number of available descriptions. However, the examples that the national research coordinators selected were considered to be a representative sample of innovative use of ICT in their respective countries.

Table 7.1 Number of respondents related to number of completions and number of translated descriptions

	Primary Education			Lower Secondary Education			Upper Secondary Education		
	Number of respondents	Number of completions	Number of descriptions	Number of respondents	Number of completions	Number of descriptions	Number of respondents	Number of completions	Number of descriptions
Belgium-French	~	~	~	128	38	9	131	55	9
Bulgaria	~	~	~	207	43	10	225	52	10
Canada**	1332	702	20	820	487	18	738	456	18
China Hong Kong	206	28	10	297	87	10	297	87	10
Chinese Taipei	204	47	10	206	48	6	227	69	10
Cyprus*	26	12	~	33	8	~	29	12	~
Czech Republic	~	~	~	250	77	11	233	127	9
Denmark	~	~	~	219	92	10	~	~	~
Finland	185	72	13	192	66	12	~	~	~
France	308	113	10	295	151	10	288	123	10
Hungary	~	~	~	254	114	10	~	~	~
Iceland	137	41	10	103	29	10	27	7	6
Israel	127	61	10	103	56	10	101	61	10
Italy	204	95	10	185	129	10	182	130	10
Japan	212	29	11	202	78	10	208	77	10
Latvia	~	~	~	~	~	~	107	36	10
Lithuania	~	~	~	237	54	10	540	143	10
Luxembourg	~	~	~	16	10	4	19	10	5
New Zealand	200	95	10	223	105	10	~	~	~
Norway	1238	398	10	768	321	10	375	165	10
Russian Federation*	~	~	~	105	17	~	105	17	~
Singapore	192	133	10	145	103	10	30	27	6
Slovak Republic	~	~	~	~	~	~	157	37	8
Slovenia	125	96	10	125	103	10	109	78	10
South Africa	~	~	~	92	28	8	98	36	5
Thailand	~	~	~	419	117	7	~	~	~
Totals	4696	1922	144	5624	2361	215	4226	1805	176

Notes: *: countries did not sent translated descriptions. **: the data for Canada originated from Canada Ontario only. ~ : no data collected.

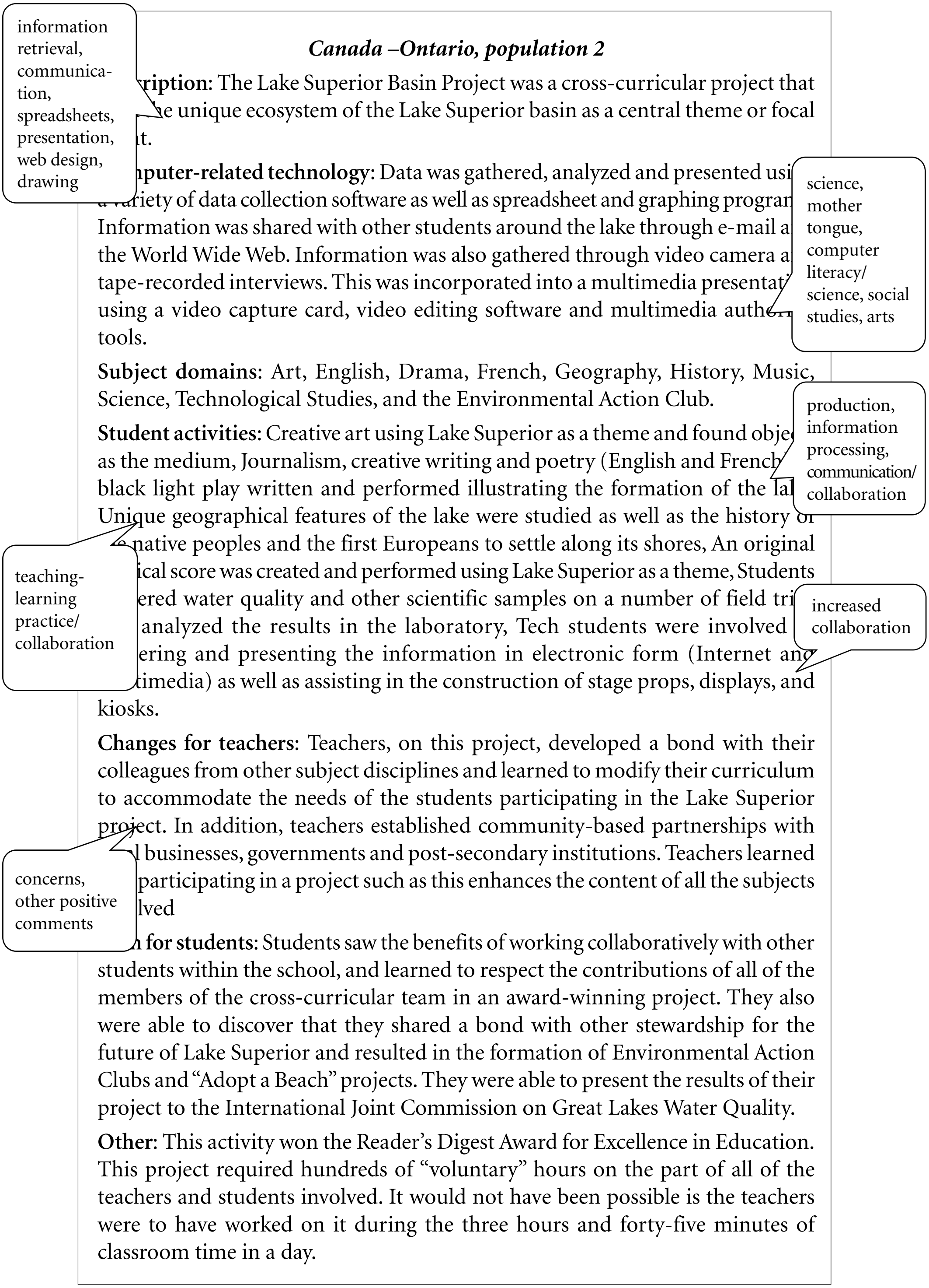
CODING

The amount of information presented in the examples varied. Some descriptions were fairly short and some were rather extensive. In order to establish a detailed list of keywords for each sub-question, the SITES researchers drew on information from a literature review on innovative use of technology in education undertaken by Voogt and Odenthal (1997) and the analysis of the results of the SITES pilot study (see Chapter 1). These keywords were then used to code the respondents' verbal descriptions. The coding allowed for the assignment of more than one keyword per sub-question. The categorizations and keywords used to analyze the descriptions were as follows:

- *Student activities:* 'information-processing activities' (such as information retrieval and data processing and manipulation); 'production activities' (publishing, the creation of texts and drawings and presentation of findings); 'communication and collaboration activities' (sharing information and/or team work); 'computer programming'; 'basic ICT skills'; technology-related activities focusing on 'remediation and/or practice'; 'other'.
- *Computer-related technology:* 'programming languages'; 'word-processing technology'; 'information-retrieval technology' (such as WWW, encyclopedias on CD-ROM); 'communication technology' (such as email, video-conferencing); 'computer operations' (DOS, Windows); 'simulation'; 'spreadsheets'; 'presentation' (e.g. PowerPoint, Hyperstudio); 'database design'; 'microcomputer-based laboratories'; 'web page design'; 'drill and practice software'; 'drawing and graphics'; 'other'.
- *Curriculum domains:* 'math'; 'science'; 'mother tongue'; 'foreign languages'; 'computer literacy/science'; 'social studies'; 'arts'; 'cross curricular' (without further specification); 'extra curricular' (outside school hours); 'other'.
- *Gain for students:* 'increase in motivation/interest/concentration'; 'increase in active participation/creativity'; 'improves knowledge/skills'; 'increase in responsibility/self-esteem/independence'; 'increase in collaboration'; 'negative impact'; 'other'.
- *Changes for teachers:* 'change in teaching/learning practice'; 'ICT skills/knowledge'; 'increase in collaboration'; 'other'.
- *Other comments:* 'part of a larger project'; 'related to in-service training/staff development'; 'related to ICT use for school management purposes'; 'concerns'; 'other positive comments'; 'other negative comments'.

Ten percent of the examples were coded by two raters. The inter-rater reliability (Cohen's Kappa) was 0.63. Figure 7.1 shows an example of a description, together with the applied coding.

The results of the analyses are presented in the following sections. The tables contain, per education level, the occurrence of a specific keyword as the percentage of the total number of observed keywords per category. To accommodate the nature of the question, the results are presented not only in figures but also as illustrations containing examples and exemplary wordings of (combinations of) keywords. Together, the figures and illustrations represent the broad range of most satisfying examples as reported by principals of learning activities in which students use computer-related technology.



Canada –Ontario, population 2

…ription: The Lake Superior Basin Project was a cross-curricular project that …e unique ecosystem of the Lake Superior basin as a central theme or focal …t.

…puter-related technology: Data was gathered, analyzed and presented usi… …riety of data collection software as well as spreadsheet and graphing progra… Information was shared with other students around the lake through e-mail a… the World Wide Web. Information was also gathered through video camera a… tape-recorded interviews. This was incorporated into a multimedia presentat… using a video capture card, video editing software and multimedia auth… tools.

Subject domains: Art, English, Drama, French, Geography, History, Music, Science, Technological Studies, and the Environmental Action Club.

Student activities: Creative art using Lake Superior as a theme and found obje… as the medium, Journalism, creative writing and poetry (English and French… black light play written and performed illustrating the formation of the la… Unique geographical features of the lake were studied as well as the history of …native peoples and the first Europeans to settle along its shores, An original …ical score was created and performed using Lake Superior as a theme, Students …ered water quality and other scientific samples on a number of field tri… analyzed the results in the laboratory, Tech students were involved …ering and presenting the information in electronic form (Internet and …timedia) as well as assisting in the construction of stage props, displays, and kiosks.

Changes for teachers: Teachers, on this project, developed a bond with their colleagues from other subject disciplines and learned to modify their curriculum to accommodate the needs of the students participating in the Lake Superior project. In addition, teachers established community-based partnerships with …l businesses, governments and post-secondary institutions. Teachers learned … participating in a project such as this enhances the content of all the subjects …lved

…n for students: Students saw the benefits of working collaboratively with other students within the school, and learned to respect the contributions of all of the members of the cross-curricular team in an award-winning project. They also were able to discover that they shared a bond with other stewardship for the future of Lake Superior and resulted in the formation of Environmental Action Clubs and "Adopt a Beach" projects. They were able to present the results of their project to the International Joint Commission on Great Lakes Water Quality.

Other: This activity won the Reader's Digest Award for Excellence in Education. This project required hundreds of "voluntary" hours on the part of all of the teachers and students involved. It would not have been possible is the teachers were to have worked on it during the three hours and forty-five minutes of classroom time in a day.

Figure 7.1 Example of coding.

The texts of the examples are, except for some minor editing, presented in their original form (that is, for non-English speaking countries the translation received by the ICC and for English-speaking countries the text as it was written by school principals).

ACTI ITIES OF STUDENTS

Box 1

Lithuania, population 2—learning environments

Description: Students participate in the national LOGO project 'My Town and LOGO'. Students collect material and create compositions on different topics concerning past and nowadays life in their towns. They exchange their works with each other by email.

Computer-related technology: 'Logo Writer' software, email software.

Subject domain: Art (students draw buildings), history (students investigate history of buildings and monuments), mother tongue (students write essays), foreign languages (students translate their compositions into English).

Student activities: Project-based work. Students search for necessary material in the library. They take interviews from persons outside the school, observe various objects.

Changes for teachers: A teacher becomes an adviser.

Gain for students: Students acquire self-evaluation and independent learning skills.

Table 7.2 provides an overview of the percentage of occurrence of each type of student activity. These results also show that often more than one type of student activity was involved, as can be inferred from the high totals. An average of 1.7 activities was mentioned at all three levels. Box 1 above is an illustration of an example in which a combination of student activities was arranged in learning environments that contained real-world tasks.

Table 7.2 Student learning activities (percentages relate to total number of activities)

Student Learning Activities	Primary Education	Lower Secondary Education	Upper Secondary Education
Information-processing activities	31	26	23
Production activities	28	35	38
Communication/collaboration activities	16	17	18
Computer programming	1	1	3
Basic ICT skills	10	6	4
Remediation, practice	11	11	9
Other	4	4	5
N =	248	359	299

A general observation from Table 7.2 is that the selection process resulted in examples of which a substantial part contained student activities related to the emerging pedagogical paradigm. At all three educational levels, information-processing activities and production activities of students, followed by communication or collaboration activities, were the activities most frequently mentioned as being the element of the most satisfying learning experience of a learning activity involving ICT. These three types of activity were often mentioned in combination. From the total number of activities recorded for *primary education*, one-quarter to one-third related to information-processing activities and/or production activities. For *lower secondary education*, information-processing activities accounted for more than one-quarter of the total number of activities, while production activities accounted for more than one-third. In *upper secondary education*, production activities covered more than one-third of the total number of activities, while information-processing activities accounted for somewhat less than a quarter. Across levels, about one-sixth of the activities related to the communication or collaboration activities of students. These kinds of student activities may be considered as 'innovative' and therefore related to the emerging paradigm.

Because of the criteria used to select examples, it was expected that student activities relating to practice or remedial learning would be recorded less frequently than other activities. The same holds for activities regarding basic ICT skills and students' programming skills. (These three activities were seen as belonging to the traditionally important paradigm.) About one-tenth of the activities at all three educational levels were related to practice or remedial learning activities. Basic ICT skills accounted for about one-tenth of the activities in primary education. At the other two levels, these skills, along with students' programming skills, were rarely recorded. Table 7.3 presents examples of the student activities mentioned in this section. These examples cover each of the three educational levels in selected countries.

Table 7.3 Examples of student activities in most satisfying experiences with technology

Description—Primary education	***Student activities***
Canada Students were actively involved in a multimedia presentation using Netscape Navigator to create an interactive Science Fair project.	*Information-processing, production, collaboration* Individual and small groups of students were actively collaborating, communicating, collating, monitoring, evaluating, synthesizing, and extrapolating information.
Iceland A natural science project relating environmental/ecological factors and ICT with special computer programs with a database, electronic maps, word-processing, and ICT.	*Information-processing, production* Measurements (statistical inspection of data), hypothesizing, analyzing and verifying, writing letters, translating texts, learning to use geographical position simulation, so as to learn extensively about one subject e.g. acid rain, weather, drinking water, garbage, etc.
Finland Collaborative Comenius project: industries and culture, especially travelling (tourism); Participants: schools from Finland, Sweden, France, Italy, and England with PC-computers, Internet-connection (modems), email, telefax.	*Information-processing, production, collaboration* To get information, to send information, to compare information, to do summary reports.

Description—Lower secondary education	***Student activities***
Denmark Newspaper project. The class made its own newspaper using word-processing, retrieval of information via Internet, down-loading, scanning pictures.	*Information-processing, production, collaboration* Individual work and group work. Investigation work in connection with making articles.
South Africa A grade 7 project in which students were required to research destinations, make airline and hotel bookings, book seats in current shows, produce a complete itinerary with costs for a family holiday, write a report with overheads/images describing the holiday, using the Internet at the IT center.	*Information-processing, production,* Finding information, working with real bookings on the Internet, taking decisions, evaluating costs, presentation skills.

contd. on page 210

Lower secondary education (contd.)	***Student activities***
Singapore Instead of the usual mid-year pen-and-paper examinations, the Humanities Department of the school introduced project-based assessment for the lower secondary classes in history and geography. The end product after a period of five months could be in the form of charts, PowerPoint presentations, all of which could be displayed at the Humanities Week Exhibition and Open House day. Students used Internet to get information (web sites recommended by their teachers) and PowerPoint. Some students presented their information on CDs (own initiative).	*Information-processing, production, collaboration* Planning their work, time-frame and deadlines, meeting to discuss data collected, work together in the library and on the computer to put their presentation together, presenting and explaining their projects to the visitors of the Open House.

Description—Upper secondary education	***Student activities***
Czech Republic During the course of economy and marketing computer simulation MESE is being used. This software helps students to understand the rules of the market.	*Information-processing* Creating and managing own virtual companies.
Italy A virtual multi-classroom through 'Sondrio' town-network: this allows for communication between students, teachers, and parents for classroom activities at school and after school hours via the city Internet network.	*Information-processing, production* Support work for students, activities planning and courseware production, searching for information.
Slovenia Using computers in physics/planning and conducting experiments, analyses of data, and computer-based presentation.	*Information-processing, production* Overview of bibliography, preparing the program for experiment, measurement, data analyses, preparing the report, presentations.

CO PUTER-RELATED TEC NOLOG

The ICT applications used in schools were clearly related to the kinds of student activities that were reported. Table 7.4 contains an overview of the types of applications. The high totals indicate that often more than one application was used in a school. The following averages were reported for the three educational levels: primary education, 1.7; lower secondary, 1.8; upper secondary, 1.9.

Table 7.4 Computer-related technology (percentages relate to total number of software applications)

Computer-related technology	Primary Education	Lower Secondary Education	Upper Secondary Education
Programming languages	1	1	3
Word-processing	20	19	17
Information retrieval	24	21	18
Communication	11	13	11
Operating system	4	3	2
Simulation	0	1	6
Spreadsheets	4	4	5
Presentation	5	5	6
Database design	1	2	3
Microcomputer-based laboratories	0	2	2
Web design	4	6	7
Drill and practice software	8	9	3
Drawing and graphics	9	9	12
Other	8	5	6
N =	247	387	333

At *all three educational levels*, software programs relating to production activities (word-processing, presentation, web design, drawing, and graphics) accounted for one-third to nearly half of the total number of applications. Word-processing software was used the most and covered about one-sixth (upper secondary education) to one-fifth (lower secondary and primary education) of the total number of applications.

Software related to information-processing activities (information retrieval, simulation, spreadsheets, database design, microcomputer-based laboratories) accounted for one-quarter to one-third of the total number of applications. Information retrieval was the most frequently reported activity—from somewhat less than one-fifth in upper secondary education, to about one-fifth in lower secondary education to nearly a quarter in primary education. More specialized applications, such as simulations, were not reported very frequently, but they were applied more in upper secondary education than in the other levels.

Across the educational levels, communications software accounted for somewhat more than one-tenth of the applications. Due to the filter applied for selection of the examples, it was expected that programming languages, and software related to the operation system and to drill and practice, would receive little mention. However, while drill and practice applications received few mentions in upper secondary education, they accounted for nearly one-tenth of the applications mentioned in primary and lower secondary education. Applications related to programming or basic ICT skills (programming languages, operating system) were hardly mentioned.

CURRICULU DO AINS

Box 2

Norway, population 3—cross-curricular approaches organized in projects

Description: Various projects of student groups, connected with International Week, a foreign aid program engaging school students.

Computer-related technology: The Internet (web), for information gathering. Writing and presentation software, such as Word and PowerPoint.

Subject domains: Social studies, religion, history, mother tongue (Norwegian), computer science.

Student activities: Working individually or in groups. Arranging an 'open house' meeting in the school, with catering and presentation of the project report.

Changes for teachers: Change of time schedule, no formal teaching for two days. Teachers help the students with the projects, as needed.

Gain for students: Significant social effects: increased contact/interaction between classes/grade levels. A relief to work with the 'real world' instead of the usual 'textbook curriculum'.

Other: This kind of activity is now done every year at our school. We work with different topics each time.

Table 7.5 contains an overview of the curriculum domains in which the most satisfying learning activities with technology took place. Again, the high totals illustrate that frequently more than one domain was involved, which implies that cross-curricular approaches, although not always mentioned as such, were often represented in the examples. The average number of curriculum domains mentioned was 2.1 for *primary education*, 2.2 for *lower secondary*, and 1.9 for *upper secondary*. Box 2 above provides an example of a typical cross-curricular approach. This approach, like many other cross-curricular approaches, was organized in the form of student projects.

For *primary schools* the most satisfying experiences with computer-related technology that passed the selection filter occurred most frequently in mother tongue (more than one-quarter of the total number of all mentioned domains), followed by social studies and science (each about one-sixth). In *lower secondary education*, these three domains were also dominant (each about one-sixth). In *upper secondary education*, social studies and science occurred most (both about one-sixth), next to computer literacy or computer science courses (also about one-sixth). Apparently, computer literacy and computer science were offered as integrated activities to students at not only the upper secondary but also the lower secondary levels. Table 7.6 provides exemplary descriptions of learning activities using ICT in both cross-curricular and single subject settings.

Table 7.5 Curriculum domains (percentages relate to total number of recorded curriculum domains)

Curriculum domains	Primary Education	Lower Secondary Education	Upper Secondary Education
Mathematics	11	11	10
Science	15	17	16
Mother tongue	28	17	13
Foreign languages	4	11	12
Computer literacy/computer sciences	6	10	16
Social studies	16	18	17
Arts	11	8	6
Cross-curricular	4	3	3
Extra-curricular	2	2	2
Other	2	3	7
N =	299	477	328

Table 7.6 Examples of curriculum domains involved in most satisfying experiences with technology

Description—Primary education	***Curriculum domains involved***
Singapore A collaborative project with children in Hawaii where students researched animals indigenous to their countries and created a virtual zoo by accessing Internet for information and emailing as well as video-conferencing. Students also created a web page on the virtual zoo.	*Cross-curricular* Science, English, social studies, art.
Taiwan Laboratory experiment contests were held in natural science classes, in which students tried to complete lab reports and searched for relevant information on the networks using Internet, web browsers, Excel.	*Single subject* Natural science.

contd. on page 214

Description—Lower secondary education	***Curriculum domains***
Japan Using, for reference, haiku (Japanese-style short poem) in English as found on the Internet, students translated their own haiku into English, then used software to create appropriate illustrations. The completed works were then printed out on 'shikishi' (decorated art).	*Cross-curricular* Japanese (kokugo), English, technology, and home economics.
China Hong Kong Collaborative writing in English with word-processing and using Internet browser.	*Single subject* Reading comprehension, vocabulary use, and scenery descriptions.

Description—Upper secondary education	***Curriculum domains***
France As part of a local project called 'reading the town' in partnership with students from primary schools, students are conceiving and producing a CD-ROM called 'From the downstream to the thread of the spindle' (*De fil de l'eau au fil du fuseau*). This describes, through the use of multimedia equipment, CD-ROM-maker and documentary research software, the development of the textile industry during the 19th century in the regions of Yvetot and Bolbec (the school is located in Bolbec).	*Cross-curricular* French, history, geography, English language, applied arts, maintenance.
Belgium-French This activity was named 'Parleunet'. The goal was to propose to the European Parliament solutions for under-employment for young people. Four groups out of three classes (one Belgian, one Dutch, and one Swedish) were created and exchanged their points of view in English by emails, video-conferences and the Web.	*Single subject* English.

I PACT OF ICT-BASED LEARNING ACTI ITIES ON STUDENTS

Box 3

New Zealand, population 1– using ICT for disadvantaged students

Description: Use of an interactive fiction program as the basis for English language development with non-English speaking background (NESB) children.

Computer-related technology: Computers, printers.

Subject-matter domains: Oral/written/visual English, mathematics, science, social studies, technology, health.

Student activities: Group co-operation, diary writing, creative writing, drama, report preparation and presentation, research from library books, CD-ROMs.

Changes for teachers: Having to develop the various curriculum areas in a different way.

Gain for students: Improved discussion and oral presentation skills; improved written English outputs, particularly as regards volume of writing; high-quality learning outcomes across the curriculum.

Other: Use of interactive fiction bases has fallen off with the introduction of more sophisticated ICT technology. This seems to be a regrettable development for NESB pupils.

Table 7.7 shows how often school principals reported the selected examples of the different gains for students as a result of ICT-related learning in their schools. The principals frequently mentioned more than one type of gain. An average of 1.7 activities was reported in *primary* and *upper secondary education*, and an average of 1.6 in *lower secondary*. Box 3 above contains an example that reported gains for a group of students from non-English speaking backgrounds. It must be noted that not many examples referred to such specific groups of students.

Table 7.7 Gains for students (percentages relate to total number of reported gains)

Gains for students	Primary Education	Lower Secondary Education	Upper Secondary Education
Increases motivation, interest, concentration	23	17	16
Increases active participation/creativity	7	6	9
Improves knowledge/skills	41	44	40
Increases responsibility/self-esteem	15	17	15
Increases collaboration	9	7	9
NEGATIVE impact	0	0	0
Other	5	8	11
N =	241	342	296

At *all three educational levels*, improved knowledge and skills (often related to improved ICT knowledge and skills) was the most reported gain (between one-third and half of the mentions). Gains in motivation and interest accounted for nearly one-quarter of the reported gains in *primary education* and about one-sixth in *secondary education*. Gains in responsibility and independence accounted at all three levels for about one-sixth of the total number of reported gains. Learning how to work collaboratively as well as active and creative participation of students were not reported that often. Given the wording of the question (that is, in terms of most satisfying experiences), expressions of negative impact were not expected and, indeed, not observed in the examples. Table 7.8 provides exemplary illustrations of the combinations of gains that school principals mentioned.

Table 7.8 Examples of gains for students involved in most satisfying experiences with technology

Description—Primary education	***Gains for students***
Norway Sending/receiving email from schools in other countries (the Comenius project) with email and Internet.	*Increased motivation, increased skills/knowledge, increased collaboration* Learn to cooperate with teachers on project work. They feel that both they and the teachers are learning new things with ICT, and this makes school more fun.
Israel Writing texts according to 10 comic drawings. Producing a book and designing a special cover for the book with a word-processor and a scanner.	*Increased skills/knowledge, increased responsibility/self-esteem/independence* They learned how to develop a product from the stage of the idea till the advertising part. They are aware of the learning process. They reflected on the process.

Description—Lower secondary education	***Gains for students***
France Very low-achieving students created four pages of regional news on the occasion of the national event, called 'Sciences in Feast'. Over one year these students wrote texts in a 'cybergazette' using word-processing, desktop publishing, and creating an e-web site.	*Increased motivation, increased skills/knowledge, increased responsibility/self-esteem/independence* Valorization of themselves—pride, gratitude; mastering some computer-related tools; heightened awareness of reading the press.
Hungary Improving cognitive skills, working in small groups using computers and students' journal with specific software (MF Studium Budapest)	*Increased skills/knowledge, increased responsibility/self-esteem/independence* They learn how to learn. They can gain more information; the chance to complete entrance exams successfully increased.

contd. on page 217

Description—Upper secondary education	*Gains for students*
Iceland Cooperation between the school and several rural communities about information on the WWW in tourism, etc., using email and construction of web pages.	*Increased motivation* They find schoolwork more interesting and diverse than usual.
Slovak Republic Teleproject—the image with school in Finland—working on a school research project using Internet.	*Increased skills/knowledge, increased responsibility/self-esteem/independence* Autonomy, responsibility, increasing skills with Internet tools, improving knowledge of foreign language.

C ANGES FOR TEAC ERS

Box 4

Italy, population 2—changing teaching/learning practices

Description: Monitoring of Piave River in order to control water pollution and the growth of riverside plants.

Computer-related technology: P.C. Pentium 200 MMX, peripherals and special instruments; Windows 95; Internet access.

Subject domain: Science, mathematics, geography, Italian language, art education.

Student activities: Water, plant, animal samples collecting: observation, classification, and chemical analysis. Data collecting, filing, processing, and data comparing via email with peer groups from other network schools.

Changes for teachers: Teachers improved their own skills in using ICT; more effectiveness using ICT in team working and in teaching/learning practice planning.

Gain for students: Environmental awareness; development of abilities with independent science learning and laboratory practice; using ICT in work planning.

Other: The activity made a positive improvement to the school's social school context. Will be used in the forthcoming years.

Table 7.9 presents an overview of the types of changes that school principals reported for teachers as a result of satisfying ICT usage in their schools. Often more than one activity was mentioned. At *all three levels*, 1.2 activities were mentioned per description. Box 4 above presents a typical illustration of the changes that teachers experienced.

According to the school principals, changes in teaching/learning practices occurred for somewhat more than one-third of the total number of changes reported in *primary education* and accounted for about half the changes mentioned in *secondary education*. An increase

Table 7.9 Changes for teachers (percentages relate to total number of changes reported)

Changes for teachers	Primary Education	Lower Secondary Education	Upper Secondary Education
Changes in the teaching learning practice	35	50	50
Increases ICT skills/knowledge	27	22	24
Increases collaboration	10	12	9
Other	28	16	17
N =	176	256	214

in ICT skills and knowledge of teachers accounted for about one-quarter of the changes. An increase in collaboration between teachers, teachers and students, or with persons outside the school was mentioned in only about one-tenth of the changes mentioned. The category 'other' was fairly large, particularly in primary education, and needs to be explored further. Some examples of the changes that principals reported are presented in Table 7.10.

Table 7.10 Examples of changes for teachers involved in satisfying experiences with technology

Description—Primary education	***Changes for teachers***
Israel Making presentations about HANUKKAH (A Jewish holiday) while learning the subject.	*Change in teaching/learning practice, increase in collaboration* The teacher became a mentor, coach. He/she is no longer the only resource of the knowledge. Three teachers worked together sharing responsibilities.
Japan In our learning about the automobile industry and discussing the idea of cars, which are both user- and environment-friendly, the computer was used as a tool for gathering information about automobile manufacturers. Videos, computers, and other pamphlet materials were used. Computers were used to download images from the Internet, and two laptop computers were available for use in the classroom.	*Change in teaching/learning practice* I was impressed with how effectively the Internet can be used to obtain up-to-date information, for use in social studies classes. The children were able to obtain information directly related to their own interest, and this information was helpful in helping me change from a passive to an active posture with regard to children's activities.
China Hong Kong Addition with numbers below 10 with simple and interesting software; students can choose an answer, and the computer can make sounds to encourage students.	*Increase in ICT skills* Teachers used computers and IT more in teaching, and were not 'afraid' of computers any more.

contd. on page 219

Description—Lower secondary education	***Changes for teachers***
Thailand Students practice computer skills during lunch break using spreadsheets, word-processors and DOS.	*Change in teaching/learning practice* They have to prepare their lesson plans thoroughly for computer literacy classes. They have to be more careful to integrate computers in other subject areas. Teachers are more satisfied with their teaching since they found their students enjoy learning.
Taiwan Students learned to use bulletin board system (BBS) to post announcements, write letters, and chat with each other, create graphics on computers, and input Chinese and English characters with the keyboards and do word-processing with computer network protocols.	*Increase in ICT knowledge/skills* Teachers felt more competent in teaching computer-related skills. The experiences also gave teachers incentive to learn more about the use of computers.
Slovenia Exercise and practice of taught topics in all subjects, learning new topics—specific didactic software and Internet.	*Change in teaching/learning practice, increase in collaboration* Additional education, strategies of active teaching, team work, more precise work planning.

Description—Upper secondary education	***Changes for teachers***
Bulgaria Training in a simulated firm (so-called study training firm) with specific software for administration and management purposes, office automation software and devices, general purpose and task-specific network-based software solutions.	*Change in teaching/learning practice* From being purely theoretical, the teachers' work is now organized in a much more practice-aimed context. ICT gives the chance for using up-to-date media and visuals in the instructional process. The classroom process is organized in a close-to-the reality context.
Luxembourg Production of an Internet site for an external client, done by Grade 12 in the 'computer science technician' branch using Internet.	*Increase in collaboration* Cooperation and coordination with the client; opening the school to the outer world.
Latvia Use of ICT in physics experiment using sound, light, and temperature sensors and special software COACH.	*ICT skills* Students participated in a real up-to-date experiment and saw an application of ICT.

OT ER RE AR S

The category 'other comments' resulted in a broad range of additional information. Table 7.11 presents a first categorization of the comments that were made by the principals. Comments were included for about three-quarters of the descriptions, and most of these (about half to two-thirds) were of a positive, general nature. There were very few negative comments. Nevertheless, quite a number of concerns were reported, but it is beyond the scope of the present study to analyze them in detail.

Table 7.11 Comments (percentages relate to the total number of comments)

Comments	Primary Education	Lower Secondary Education	Upper Secondary Education
Part of a larger project	3	11	8
Related to inservice tr./staff dev.	0	1	2
Related to ICT use in school management	0	0	0
Description of concerns	27	22	30
Other comments positive	68	65	58
Other comments negative	3	2	2
N =	111	172	129

TOWARD CASE STUDIES OF INNO ATI E PEDAGOGICAL PRACTICES USING TEC NOLOG

The following picture emerges from the results presented in this chapter.[1] From a general perspective, a great deal of similarity was evident for all three levels of education, with social studies, science, and mother tongue forming the domains that elicited the most satisfying examples. However, the majority of experiences focused not on single subjects but on combinations of subjects. Students' activities focused on information-processing, production, or communication, in combination with word-processing, technology for searching out information, and technology for facilitating communication. From the description, one may infer that quite a number of these examples were aimed at offering active/productive learning activities to students, in which ICT played a substantial role. General-purpose application and communication software seemed to be used more than school subject-specific software. This finding is consistent with the findings presented in Chapter 3, which showed that general purpose software, such as word-processing, were more widely available than subject-specific software.

Examples of innovative use of ICT in education are often referred to as 'innovative', 'exemplary', 'good', or 'best' practices. These terms have connotations that differ among countries and audiences such as practitioners and professionals. Therefore, using these terms often causes a confusing communication about the kind of use or the kind of *technology* that the practice should contain. This was the main reason for introducing the term '*most satisfying experience*' in SITES Module-1. This wording takes into account the perceptions and local context of the SITES Module-1 respondents (that is, the school

1 When interpreting the results, it is important to keep in mind that the examples provided in the sections of this chapter were specifically selected to reflect the emerging paradigm.

principals) as the most important criterion for defining innovative use of ICT in education. The results of the analysis of the selected examples show that many respondents were able to provide examples of satisfying experiences with computer-related technology. It is striking that across countries a fairly large number of these satisfying experiences comply with what is indicated in SITES Module-1 as the emerging paradigm. Of course, this situation is due largely to the selection filter applied, which aimed at excluding examples that were perceived as traditional. Quite a number of school principals across countries reported on the contribution that ICT made to new curriculum approaches (such as cross-curricular approaches), different roles for teachers, and productive learning activities for students. All these experiences or practices are indicated in SITES Module-1 as the emerging paradigm.

The overall conclusion from this part of the Module-1 exercise is that it has resulted in a rich database of selected examples. Also, it needs to be kept in mind that for each country/ school level, only 10 examples were selected from the nationally administered questionnaires. With 25 countries represented in this phase of SITES, a very rich database therefore is available for further investigation. Although the construction of this database is labor-intensive (due to the translation process involved), once available it can contribute, because of its links with the survey data, to initiating relevant research projects. The data that are already available, along with the whole set of data, allow for interesting questions that could be investigated further. For example:

- To what extent is 'the most satisfying experience' affecting other teaching/learning practices in the school? How, when, and by whom did the experience start?
- To what extent was ICT important in realizing cross-curricular approaches? How do teachers perceive their role in a cross-curricular project? How did a cross-curricular project affect the curriculum and the school organization?
- How do teachers perceive their (new) role? To what extent does a new relationship with students and/or with the world outside school (community, local business) affect teaching/ learning practice? What exactly is the role of ICT in facilitating this new role?
- How are the various gains for students determined? To what extent are they based on systematic assessment strategies? Which strategies are used, and are they considered satisfactory?
- What concerns do school principals have for 'most satisfying experiences' and to what extent are these concerns a threat to the sustainability of the learning activity?

Moreover, such a database may help in identifying schools where follow-up studies would be particularly relevant. Also, the over-arching theme of SITES Module-1, namely the potential that ICT has to facilitate the creation of educational learning settings deemed important for meeting the challenges of the Information Society, could be addressed in more detail. Examples of research questions in this area are:

- To what extent do schools that submitted examples judged as highly innovative differ from other schools in terms of the indicators described in Chapters 3 to 6?
- Are schools that scored high on the indicators of emerging pedagogical paradigm, emerging objectives, and emerging opportunities also submitting practical examples that reflect these orientations?

Although it may be expected that a number of the above questions will be incorporated in SITES Module-2 and Module-3, it seems that there is also considerable potential for researchers who work (inter-)nationally to broaden the scope of their studies beyond that of the IEA context.

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Cha ter

SU AR AND REFLECTIONS

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This chapter summarizes the results of SITES Module-1 with respect to curriculum and pedagogy, ICT infrastructure, staff development, management and organization, and innovative pedagogical practices with ICT. The implications of these findings are discussed with reference to the policy actions being taken by the participating countries. Reflections are offered for the present and future policy issues posed by the challenges of rapidly evolving ICT.

INTRODUCTION

Our conceptual framework specified the following four systemic aspects as most essential to describing and comparing ICT-related activities in education. They are:

- *Curriculum and pedagogy:* Included here are ICT-related objectives and pedagogical practices employed in schools across various subjects, not just informatics. A most important question within this aspect is: to what extent have the goals and practices been re-directed to satisfy the needs of life-long learning and other requirements of information societies?
- *Infrastructure:* The information infrastructure consists not only of hardware and software but also of support services to maintain them. The latest and most pressing development in this aspect of the system is the emergence of networks, particularly the Internet.
- *Staff development:* Because ICT has been evolving at such a rapid pace, the challenge of developing ICT skills, both technical and pedagogical, of administrators and teachers looms large. Programs for professional development of these skills require funding, facilities, incentives, and setting of priorities.
- *Management and organization:* Leadership for successful ICT integration requires not only budgets but also policies and other actions to ensure that the ICT programs are guided and implemented with the understanding that comes from evaluating the interim results of these programs.

A chapter was devoted to each of these four aspects, and these also structure the following summary. While the curriculum has been the focal point of the study, all of these aspects of the system are essential to progress. However, before addressing these matters, we comment briefly on policy issues, showing how they relate to the different aspects of ICT support systems.

POLIC ISSUES

As an aid to identifying how the study contributes to policy questions, a typology of policy issues is summarized in Table 8.1. For each of the four major aspects of the educational system outlined above, this table gives illustrative policy questions for three types of decisions: planning, implementation, and assessment. While a policy question often pertains to multiple decisions across these three decision areas, it is especially useful to distinguish planning decisions from implementation decisions because the former are more often made at a national or regional level while the latter are made at a local or school level. Assessment questions follow from decisions that need to be made at both these levels.

A number of the policy-related questions given in Table 8.1 were at least partially answered in the SITES Module-1 study. The other questions in the table arise from the implications of the findings and thus are suggestive of directions for future research. Some of these questions will be explored in other modules of SITES.

A variety of indicators from different aspects of education make it possible to answer policy questions about many current trends in ICT and education. The findings pertaining to these trends are summarized in the next four sections corresponding to each of the major aspects of the educational ICT systems. Each section begins with a summary of the trends identified in Chapter 2 on the national policies. These accounts were prepared by the national research coordinators (NRCs), who summarized the policy goals and actions of their respective countries.

CURRICULU AND PEDAGOG

A unifying theme of this entire report has been the emergence of a new paradigm for learning and teaching. In many different educational systems, shifting goals and pedagogical practices have been observed, which we have called the 'emerging paradigm'. This paradigm is grounded in the growing need for information in the society at large and for life-long learning in particular. In this section we focus upon the instructional practices that are consistent with this paradigm—those that are called 'emerging practices' in Chapter 3.

As reported by the NRCs (Chapter 2), many national governments have formally acknowledged the importance of 'Information Society' goals for educational planning. For example, the Finnish government has sought 'to develop ICT in education as part of its policy of building a Finnish information society'. Even in Latvia, where less than 5% of the upper secondary schools had access to the Internet, the government had acknowledged 'the rapidly strengthening impact of ICT on society and the marked tendency for industrial societies to evolve into "information societies"'. Almost half of the NRCs participating in SITES used the rhetoric of life-long learning in their descriptions of national education goals. Hong Kong viewed technology as a catalyst for 'developing in students the attitudes and capabilities needed to achieve independent life-long learning'. Israel took a similar position, using life-long learning as a justification for educational reform in other areas. Specifically, Israel was endeavoring to encourage independent, investigative learning, cooperation among students as well as teachers, and active participation of the learner.

Table 8.1 ICT-related policy issues

	Decision areas		
	Planning	**Implementation**	**Decision data**
Curriculum and pedagogy, including vision, goals, and instruction	As the society becomes more information and ICT oriented, how should schools be made ready for this? What are the most promising innovative pedagogical practices using ICT, and how can they be encouraged? What should be the priority for teaching informatics versus teaching all subjects with the help of ICT?	What policies are needed to make sure that sufficient resources are provided to students and teachers? What changes in teaching practices are needed to maximize benefits from ICT?	How are teachers and students utilizing ICT? How can these practices be improved? Have the interventions improved learning? Are the digital divides widening? What reform programs related to ICT are in place and what evidence is there of impact? Were there unexpected consequences? Did they yield any evidence of improved student learning?
Infrastructure (technology, software, support)	What equipment and support now exists in the schools, and is this adequate to achieve the goals? What equipment renewal is needed? What is the desired replacement cycle for existing resources?	Is there sufficient high-quality human and software support for the users of the resources? Is the budget adequate for maintaining the desired infrastructure?	What is the pattern of ICT use? What obstacles hinder desired utilization? What are the perceived needs for resources?
Staff development	What professional development services are needed, now and in the near future? Should development coursework in ICT be mandatory?	What incentives are needed for participation in staff development? Do staff get adequate one-on-one help in both technical and instructional areas?	What are the ICT skills of the support staff and teachers? Are the development services adequate? What additional services are desired?
Management and organization	Do systems provide all information needed for management decisions at national and local levels? What policies and other actions are needed for ensuring ethical behavior? What network and Web services can improve the home-school connection?	What information should parents and students be able to access from home via the Web? What actions should be taken in response to unethical activity using ICT?	What information is being utilized by various staff and parents? What additional information is desired and how can it be delivered?

A major challenge in SITES Module-1 was the construction of indicators of emerging pedagogical practices. A large number of questionnaire items were constructed or adapted from existing ICT national assessment/monitoring programs (for example, the Dutch ICT monitor, ten Brummelhuis, 1999). From these items our indicators of emerging pedagogical practices emphasized individual students taking responsibility for their own learning, including self-pacing and searching for information. Cooperative learning and project-based learning were included in the composite scores used to measure the degree of support for emerging practices. As shown in Chapter 3, considerable variation existed on indicators of the presence of emerging pedagogical practices both within and between countries.

The most important finding was that emerging pedagogical practices were playing a significant role in a majority of the participating countries. The school principals indicated considerable presence of emerging practices for all the countries except China Hong Kong and Japan. (China Hong Kong and Japan may have been low on emerging practices due to the emphasis of our indicator on student independence, which may have been perceived as contrary to their cultural emphasis of the classroom as a group.) The principals also tended to agree that ICT was helping to implement emerging practices, that is, to make them realized.

Another noteworthy finding was the large percentage of schools indicating that students in their schools used email and the World Wide Web. In about half of the countries, at least half of the secondary school principals reported such use of ICT by students. This demonstrates not only that a very large number of schools had access to the Internet, but that the students actually were using it as part of their instruction.

Principals in our survey were asked to write a brief description of the 'most satisfying' learning activity in which their students used computers. As detailed in the previous chapter, these instructional activities were screened so that they did not include instruction in computer programming, ICT basic skills, or drill and practice applications. The principals' descriptions of each of these learning activities were coded on the basis of the work of Voogt and Odenthal (1997). The analysis demonstrated considerable variety in terms of the curricular areas, the types of learning activities, and the roles of the teachers. This diversity is noteworthy, but the most important finding is the persistent prevalence of emerging practices across most of the countries. Many school principals not only saw these emerging pedagogical practices as commonplace but also found many of them as 'most satisfying'.

The main policy implications of these findings relate to the planning column of Table 8.1, specifically the question on how to deal with an increasingly information-oriented environment. The typical response by the countries in the study was to utilize ICT in pedagogical activities that follow the emerging practices paradigm. By emphasizing such practices as self-responsibility for learning and project-based learning, schools are preparing students to become life-long learners.

While we found evidence of emerging support for new technology-supported pedagogical practices, the reality is that these new practices have not permeated the curriculum. The students may be learning word-processing and spreadsheets in their informatics or business education classes, but they are not necessarily using educational software in their other classes. In most countries a few teachers were attempting to integrate technology tools into their teaching of various subjects. Only in rare instances was this pedagogical practice widespread. Educational leaders therefore need to examine why ICT typically plays such a narrow role in the curriculum.

INFRASTRUCTURE

As reported in Chapter 2, nearly all of the nations participating in IEA SITES Module-1 had national initiatives to provide all K–12 schools with ICT. For example, Taipei's Ministry of Education had promised that 'each school will be equipped with adequate hardware and software'. Similarly, Bulgaria had established legislative policies 'aimed at equipping schools with adequate ICT resources'. Some other countries, such as Iceland and Singapore, had been much more concrete in establishing an information infrastructure, with an Internet connection in every school and a relatively high density of computers in relation to students. More than half of the participating nations had developed national Intranets for educational purposes. For example, the Norwegian School Net was offering 'a centrally maintained and controlled web site' that provides educators with a wide range of services and information about education. In Singapore a school-wide network was facilitating the 'high-speed delivery of multimedia services on an island-wide basis'.

By utilizing data from the 1995 TIMSS study, we were able to determine that the infrastructure, as measured by computer density, has been doubling every three to five years in most participating countries. The typical country cut their student-computer ratios by slightly more than a half between 1995 and 1998. Several countries reduced their ratios even more rapidly, with national programs to expand their educational ICT infrastructure. There are many good reasons to anticipate that this rapid growth in school ICT will continue for the next five years or more.

The percentage of school computers that are multimedia-ready is an increasingly used indicator of whether or not the installed base of ICT is adequate for contemporary applications. In most of our participating countries, the average percentage of multimedia-ready computers in primary schools was between 50 and 75, whereas at the secondary level it was between 25 and 50. This primary school advantage probably resulted from the fact that most countries first introduced computers into the secondary grades. In recent years many countries have initiated new programs for the primary grades, providing them with all-new, multimedia-ready computers. SITES Module-1 revealed that a large proportion of the computers in most countries were still not equipped for multimedia applications. Two major exceptions were China Hong Kong and Singapore, where almost all of the instructional computers were using multimedia. One implication of these findings is that improved policies on ICT renewal or replacement are needed in most educational systems. For example, the computers should be upgraded or replaced every two to four years.

The Internet is the most dramatic new aspect of school information infrastructure. According to the reports of the NRCs, more than one-third of the countries participating in SITES had a national initiative to give schools or their students access to the Internet.

For example, Bulgaria had established a six-year program to connect all schools to the Internet. Similarly, China Hong Kong had a five-year strategy to ensure that all schools would be connected to the Internet by the year 2000. The Module-1 survey found that most of the countries already had connected over 50% of their schools. However, while 100% of the schools in Iceland and Singapore had access, some countries had connected less than one-fourth of their schools.

What is most remarkable about these 1998 findings is that almost all of the Internet connections were installed within less than five years, arguably one of the most rapid major institutional changes in education. Furthermore, the Internet connections appeared to be growing just as quickly in countries that do not speak English as their primary language as in those countries that do. Given that English is still the dominant language of the Internet (although an increasing number of countries have national educational portals in their own language), this pattern of adoption implies an unusually compelling force for educational change.

STAFF DE ELOP ENT

By building infrastructure in schools, the hope is that students will be able to use ICT and benefit from it. However, even with a costly infrastructure, an effective environment for learning with the aid of ICT may not be realized due to inadequate staff support, which is likely to be a consequence of insufficient staff development.

Almost all of the countries participating in SITES Module-1 had one or more national initiatives for promoting the development of ICT skills for existing teachers. In addition, a large number had ICT requirements for new teachers, and others were in the process of developing requirements. For instance, Denmark was developing 'general and subject-specific ICT qualifications' for its teachers. Also, since 2000, Japan has required all its pre-service teachers to take at least two general ICT courses and one specifically devoted to 'method and technology of education'. Singapore already has required all of its pre-service teachers to 'undergo compulsory courses to equip them with core skills in teaching with ICT'.

As reported in Chapter 5, the Module-1 survey of principals found nearly all of them agreeing that their goal was to provide all their teachers with opportunity to develop their abilities to use ICT. However only about one-fifth of them agreed that they had actually realized this goal. This surprisingly large gap between desire and implementation (realization) identifies a major weakness in the ICT-related strategies of most educational systems.

Most countries were found to be providing very little teacher preparation in ICT relative to what would be needed for them to accomplish the goals of integrating ICT into their daily instruction. It would seem that many policy decision-makers do not realize that for their investments on infrastructure to be effective, comparable investments are needed for development of teacher skills in the technical and pedagogical aspects of ICT.

As noted, some countries had mandatory ICT course requirements for teachers. The survey found another surprising pattern across many countries, namely that many teachers were actually taking basic ICT courses even when they were not mandatory. However, this pattern did not hold up for continuing staff development. Thus, it seems that teachers are willing to attend some introductory ICT courses, but are not so eager to continuously refresh their ICT knowledge and skills.

Another important finding was that not only were teachers experiencing problems related to receiving adequate opportunities for ICT skills-related professional development, but school technology specialists or coordinators were having similar difficulty. The school technology experts tended to feel that although their technical preparation was adequate, their preparation in instructional applications was not. In almost all countries relatively few technology coordinators (or specialists) said they were prepared for applications needed to integrate ICT into instruction.

ANAGE ENT AND ORGANI ATION

Management and organization is a policy matter generally left up to local school leadership. However some ministries of education establish curricula for their schools and also develop instructional materials. Systems undergoing a process of decentralization may have additional problems. For example, as reported in Chapter 2, the Lithuanian government had given schools local control over curricula, but the schools still expected curriculum and other resources from their ministry.

The main themes of management and organization in this study were vision of the leadership, the establishment of ICT-related policies, and the extent to which ICT was being used in management functions in the schools. Principals were asked if their 'school had developed a common vision on the use of computers'. Almost all of them indicated that their school had a goal for such a vision, but quite a few said that this goal was not being realized at all.

The principals in general tended to have favorable attitudes toward ICT, but this was often not translated into managerial action. The principals were asked if their school had explicit policies on a variety of different ICT-related matters, and in some countries only a very small percentage had such policies. In regard to the question of whether the school had taken measures to prevent unauthorized access to computer systems, less than one-third of the schools in some countries had done so. In most countries, a substantial number of schools had not done this. The same pattern was true for taking measures to prohibit access to adults only material. There are specific steps that can be taken, both technical and ethical, to minimize problems in these two areas. In schools that are utilizing ICT extensively in many subjects, such steps are generally necessary to reduce the likelihood of serious problems developing. These findings signal that managing the Internet is an emerging demand for schools. This management requirement is not so much a matter of resources or equipment but of social and political concerns. It is very easy for students and teachers to use the Internet inappropriately, so policies have to be established to define acceptable boundaries and the consequences for crossing such boundaries.

For an indicator of the extent to which schools were using management information systems, principals were asked if they used computers for staff administration, finances, scheduling, library management, and communicating with parents. At the secondary level the principals typically reported engaging in four out of five of these types of computerized information system functions. This implies that schools may find it easier to implement managerial applications than instructional ones. Further research is needed to investigate whether or not implementation success in the management areas identified could be extended easily into additional management and instructional applications.

SITES AND FUTURE RESEARC ODULES

As noted in the first chapter, this study is Module-1 of a three-module IEA study called the Second International Technology in Education Study (SITES). Even before the first module was completed, Module-2 and Module-3 planning was underway. Nearly 30 countries are now engaged in Module 2, conducting several in-depth case studies of pedagogical practices using ICT that they consider innovative. The methodology and the conceptualization of Module-2 have been greatly enhanced by findings from Module-1, particularly those findings from the analysis of ICT activities that the principals considered 'most satisfying'.

One preliminary finding of note from Module-2 is that the students involved in these innovative pedagogical practices often engage in activities that could be considered 'knowledge management', in that they frequently construct knowledge products. Such activities typically were called projects and included the tasks of searching, organizing, and evaluating knowledge. For instance, Germany's first case study found that students 'turned into providers of knowledge'. Portugal's pilot case reported that the teachers wanted their students to be 'constructors rather than receptors of mathematical knowledge'. In Norway and the United States the case studies found students working collaboratively with ICT tools to complete projects yielding diverse types of knowledge.

Module-3 will build upon these Module-1 and Module-2 findings by utilizing such emerging practices to define the central issues for a school survey, a teacher survey, and a student assessment. More specifically, the study will measure the ICT-supported knowledge management competencies of students, including their abilities to retrieve, organize, critically evaluate, communicate, and produce knowledge. In addition, the study will determine the readiness of schools and teachers to provide a learning environment where students can develop these abilities. Module-3 will follow up SITES Module-1 by having a school survey administered to principals and ICT-coordinators to measure trends of technology availability and use in schools. Data collection for Module-3 is planned for the year 2004.

The findings from SITES ultimately will offer comparisons of student, teacher, and school readiness to manage ICT-based knowledge. They will make it possible to investigate the nature of the relationship of these student ICT competencies to student ICT experiences (both school and home) and to the instructional and structural contexts of their schools. Having such data will improve the ability of policy-makers to determine whether or not adjustments need to be made to effectively prepare students for the Information/Knowledge Society.

I PLICATIONS FOR T E FUTURE

Information technology is changing at a very fast pace, and all evidence suggests that it will continue to do so. The research reported in this study confirms that schools around the world are adapting to the evolving technology. In fact, what we have documented here is the particularly remarkable role that ICT is playing in the evolving or emerging instructional practices that increasingly are being used in schools.

The breadth and depth of these ICT-supported emerging practices suggest that these trends will persist, if not accelerate and expand, in the coming decade. For ICT to play a supportive, beneficial role in improving education in the future, the most critical factor is whether or not educational leadership, at all levels, continues to address the policy issues as they emerge, including the need to develop the capacity for schools to be ICT-supportive learning organizations.

The future depends upon whether key future-oriented policy issues are given ongoing attention. For instance, are ICT replacement policies being frequently modified to adjust for technological changes? Are policies being established and refined whenever new Internet opportunities are created for students to find and use harmful materials? Is the content of staff development current with the technical and instructional opportunities available for teachers? Are periodic assessments in place to illuminate instances (digital divides) where students are not getting equal opportunities for participation in ICT-supported functions? The results of this study point to such issue areas as those that need to be monitored, analyzed, and addressed by school policies. Overall, the results of this study raise many difficult but important questions about the effects of various modes of utilizing ICT in the learning process. Future research can help build upon this foundation to improve the ways in which information and communication technologies improve education.

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SITES Module-1 was a cooperative effort of researchers who all are acknowledged for their active contribution to the design and execution of the study. Below is a list of persons who were involved in the study at the international and national levels.

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APPENDI B SA PLING INFOR ATION

This appendix contains information about the sampling designs that were used in the participating countries. It shows the stratification that was used, the percentage of ICT-using schools, the population size in terms of number of schools and number of students, the type of selection procedure, the basis for identifying the population size and the frame from which the sample was drawn.

	Population	Stratum-id	Stratum name	Percentage ICT use	Number of students	Number of schools	Invited number of	Selection procedure	Basis for population size	Sample based on
Belgium-French	2	101	State-Brussels	63	14013	27	27	2	1	1
Belgium-French	2	102	State-Brabant	100	5203	7	7	2	1	1
Belgium-French	2	103	State-Namur	69	8251	17	17	2	1	1
Belgium-French	2	104	State-Liège	63	23334	34	34	2	1	1
Belgium-French	2	105	State-Luxembourg	90	7758	17	17	2	1	1
Belgium-French	2	106	State-Hainaut	73	23470	41	41	2	1	1
Belgium-French	2	201	Catholic-Brussels	65	34279	51	51	2	1	1
Belgium-French	2	202	Catholic-Brabant	48	15538	17	17	2	1	1
Belgium-French	2	203	Catholic-Namur	85	29750	36	36	2	1	1
Belgium-French	2	204	Catholic-Liège	84	40300	54	54	2	1	1
Belgium-French	2	205	Catholic-Luxembourg	91	13011	21	21	2	1	1
Belgium-French	2	206	Catholic-Hainaut	75	49853	64	64	2	1	1
Belgium-French	2	301	Province/Commune-Brussels	72	17685	28	28	2	1	1
Belgium-French	2	302	Province/Commune-Brabant	37	1500	2	2	2	1	1
Belgium-French	2	303	Province/Commune-Namur	50	2125	4	4	2	1	1
Belgium-French	2	304	Province/Commune-Liege	76	11150	21	21	2	1	1
Belgium-French	2	305	Province/Commune-Luxembourg	100	718	1	1	2	1	1
Belgium-French	2	306	Province/Commune-Hainaut	57	22364	28	28	2	1	1
Belgium-French	3	101	State-Brussels	70	13408	26	26	2	1	1
Belgium-French	3	102	State-Brabant	62	5203	7	7	2	1	1
Belgium-French	3	103	State-Namur	66	8814	19	19	2	1	1
Belgium-French	3	104	State-Liège	86	23334	34	34	2	1	1
Belgium-French	3	105	State-Luxembourg	57	7193	15	15	2	1	1
Belgium-French	3	106	State-Hainaut	68	22284	37	37	2	1	1
Belgium-French	3	201	Catholic-Brussels	85	34434	52	52	2	1	1
Belgium-French	3	202	Catholic-Brabant	74	15538	17	17	2	1	1
Belgium-French	3	203	Catholic-Namur	67	30252	36	36	2	1	1
Belgium-French	3	204	Catholic-Liège	61	41132	55	55	2	1	1

	Population	Stratum-id	Stratum name	Percentage ICT use	Number of students	Number of schools	Invited number of	Selection procedure	Basis for population size	Sample based on
Belgium-French	3	205	Catholic-Luxembourg	74	11876	19	19	2	1	1
Belgium-French	3	206	Catholic-Hainaut	78	50859	64	64	2	1	1
Belgium-French	3	301	Province/Commune-Brussels	75	17685	28	28	2	1	1
Belgium-French	3	302	Province/Commune-Brabant	100	1500	2	2	2	1	1
Belgium-French	3	303	Province/Commune-Namur	74	2408	5	5	2	1	1
Belgium-French	3	304	Province/Commune-Liege	70	11150	21	21	2	1	1
Belgium-French	3	305	Province/Commune-Luxembourg	100	718	1	1	2	1	1
Belgium-French	3	306	Province/Commune-Hainaut	91	22364	28	28	2	1	1
Bulgaria	2	1	Gymnasia (after grade 9)	70	29284	103	60	1	1	2
Bulgaria	2	2	Primary schools (grade 8)	3	174165	1988	60	1	1	2
Bulgaria	2	3	Secondary schools (grade 8)	34	84154	471	130	1	1	2
Bulgaria	3	1	Gymnasia (grade 11)	95	42124	104	35	1	1	2
Bulgaria	3	2	Sec. compr. schools (grade 11)	95	71918	474	85	1	1	2
Bulgaria	3	3	Secondary technical schools	95	42767	94	40	1	1	2
Bulgaria	3	4	Secondary technical schools	50	45538	200	60	1	1	2
Bulgaria	3	5	Secondary vocational schools	25	67135	184	30	1	1	2
Canada	1	999	Whole country	99	386201	10678	2267	4	1	1
Canada	2	999	Whole country	100	400763	4094	1534	4	1	1
Canada	3	999	Whole country	100	470493	3080	1258	4	1	1
Canada-Ontario	1	999	Ontario	100	137755	3571	450	3	1	1
Canada-Ontario	2	999	Ontario	100	151102	748	289	3	1	1
Canada-Ontario	3	999	Ontario	100	226824	765	288	3	1	1
Chinese Taipei	1	999	Whole country	50	1934756	2519	*240*	3	1	2
Chinese Taipei	2	999	Whole country	100	1120716	717	*244*	3	1	1
Chinese Taipei	3	1	Public senior high schools	100	189214	108	*70*	3	1	1
Chinese Taipei	3	2	Private senior high schools	100	78852	109	*60*	3	1	1
Chinese Taipei	3	3	Public vocational high schools	100	187115	98	*66*	3	1	1
Chinese Taipei	3	4	Private vocational high schools	100	333638	106	*60*	3	1	1

	Population	Stratum-id	Stratum name	Percentage ICT use	Number of students	Number of schools	Invited number of	Selection procedure	Basis for population size	Sample based on
Cyprus	1	11	NICOSIA Urban	23	1887	10	10	2	2	2
Cyprus	1	12	NICOSIA Rural	8	289	2	2	2	2	2
Cyprus	1	21	LIMASSOL Urban	18	1247	6	6	2	2	2
Cyprus	1	22	LIMASOL Rural	5	84	2	2	2	2	2
Cyprus	1	31	LANARKA Urban	5	155	1	1	2	2	2
Cyprus	1	32	LANARKA Rural	17	694	5	5	2	2	2
Cyprus	1	41	PAPHOS Urban	21	435	3	3	2	2	2
Cyprus	1	42	PAPHOS Rural	0	0	0	0	2	2	2
Cyprus	2	11	NICOSIA Urban	67	3475	11	11	2	2	2
Cyprus	2	12	NICOSIA Rural	86	1491	5	5	2	2	2
Cyprus	2	21	LIMASSOL Urban	76	3614	9	9	2	2	2
Cyprus	2	22	LIMASOL Rural	76	1491	1	1	2	2	2
Cyprus	2	31	LANARKA Urban	96	2470	7	7	2	2	2
Cyprus	2	32	LANARKA Rural	57	1954	3	3	2	2	2
Cyprus	2	41	PAPHOS Urban	100	1348	4	4	2	2	2
Cyprus	2	42	PAPHOS Rural	69	299	2	2	2	2	2
Cyprus	3	11	NICOSIA Urban	100	2576	9	9	2	2	2
Cyprus	3	12	NICOSIA Rural	100	103	2	2	2	2	2
Cyprus	3	21	LIMASSOL Urban	100	1858	8	8	2	2	2
Cyprus	3	22	LIMASOL Rural	100	53	2	2	2	2	2
Cyprus	3	31	LANARKA Urban	100	94	3	3	2	2	2
Cyprus	3	32	LANARKA Rural	100	393	3	3	2	2	2
Cyprus	3	41	PAPHOS Urban	100	371	3	3	2	2	2
Cyprus	3	42	PAPHOS Rural	100	100	3	3	2	2	2
Czech Republic	2	1	Basics schools (with grades 1-9)	85	112261	2422	300	1	1	1
Czech Republic	2	2	Gymnasia (with grades 6(8)-13)	100	12322	265	30	1	1	1
Czech Republic	3	1	Gymnasia	100	23103	325	40	1	1	1
Czech Republic	3	2	Technical schools	100	48192	672	90	1	1	1

	Population	Stratum-id	Stratum name	Percentage ICT use	Number of students	Number of schools	Invited number of	Selection procedure	Basis for population size	Sample based on
Czech Republic	3	3	Vocational schools	95	45049	479	100	1	1	1
Czech Republic	3	4	Combined schools (tech. + voc.)	95	28382	193	50	1	1	1
Czech Republic	3	5	Special secondary schools	40	4388	149	30	1	1	1
Denmark	2	999	Whole country	100	132900	1507	250	1	1	1
Finland	1	1	Capital Region	100	85246	392	52	1	1	1
Finland	1	2	Southern Finland	100	122180	1037	75	1	1	1
Finland	1	3	Eastern Finland	100	53976	658	33	1	1	1
Finland	1	4	Mid-Finland	100	47892	549	30	1	1	1
Finland	1	5	Northern Finland	100	49354	543	30	1	1	1
Finland	2	1	Capital Region	100	40253	116	48	1	1	1
Finland	2	2	Southern Finland	100	65041	207	78	1	1	1
Finland	2	3	Eastern Finland	100	28671	101	34	1	1	1
Finland	2	4	Mid-Finland	100	25248	89	30	1	1	1
Finland	2	5	Northern Finland	100	25482	95	30	1	1	1
France	1	1	Communes rurales, basic schools	73	1085401	15909	288	1	1	1
France	1	2	Communes urbaines <100.000,bs	88	1366025	8691	156	1	1	1
France	1	3	Communes urbaines >100.000,bs	83	1159643	5909	108	1	1	1
France	1	4	Agglom. Parisienne, basic schools	80	654635	2637	48	1	1	1
France	2	1	Communes rurales, colleges	100	283859	1099	66	1	1	1
France	2	2	Communes urbaines <100.000,col	100	1459057	2914	176	1	1	1
France	2	3	Communes urbaines>100.000,col	100	961346	1732	104	1	1	1
France	2	4	Agglom. Parisienne, colleges	100	502504	896	54	1	1	1
France	3	999	Lycees	100	2477133	3702	400	1	1	1
Hong Kong	1	999	Whole country	100	~	310	310	2	1	1
Hong Kong	2	999	Whole country	100	~	428	428	2	1	1
Hong Kong	3	999	Whole country	100	~	428	428	2	1	1
Hungary	2	1	Capital	100	*18265*	431	48	1	1	1
Hungary	2	2	City	100	*24734*	583	65	1	1	1

	Population	Stratum-id	Stratum name	Percentage ICT use	Number of students	Number of schools	Invited number of	Selection procedure	Basis for population size	Sample based on
Hungary	2	3	Town	100	*31964*	754	84	1	1	1
Hungary	2	4	Village	100	*39194*	925	103	1	1	1
Iceland	1	999	Whole country	100	~	169	169	2	1	1
Iceland	2	999	Whole country	100	~	134	134	2	1	1
Iceland	3	999	Whole country	100	~	29	29	2	1	1
Israel	1	999	Whole country	85	100282	1590	200	1	1	1
Israel	2	999	Whole country	85	98005	994	200	1	1	1
Israel	3	999	Whole country	85	77812	643	200	1	1	1
Italy	1	20	Piemonte: Not Provincial Capital Town	65	21263	1350	14	1	1	1
Italy	1	21	Piemonte: Provincial Capital Town	65	8809	81	6	1	1	1
Italy	1	30	Liguria: Not Provincial Capital Town	65	4747	56	4	1	1	1
Italy	1	31	Liguria: Provincial Capital Town	65	4856	46	3	1	1	1
Italy	1	40	Lombardia: Not Provincial Capital Town	65	54822	479	38	1	1	1
Italy	1	41	Lombardia: Provincial Capital Town	65	13045	113	9	1	1	1
Italy	1	50	Trentino-Alto Adige: Not Provincial Capital Town	65	7333	86	5	1	1	1
Italy	1	51	Trentino-Alto Adige: Provincial Capital Town	65	1610	18	1	1	1	1
Italy	1	60	Veneto: Not Provincial Capital Town	65	14229	131	9	1	1	1
Italy	1	61	Veneto: Provincial Capital Town	65	3832	38	3	1	1	1
Italy	1	70	Friuli-Venezia Giulia: Not Provincial Capital Town	65	5543	68	4	1	1	1
Italy	1	71	Friuli-Venezia Giulia: Provincial Capital Town	65	2222	21	1	1	1	1
Italy	1	80	Emilia-Romagna: Not Provincial Capital Town	65	16142	171	11	1	1	1
Italy	1	81	Emilia-Romagna: Provincial Capital Town	65	8414	66	6	1	1	1
Italy	1	90	Toscana: Not Provincial Capital Town	65	15028	163	10	1	1	1
Italy	1	91	Toscana: Provincial Capital Town	65	8544	76	6	1	1	1
Italy	1	100	Umbria: Not Provincial Capital Town	65	4344	53	3	1	1	1
Italy	1	101	Umbria: Provincial Capital Town	65	1782	16	1	1	1	1
Italy	1	110	Marche: Not Provincial Capital Town	65	8909	96	7	1	1	1
Italy	1	111	Marche: Provincial Capital Town	65	2254	22	1	1	1	1

	Population	Stratum-id	Stratum name	Percentage ICT use	Number of students	Number of schools	Invited number of	Selection procedure	Basis for population size	Sample based on
Italy	1	120	Lazio: Not Provincial Capital Town	65	20506	177	14	1	1	1
Italy	1	121	Lazio: Provincial Capital Town	65	19902	156	14	1	1	1
Italy	1	130	Abruzzo: Not Provincial Capital Town	65	8682	92	6	1	1	1
Italy	1	131	Abruzzo: Provincial Capital Town	65	2964	27	2	1	1	1
Italy	1	140	Molise: Not Provincial Capital Town	65	1941	29	1	1	1	1
Italy	1	141	Molise: Provincial Capital Town	65	938	7	1	1	1	1
Italy	1	150	Campania: Not Provincial Capital Town	65	53884	415	38	1	1	1
Italy	1	151	Campania: Provincial Capital Town	65	14608	113	10	1	1	1
Italy	1	160	Puglia: Not Provincial Capital Town	65	38420	281	26	1	1	1
Italy	1	161	Pulgli: Provincial Capital Town	65	9129	67	6	1	1	1
Italy	1	170	Basilicata: Not Provincial Capital Town	65	5149	63	4	1	1	1
Italy	1	171	Basilicata: Provincial Capital Town	65	1418	12	1	1	1	1
Italy	1	180	Calabria: Not Provincial Capital Town	65	17725	190	12	1	1	1
Italy	1	181	Calabria: Provincial Capital Town	65	4932	42	3	1	1	1
Italy	1	190	Sicilia: Not Provincial Capital Town	65	38649	298	27	1	1	1
Italy	1	191	Sicilia: Provincial Capital Town	65	19284	136	13	1	1	1
Italy	1	200	Sardegna: Not Provincial Capital Town	65	12526	130	9	1	1	1
Italy	1	201	Sardegna: Provincial Capital Town	65	3415	32	2	1	1	1
Italy	2	20	Piemonte: Not Provincial Capital Town	79	14673	118	7	1	1	1
Italy	2	21	Piemonte: Provincial Capital Town	79	18923	110	9	1	1	1
Italy	2	30	Liguria: Not Provincial Capital Town	79	3168	27	2	1	1	1
Italy	2	31	Liguria: Provincial Capital Town	79	8837	63	4	1	1	1
Italy	2	40	Lombardia: Not Provincial Capital Town	79	36552	226	18	1	1	1
Italy	2	41	Lombardia: Provincial Capital Town	79	36089	180	16	1	1	1
Italy	2	50	Trentino-Alta Adige: Not Provincial Capital Town	79	4312	49	2	1	1	1
Italy	2	51	Trentino-Alta Adige: Provincial Capital Town	79	3097	27	1	1	1	1
Italy	2	60	Veneto: Not Provincial Capital Town	79	18530	149	11	1	1	1
Italy	2	61	Veneto: Provincial Capital Town	79	18006	117	6	1	1	1

	Population	Stratum-id	Stratum name	Percentage ICT use	Number of students	Number of schools	Invited number of	Selection procedure	Basis for population size	Sample based on
Italy	2	70	Friuli-Venezia Giulia: Not Provincial Capital Town	79	2253	32	1	1	1	1
Italy	2	71	Friuli-Venezia Giulia: Provincial Capital Town	79	6531	51	4	1	1	1
Italy	2	80	Emilia-Romagna: Not Provincial Capital Town	79	13144	109	7	1	1	1
Italy	2	81	Emilia-Romagna: Provincial Capital Town	79	15832	102	7	1	1	1
Italy	2	90	Toscana: Not Provincial Capital Town	79	12849	116	3	1	1	1
Italy	2	91	Toscana: Provincial Capital Town	79	17077	121	11	1	1	1
Italy	2	100	Umbria: Not Provincial Capital Town	79	4427	46	2	1	1	1
Italy	2	101	Umbria: Provincial Capital Town	79	3663	23	2	1	1	1
Italy	2	110	Marche: Not Provincial Capital Town	79	8603	73	5	1	1	1
Italy	2	111	Marche: Provincial Capital Town	79	5518	41	2	1	1	1
Italy	2	120	Lazio: Not Provincial Capital Town	79	20631	137	8	1	1	1
Italy	2	121	Lazio: Provincial Capital Town	79	35337	215	17	1	1	1
Italy	2	130	Abruzzo: Not Provincial Capital Town	79	7133	56	4	1	1	1
Italy	2	131	Abruzzo: Provincial Capital Town	79	7069	46	3	1	1	1
Italy	2	140	Molise: Not Provincial Capital Town	79	1191	16	1	1	1	1
Italy	2	141	Molise: Provincial Capital Town	79	2375	18	1	1	1	1
Italy	2	150	Campania: Not Provincial Capital Town	79	43893	225	23	1	1	1
Italy	2	151	Campania: Provincial Capital Town	79	30539	143	11	1	1	1
Italy	2	160	Puglia: Not Provincial Capital Town	79	28342	195	13	1	1	1
Italy	2	161	Puglia: Provincial Capital Town	79	18119	98	9	1	1	1
Italy	2	170	Basilicata: Not Provincial Capital Town	79	3526	38	2	1	1	1
Italy	2	171	Basilicata: Provincial Capital Town	79	4085	30	6	1	1	1
Italy	2	180	Calabria: Not Provincial Capital Town	79	13646	125	4	1	1	1
Italy	2	181	Calabria: Provincial Capital Town	79	11277	77	4	1	1	1
Italy	2	190	Sicilia: Not Provincial Capital Town	79	27812	211	13	1	1	1
Italy	2	191	Sicilia: Provincial Capital Town	79	29909	144	14	1	1	1
Italy	2	200	Sardegna: Not Provincial Capital Town	79	12387	91	5	1	1	1
Italy	2	201	Sardegna: Provincial Capital Town	79	11148	52	6	1	1	1

	Population	Stratum-id	Stratum name	Percentage ICT use	Number of students	Number of schools	Invited number of	Selection procedure	Basis for population size	Sample based on
Italy	3	20	Piemonte: Not Provincial Capital Town	89	11982	118	8	1	1	1
Italy	3	21	Piemonte: Provincial Capital Town	89	11286	110	7	1	1	1
Italy	3	30	Liguria: Not Provincial Capital Town	89	2537	27	3	1	1	1
Italy	3	31	Liguria: Provincial Capital Town	89	6847	63	2	1	1	1
Italy	3	40	Lombardia: Not Provincial Capital Town	89	28130	226	15	1	1	1
Italy	3	41	Lombardia: Provincial Capital Town	89	24686	180	16	1	1	1
Italy	3	50	Trentino-Alto Adige: Not Provincial Capital Town	89	3345	49	3	1	1	1
Italy	3	51	Trentino-Alta Adige: Provincial Capital Town	89	2256	27	0	1	1	1
Italy	3	60	Veneto: Not Provincial Capital Town	89	15545	149	9	1	1	1
Italy	3	61	Veneto: Provincial Capital Town	89	14911	117	8	1	1	1
Italy	3	70	Friuli-Venezia Giulia: Not Provincial Capital Town	89	2125	32	2	1	1	1
Italy	3	71	Friuli-Venezia Giulia: Provincial Capital Town	89	5314	51	3	1	1	1
Italy	3	80	Emilia-Romagna: Not Provincial Capital Town	89	11029	109	6	1	1	1
Italy	3	81	Emilia-Romagna: Provincial Capital Town	89	10952	102	8	1	1	1
Italy	3	90	Toscana: Not Provincial Capital Town	89	10592	116	5	1	1	1
Italy	3	91	Toscana: Provincial Capital Town	89	12130	121	9	1	1	1
Italy	3	100	Umbria: Not Provincial Capital Town	89	3675	46	1	1	1	1
Italy	3	101	Umbria: Provincial Capital Town	89	3017	23	3	1	1	1
Italy	3	110	Marche: Not Provincial Capital Town	89	7158	73	4	1	1	1
Italy	3	111	Marche: Provincial Capital Town	89	4367	41	3	1	1	1
Italy	3	120	Lazio: Not Provincial Capital Town	89	15165	137	8	1	1	1
Italy	3	121	Lazio: Provincial Capital Town	89	25335	215	15	1	1	1
Italy	3	130	Abruzzo: Not Provincial Capital Town	89	5730	56	3	1	1	1
Italy	3	131	Abruzzo: Provincial Capital Town	89	4969	46	3	1	1	1
Italy	3	140	Molise: Not Provincial Capital Town	89	1675	16	2	1	1	1
Italy	3	141	Molise: Provincial Capital Town	89	1346	18	1	1	1	1
Italy	3	150	Campania: Not Provincial Capital Town	89	31220	225	20	1	1	1
Italy	3	151	Campania: Provincial Capital Town	89	20934	143	9	1	1	1

	Population	Stratum-id	Stratum name	Percentage ICT use	Number of students	Number of schools	Invited number of	Selection procedure	Basis for population size	Sample based on
Italy	3	160	Puglia: Not Provincial Capital Town	89	23506	195	12	1	1	1
Italy	3	161	Puglia: Provincial Capital Town	89	11575	98	9	1	1	1
Italy	3	170	Basilicata: Not Provincial Capital Town	89	3183	38	1	1	1	1
Italy	3	171	Basilicata: Provincial Capital Town	89	2390	30	2	1	1	1
Italy	3	180	Calabria: Not Provincial Capital Town	89	11299	125	6	1	1	1
Italy	3	181	Calabria: Provincial Capital Town	89	7697	77	7	1	1	1
Italy	3	190	Sicilia: Not Provincial Capital Town	89	21283	211	12	1	1	1
Italy	3	191	Sicilia: Provincial Capital Town	89	17463	144	10	1	1	1
Italy	3	200	Sardegna: Not Provincial Capital Town	89	9028	91	5	1	1	1
Italy	3	201	Sardegna: Provincial Capital Town	89	6413	52	4	1	1	1
Japan	1	1	Public City	100	~	3114	37	3	1	1
Japan	1	2	Private City	100	~	90	1	3	1	1
Japan	1	3	Public Suburb/rural	100	~	17423	210	3	1	1
Japan	1	4	Private Suburb/rural	100	~	141	2	3	1	1
Japan	2	1	Public City	100	~	1433	33	3	1	1
Japan	2	2	Private City	100	~	295	7	3	1	1
Japan	2	3	Public Suburb/rural	100	~	8812	202	3	1	1
Japan	2	4	Private Suburb/rural	100	~	393	9	3	1	1
Japan	3	1	General Public City	100	~	317	15	3	1	1
Japan	3	2	General Private City	100	~	307	14	3	1	1
Japan	3	3	General Public Suburb/rural	100	~	1723	82	3	1	1
Japan	3	4	General Private Suburb/rural	100	~	472	22	3	1	1
Japan	3	5	Vocational Public City	100	~	180	8	3	1	1
Japan	3	6	Vocational Private City	100	~	144	7	3	1	1
Japan	3	7	Vocational Public Suburb/rural	100	~	1769	84	3	1	1
Japan	3	8	Vocational Private Suburb/rural	100	~	391	18	3	1	1
Latvia	3	999	Full coverage	100	200000	363	363	2	1	1
Lithuania	2	1	Secondary school (1-12 grades)	87	127083	692	240	1	1	1

	Population	Stratum-id	Stratum name	Percentage ICT use	Number of students	Number of schools	Invited number of	Selection procedure	Basis for population size	Sample based on
Lithuania	2	2	Basic school (1-10 grades)	14	17474	564	40	1	1	2
Lithuania	3	999	Secondary school	93	48554	683	683	2	1	1
Luxembourg	2	999	Full coverage	100	14660	24	24	2	1	1
Luxembourg	3	999		100	8384	28	28	2	1	1
New Zealand	1	1	Urban, decile 1-3 (low)	100	37580	326	55	1	1	1
New Zealand	1	2	Urban, decile 4-7 (middle)	100	34589	304	51	1	1	1
New Zealand	1	3	Urban, decile 8-10 (high)	100	41900	358	61	1	1	1
New Zealand	1	4	Rural, decile 1-3 (low)	100	16652	333	25	1	1	1
New Zealand	1	5	Rural, decile 4-7 (middle)	100	25755	538	38	1	1	1
New Zealand	1	6	Rural, decile 8-10 (high)	100	13337	378	20	1	1	1
New Zealand	2	999	Full coverage	100	103974	424	424	2	1	1
Norway	1	0	Full coverage	100	~	1730	1730	2	1	1
Norway	2	999	Full coverage	100	~	1073	1073	2	1	1
Norway	3	999	Full coverage	100	~	512	512	2	1	1
Russian Federation	2	999	Whole country	53	*special*	*special*	106	4	2	2
Russian Federation	3	999	Whole country	53	*special*	*special*	106	4	2	2
Singapore	1	999	Full coverage	100	97960	192	192	2	1	1
Singapore	2	999	Full coverage	100	82996	145	145	2	1	1
Singapore	3	999	Full coverage	100	30532	30	30	2	1	1
Slovak Republic	3	999	Whole country	100	30772	450	450	2	1	1
South Africa	2	999	Junior Secondary: General Education	16	~	1147	251	1	2	2
South Africa	3	999	Senior Secondary: Further Education	18	~	1147	247	1	2	2
Thailand	2	1	Government Education	50	653726	1204	470	1	2	2
Thailand	2	2	Private Education	50	18726	111	30	1	2	2
Slovenia	1	1	Largest cities (LJ, MB)	100	34478	65	35	1	1	1
Slovenia	1	2	Larger towns	100	10244	20	11	1	1	1
Slovenia	1	3	Medium towns	100	26532	43	27	1	1	1
Slovenia	1	4	Smaller towns	100	53889	90	54	1	1	1

	Population	Stratum-id	Stratum name	Percentage ICT use	Number of students	Number of schools	Invited number of	Selection procedure	Basis for population size	Sample based on
Slovenia	1	5	Villages	100	70460	226	62	1	1	1
Slovenia	2	1	Largest cities (LJ, MB)	100	34478	65	35	1	1	1
Slovenia	2	2	Larger towns	100	10244	20	11	1	1	1
Slovenia	2	3	Medium towns	100	26532	43	27	1	1	1
Slovenia	2	4	Smaller towns	100	53889	90	54	1	1	1
Slovenia	2	5	Villages	100	70460	226	62	1	1	1
Slovenia	3	999	All schools	100	*special*	*special*	*special*	2	1	1

Notes:

Population: 1=Primary Education, 2=Lower Secondary Education, 3=Upper Secondary Education.

Selection procedure: 1=probabilities proportional to size (PPS), 2=complete enumeration, 3=equal probabilities, 4=other.

Basis for population size (columns 6 and 7): 1=all schools, 2=computer-using schools.

Sample based on: 1=all schools, 2=computer-using schools.

~: not relevant for computation of weights, given the national sampling design.

Numbers in italics: estimated on the basis of known number of schools and average number of students per school, computed from data files.

Special: deviating sampling design.

APPENDI C UESTIONNAIRES

Identification Label

SCHOOL: ___________

SITES

Principal Questionnaire

Population 2

MAIN RUN

15 September 1998

The Second Information Technology in Education Study (SITES) is an international assessment of Information and Communication Technologies (ICT) in primary and secondary schools around the world. Twenty-five countries will provide information on available facilities, use and obstacles regarding information and communication technologies in representative samples of schools. On the basis of this information a better insight into the current state-of-the-art technologies will be possible. This information will allow educational practitioners and policy makers to get a better understanding of the areas where intervention and additional support measures are needed.

NRCs:
Please refer to translation manual for guidelines

University of Twente, OCTO, P.O. Box 217,
7500 AE Enschede, The Netherlands
E-mail: pelgrum@edte.utwente.nl

Introduction
The <name of country> is taking part in an international study of the use of computers in education along with about 24 other countries. The study is being conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA).

Your help is needed
This questionnaire will be administered to representative samples of schools in about 25 countries. We are asking your help in order to determine the current state of ICT in our country. Please try to answer each question as accurately as possible.

Confidentiality
All information that is collected in this study will be treated confidentially. At no time will the name of any school or individual be identified. While results will be made available by country and by type of school within a country, you are guaranteed that neither your school nor any of its personnel will be identified in any report of the results of the study. <*For countries which have ethical survey guidelines which emphasize voluntary participation:* Participation in this survey is voluntary and any individual may withdraw at any time.>

Questionnaire
This questionnaire asks for information from schools about education and policy matters related to computers. **We would like this questionnaire to be completed by the principal of the school**.

How to answer?
If you do not have the information to answer particular questions please consult other persons in the school.

Question types
Guidelines for answering the questions are typed in italic.
Most questions can be answered by **ticking** the one most appropriate answer.
When a question states: *Please, tick all that apply*, you may give more than one answer.
If in the answer [ ] appears, you should write down your own answer. Please write in block letters or other legible handwriting.

Terminology
In this questionnaire the words ***computers*** and ***ICT*** (Information and Communication Technologies) are used interchangeably.

School, grade range, grade *
Please note that some questions refer to the entire school, other questions refer to grades *-*, while some questions pertain to grade *.

Pen or ballpoint
Please use a writing pen or ballpoint to mark your answers.

Further information
When in doubt about the questionnaires or in case you would like more information, you can always reach us by phone at the following numbers:
(***NAMES AND NUMBERS***)

After answering
When you have completed this questionnaire, please put it into the stamped, addressed envelope that has been provided and put it in the mail, preferably before <NRC: include date>.

Thank you very much for your cooperation

CONTENT

GENERAL INFOR ATION ABOUT OUR SC OOL

1. Which of the following grade levels are present in your school?

☑ Tick all that apply.

☐ 1 ☐ 7 ☐ 13
☐ 2 ☐ 8
☐ 3 ☐ 9
☐ 4 ☐ 10
☐ 5 ☐ 11
☐ 6 ☐ 12

2. How many classes are there in grades *, *, * in your school? How many male and female students are there in grades *, *, * respectively?

*****Total number of classes is an International option*****

Grade	***Total number of classes***	Number of male students	Number of female students
*			
*			
*			
TOTAL in the school (all grades)			

3. How many male and female teachers are employed at your school altogether, and how many of them are full-time equivalents?

If none, write 'none' or '0'. For the full-time equivalents you may use one decimal place.

Number of full-time and part-time teachers

in entire school: Male ☐ Female ☐

Number of full-time equivalents in entire school: Male ☐ Female ☐

(for example, three part-time teachers can make one and a half (1.5) full-time equivalents)

4. Please tick one box which best describes the area in which the students in your school live.

   NRCs: please use national categories (see translation manual) and replace these in the international categories shown below

   - ☐ Rural
   - ☐ Small town
   - ☐ Outer area of large town or city
   - ☐ Inner area of large town or city
   - ☐ Other

ISTOR OF ICT IN OUR SC OOL, CURRENT OB ECTI ES, AND USE

5. How many years have computers been used by your school for teaching and/or learning activities/purposes for students in grades *-*?

☑ *Tick one.*

- ☐ 0 – 2 years
- ☐ 3 – 5 years
- ☐ 6 – 10 years
- ☐ 11 – 15 years
- ☐ More than 15 years
- ☐ Don't know

6. How important were each of the following goals in determining how computers are now used at your school?

☑ *Tick one answer for each goal.*

Goals	Not important	Important	Very important
1. To prepare students for future jobs	☐	☐	☐
2. To improve student achievement	☐	☐	☐
3. To promote active learning strategies	☐	☐	☐
4. To individualize student learning experiences	☐	☐	☐
5. To encourage more cooperative and project-based learning	☐	☐	☐
6. To develop student independence and responsibility for own learning	☐	☐	☐
7. To give students drill and practice exercises	☐	☐	☐
8. To make the learning process more interesting	☐	☐	☐
9. To satisfy parents' and community expectations	☐	☐	☐

7. To what extent is each of the following aspects of teaching and learning present in your school and to what extent has ICT been used in realizing these aspects?

☑ *Tick two answers per practice: one for presence and one for the realization via ICT.*

Teaching and learning practices	**Present**			**Realized through ICT**		
	not at all	**to some extent**	**a lot**	**not at all**	**some**	**a lot**
1. Students developing abilities to undertake independent learning	☐	☐	☐	☐	☐	☐
2. Providing weaker students additional instruction	☐	☐	☐	☐	☐	☐
3. Organizing teaching and learning so that differences in entrance level, learning pace, and learning route are taken into account	☐	☐	☐	☐	☐	☐
4. Students learning to search for information, process data, and present information	☐	☐	☐	☐	☐	☐
5. The emphasis in learning is on the development of skills	☐	☐	☐	☐	☐	☐
6. Students working on the same learning materials at the same pace and/or sequence	☐	☐	☐	☐	☐	☐
7. Teachers keeping track of all student activities and progress	☐	☐	☐	☐	☐	☐
8. Students being largely responsible for controlling their own learning progress	☐	☐	☐	☐	☐	☐
9. Students learning and/or working during lessons at their own pace	☐	☐	☐	☐	☐	☐
10. Students involved in cooperative and/or project-based learning	☐	☐	☐	☐	☐	☐
11. Students determining for themselves when to take a test	☐	☐	☐	☐	☐	☐
12. Students learning by doing	☐	☐	☐	☐	☐	☐
13. Combining parts of school subjects with one another (multidisciplinary approach)	☐	☐	☐	☐	☐	☐

8. According to your school's objectives, which of the following skills should your students acquire by the end of grade *?

☑ *Tick all that apply.*

- ☐ Operating a computer (saving files, printing, keyboarding)
- ☐ Writing documents with a word processor (typing, editing, layout)
- ☐ Making illustrations with graphical programs
- ☐ Calculating with spreadsheet programs (sheet creation, using formulas)
- ☐ Writing simple programs (in e.g. Logo, Pascal)
- ☐ Communicating via e-mail with teachers and other students
- ☐ Sending, searching for, and using electronic forms of information
- ☐ Other

☑ **Tick here if none of the above applies.**

International Option

9. Does your school have a written policy or statement with regard to the use of computers for educational purposes by students in grades *-*?

☑ *Tick 'no' or 'yes'.*

- ☐ No, *proceed to question 10*
- ☐ Yes

9a. Which of the following does it include?

☑ *Tick all that apply.*

- ☐ Use of computers in the current school year
- ☐ Use of computers in the forthcoming school years
- ☐ Plans for hardware replacement or upgrading
- ☐ Plans for staff development with regard to ICT training
- ☐ Specifications for computer-related tasks and persons in charge
- ☐ Plans for software acquisition
- ☐ Equity of access
- ☐ Internet policy
- ☐ Other

10. Indicate whether special measures have been set up in your school to ensure the following:

☑ *Tick all that apply.*

- ☐ Rewards (salary or other bonus) given to teachers who use ICT
- ☐ Incentives for teachers to take ICT courses or training
- ☐ Security measures to prevent unauthorized system access or entry
- ☐ The honoring of intellectual property rights, e.g. software copyrights
- ☐ Prohibiting access to adults-only material (e.g. pornography, violence)
- ☐ Restricted game playing on school computers
- ☐ Specifications of compulsory student computer-related knowledge and skills
- ☐ Local community access to school computers or the Internet (parents and/or others)

☑ **Tick here if none of the above applies.**

11. In relation to using ICT for teaching and learning, is any of the following practiced?

☑ *Tick all that apply.*

- ☐ Using drills and tutorials to improve learning in particular subject areas
- ☐ Use of special software or hardware for physically disabled students
- ☐ Use of special programs for gifted students, perhaps after regular school hours
- ☐ Use of remedial programs providing individualized learning experiences
- ☐ Cooperative projects with other schools using electronic networks

☑ **Tick here if none of the above applies.**

12. The following statements concern the use of computers in different aspects.

✓ *Please answer two questions for each aspect:*

1) Is this a policy goal in your school?

2) To what extent has this been realized in your school?

	Policy goal		Realized		
	no	yes	not or hardly	partially	almost or fully
Administration					
1. Using computers to keep track of student data	☐	☐	☐	☐	☐
2. Using computers for other school administrative matters	☐	☐	☐	☐	☐
Learning process					
3. One or more computers available in every classroom	☐	☐	☐	☐	☐
4. Teachers use computers in their instructional practice	☐	☐	☐	☐	☐
5. Using software for students with learning problems	☐	☐	☐	☐	☐
6. Encouraging students' learning on their own with the computer / encouraging independent learning with the aid of computers	☐	☐	☐	☐	☐
7. Students using computers as supportive learning aids (e.g. searching, analyzing, and presenting information)	☐	☐	☐	☐	☐
Communication/collaboration					
8. Every teacher has an individual e-mail address at/via school	☐	☐	☐	☐	☐
9. Students use e-mail	☐	☐	☐	☐	☐
10. Students access external databases via the Internet/WWW	☐	☐	☐	☐	☐
11. Cooperation with other schools in the area of computers	☐	☐	☐	☐	☐
Other					
12. Provision of training for all teachers in using ICT for educational purposes	☐	☐	☐	☐	☐
13. Provision of training for one or a couple of teachers to become an ICT-specialist	☐	☐	☐	☐	☐
14. Development of a common vision on the use of computers within the school					

contd. on next page

15. Assignment of non-teaching hours to teachers to support the use of computers in the school	☐	☐	☐	☐	☐
16. Attention to norms and values (e.g. language, violence, pornography) in using Internet/WWW	☐	☐	☐	☐	☐

13. How often during the school year are computers used (at your school) for the following administrative/management activities?

☑ *Tick one answer per activity.*

Activities	**Never**	**A few times**	**Monthly**	**Weekly / Daily**
1. Keeping track of student's learning progress	☐	☐	☐	☐
2. Updating the library database	☐	☐	☐	☐
3. Creating and updating of lesson schedule	☐	☐	☐	☐
4. Staff administration	☐	☐	☐	☐
5. Financial administration	☐	☐	☐	☐
6. Communication with parents and others outside the school	☐	☐	☐	☐

14. Can you provide an example of one of the most satisfying experiences of a learning activity in your school in which students are using computer-related technology?

The example should be the one that you feel gives students the most useful, effective, and advanced learning experiences with technology. It does not need to be focused on technology, but it could be a new activity in which technology plays an important role.

- ☐ No, I cannot provide such an example, *proceed to question 15*
- ☐ Yes, see below

Please describe your example by answering the following questions (*use a maximum of 20 words for each answer*):

1. Give a brief description of the activity

2. What computer-related technology is involved?

2. What subject domains are involved?

contd. on next page

4. What student activities are involved?

5. What changes, if any, took place for teachers?

6. What did students gain from it?

7. Any other comments on this activity?

OUR PERSONAL OPINIONS ABOUT T E ALUE OF ICT

15. Please indicate how strongly you agree or disagree with the following statements related to the role of computers and other Information and Communication Technologies.

Please indicate for each of the following statements your personal opinion.

☑ *Try to give a spontaneous reaction by ticking one answer for each item.*

	Statements	**Strongly disagree**	**Slightly disagree**	**Uncertain**	**Slightly agree**	**Strongly agree**
1.	Students are more attentive when computers are used in class	☐	☐	☐	☐	☐
2.	ICT improves the efficiency of the school administration	☐	☐	☐	☐	☐
3.	ICT improves the effectiveness of school management	☐	☐	☐	☐	☐
4.	ICT improves the evaluation of the functioning of the school	☐	☐	☐	☐	☐
5.	Every school should have access to the Internet/World Wide Web	☐	☐	☐	☐	☐
6.	Every student should learn about e-mail	☐	☐	☐	☐	☐
7.	Internet/WWW offers excellent opportunities for educational applications	☐	☐	☐	☐	☐
8.	ICT can effectively enhance problem solving and critical thinking skills of students	☐	☐	☐	☐	☐
9.	All teachers should have their own e-mail address	☐	☐	☐	☐	☐
10.	Computers are valuable tools to improve the quality of a child's education	☐	☐	☐	☐	☐
11.	ICT-based learning enables students to take more responsibility for their own learning	☐	☐	☐	☐	☐
12.	ICT can accommodate students' varied needs, preferences and learning strategies by providing new tools for knowledge manipulation, expression and creativity	☐	☐	☐	☐	☐
13.	ICT can help teachers to attune to the learning level and pace of the individual student	☐	☐	☐	☐	☐

contd. on next page

	Statements	Strongly disagree	Slightly disagree	Uncertain	Slightly agree	Strongly agree
14.	ICT should be used more by teachers to create environments for students' independent learning	☐	☐	☐	☐	☐
15.	ICT improves the monitoring of students' learning progress	☐	☐	☐	☐	☐
16.	Computers help to teach more effectively	☐	☐	☐	☐	☐
17.	In-service training courses on computers should be made compulsory	☐	☐	☐	☐	☐
18.	The achievement of students can be increased when using computers for teaching	☐	☐	☐	☐	☐
19.	The use of e-mail increases the motivation of students	☐	☐	☐	☐	☐
20.	Teachers should initiate more cooperative and/or project-based learning	☐	☐	☐	☐	☐
21.	ICT is a valuable support in solving problems that our school is confronted with	☐	☐	☐	☐	☐
22.	All teachers should acquire ICT certification	☐	☐	☐	☐	☐
23.	Using computers in class leads to more productivity of students	☐	☐	☐	☐	☐
24.	E-mail is an effective facility for disseminating information in the school	☐	☐	☐	☐	☐

STAFF DE ELOP ENT

16. The following contains some questions about the ICT-related training for teachers of grades *-*.

☑ *Tick 'no' or 'yes' for each question.*

	No	Yes
A)		
Is it obligatory for:		
1. All grades *-* teachers to take at least some basic computer courses?	☐	☐
2. All grades *-* teachers to regularly take courses to update their ICT-knowledge and skills?	☐	☐
B)		
Have a substantial number of teachers from grades *-*.		
1. Attended at least some basic computer courses?	☐	☐
2. Regularly attended courses to update their ICT-knowledge and skills?	☐	☐

ICT SUPPORT AND NEEDS

17. Who coordinates computer-related activities and/or provides leadership at your school relating to teachers' instructional use of computers and training of teachers?

☑ *Tick all that apply, and list the number of people that fit into that category.*

	Number
☐ Nobody coordinates	
☐ A full-time computer coordinator with possibly a small teaching load	
☐ A classroom teacher	
☐ A person from the <national, regional, provincial, district> level	
☐ The school principal or non-teaching administrator	
☐ Another person	
☐ A committee for the coordination of technology	

International Option

18. How many hours a week are formally allocated to computer coordination for the individual(s) marked in question 17?

If nobody coordinates write 'none' or '0'.

Hours a week: ______

*****International Option*****

19. Who provides support for search, analysis, and retrieval of relevant information from the World Wide Web and other databases) for students and teachers?

☑ *Tick all that apply.*

- ☐ Nobody
- ☐ The computer coordinator
- ☐ A full-time information specialist/librarian with possibly small teaching load
- ☐ A member of the teaching staff
- ☐ A person from the local district, area or region
- ☐ The school principal or non-teaching administrator
- ☐ Parent
- ☐ Other persons

20. Please indicate the extent to which your school considers each of the following a priority for further advice/information/support.

☑ *Tick one answer per area.*

	Advice/information/support areas	**No need**	**Low priority**	**High priority**
1.	How to use ICT to support the curriculum	☐	☐	☐
2.	How to use ICT with pupils with sensorial or physical disabilities	☐	☐	☐
3.	How to use ICT with underachieving pupils	☐	☐	☐
4.	How to use ICT with highly gifted pupils	☐	☐	☐
5.	<National, regional, provincial, district> prescribed ICT capabilities	☐	☐	☐
6.	Information handling skills of students and teachers	☐	☐	☐
7.	How to use ICT for management support	☐	☐	☐
8.	How to use ICT for evaluating the functioning of the school	☐	☐	☐
9.	How to use ICT for administrative work	☐	☐	☐
10.	Other	☐	☐	☐

International Option

21. How much money did your school spend with regard to ICT for students in grades *-* in the previous two school years? What priority will you give to each of the budgetary items listed below, in obtaining further external financial support?

or each budgetary item:

Write expenditures, if none please write 'none' or '0'.

☑ **Tick one priority rating.**

	Budgetary items	Expenditures in <national currency> last two school years	Priority ratings for future: No need	Low	High
1.	Hardware (including new hardware, internal network, expansions, replacement, etc.)	☐	☐	☐	☐
2.	Software (incl. upgrades, licenses, etc.)	☐	☐	☐	☐
3.	Staff development with regard to ICT (incl. courses, documentation, etc.)	☐	☐	☐	☐
4.	Maintenance (incl. repairs, insurance, etc.), and other costs (such as printer paper, toner, Internet access)	☐	☐	☐	☐
5.	Staff salaries (for e.g. ICT coordinator, information specialist)	☐			

OBSTACLES WIT REGARD TO ICT IN OUR SC OOL

22. Indicate whether or not you consider each of the following to be **major obstacles** affecting the realization of your school's computer-related goals for students in grades *-*.

☑ **Tick all that apply.**

Hardware

1. Insufficient number of computers ☐

Software

2. Not enough copies of software for instructional purposes ☐
3. Not enough types (variety) of software ☐

Instruction

4. Insufficient time for teachers to prepare lessons in which computers are used ☐
5. Difficult to integrate computers in classroom instruction practices ☐
6. Not enough staff for supervising computer using students ☐
7. Problems in scheduling enough computer time for different classes ☐

Internet/WWW

8. Difficult to use with low-achieving students ☐
9. No time in the school schedule for using the Internet/WWW ☐
10. No time in teachers' schedules to explore opportunities for using the Internet/WWW ☐

Other

11. Not enough space to locate computers appropriately ☐
12. Lack of interest/willingness of teachers to use computers ☐
13. Teachers lack knowledge of/skills in using computers for instructional purposes ☐
14. Not enough training opportunities for teachers ☐
15. Insufficient plans and/or resources to prevent theft and vandalism of computers ☐
16. Lack of support from school's governing body or community ☐
17. Weak infrastructure (telecommunications, electricity, etc.) ☐
18. Other ☐

☑ **Tick here if none of the above applies.**

22a. Which obstacles from the list above do you consider as most serious?

Please list a maximum of 4 numbers from the list above: ☐ ☐ ☐ ☐

PERSONAL BAC GROUND INFOR ATION

23. Including this school year, how many years have you been:

Please give the number of years (rounded to whole numbers).

	Number of years
Principal of this school?	☐
Working in any professional capacity at this school (including years as teacher, vice-principal, and principal)?	☐
Principal of any school (including years as principal in this school)?	☐

24. Please indicate whether you are:

☑ *Tick one.*

☐ Male
☐ Female

25. In what year were you born?

Year of birth: ☐

26. How often do you personally use a computer?

☑ *Tick one.*

☐ Never, *skip question 27 and proceed to the end of the questionnaire*
☐ A few times per year
☐ Almost monthly
☐ Weekly
☐ Daily

27. What do you use your computer for?

☑ *Tick all that apply.*

☐ Writing documents and letters
☐ Using spreadsheets
☐ For planning purposes
☐ For communication - the Internet, e-mail
☐ For searching and using information on the World Wide Web and/or CD-ROM
☐ For teaching/instruction
☐ Other

☑ **Tick here if none of the above applies.**

This is the end of the questionnaire.

Thank you very much for your cooperation.

Please put the questionnaire in the stamped, addressed envelope and put it in the mail.

Identification Label

SCHOOL: ____________

SITES

Technical Questionnaire

Population 2

MAIN RUN

15 September 1998

The Second Information Technology in Education Study (SITES) is an international assessment of Information and Communication Technologies (ICT) in primary and secondary schools around the world. Twenty-five countries will provide information on available facilities, use and obstacles regarding information and communication technologies in representative samples of schools. On the basis of this information a better insight into the current state-of-the-art technologies will be possible. This information will allow educational practitioners and policy makers to get a better understanding of the areas where intervention and additional support measures are needed.

NRCs:
Please refer to translation manual for guidelines

University of Twente, OCTO, P.O. Box 217,
7500 AE Enschede, The Netherlands
E-mail: pelgrum@edte.utwente.nl

Introduction
The <name of country> is taking part in an international study of the use of computers in education along with about 24 other countries. The study is being conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA).

Your help is needed
This questionnaire will be administered to representative samples of schools in about 25 countries. We are asking your help in order to determine the current state of ICT in our country. Please try to answer each question as accurately as possible.

Confidentiality
All information that is collected in this study will be treated confidentially. At no time will the name of any school or individual be identified. While results will be made available by country and by type of school within a country, you are guaranteed that neither your school nor any of its personnel will be identified in any report of the results of the study. <*For countries which have ethical survey guidelines which emphasize voluntary participation:* Participation in this survey is voluntary and any individual may withdraw at any time.>

Questionnaire
This questionnaire asks for information from schools about education and policy matters related to computers. **We would like this questionnaire to be completed by a person who is informed about computer facilities and practices regarding the use of computers in the school.**

How to answer?
If you do not have the information to answer particular questions please consult other persons in the school.

Question types
Guidelines for answering the questions are typed in *italic*.
Most questions can be answered by **ticking** the one most appropriate answer.
When a question states: *Please, tick all that apply*, you may give more than one answer.
If in the answer [ ] appears, you should write down your own answer. Please write in block letters or other legible handwriting.

Terminology
In this questionnaire the words ***computers*** and ***ICT*** (Information and Communication Technologies) are used interchangeably.

School, grade range, grade *
Please note that some questions refer to the entire school, other questions refer to grades *-*, while some questions pertain to grade *.

Pen or ballpoint
Please use a writing pen or ballpoint to mark your answers.

Further information
When in doubt about the questionnaires or in case you would like more information, you can always reach us by phone at the following numbers:
(***NAMES AND NUMBERS***)

After answering
When you have completed this questionnaire, please put it into the stamped, addressed envelope that has been provided and put it in the mail, preferably before <NRC: include date>.

Thank you very much for your cooperation

CONTENT

BAC GROUND INFOR ATION

1. Which of the following roles or tasks are you required to serve/perform in your current position at this school?

☑ *Tick all that apply.*

☐ Classroom teaching
☐ Technology or computer coordination
☐ Networking coordination
☐ General administration
☐ Media (audio visual) specialist
☐ Other

2. Do you, at your school, hold the position of technology- or computer coordinator?

☑ Tick one.

☐ I formally serve as coordinator
☐ I informally serve as coordinator
☐ None of the above

*****International Option*****

3. Approximately how many hours per week (on average) do you (and your assistants) spend on providing technology coordination, training, and user support in each of the following ways?

   Think about last week in particular; then adjust if it was different than usual. If you also work at other schools, count only the hours spent for THIS school. Please round to the nearest hour.

		Hours per week
1.	Technology-, Training-, Coordination-, User-Support and Activities	☐
2.	Installing, maintaining, repairing/troubleshooting equipment, networks, operating systems, and software	☐
3.	Planning and delivering staff development workshops on ICT	☐
4.	Writing lesson plans/ units that integrate ICT into different curricula with other teachers	☐
5.	Selecting and acquiring computer-related hardware, software, and support materials for the school	☐
6.	Other technology coordination & support	☐
	TOTAL hours per week	☐

4. Including this year, for how many years have you been:

   Please give the number of years. If none, write 'none' or '0'. Please round to whole years.

	Number of years
Computer coordinator of this school?	☐
Working in any professional capacity at this school (including years as computer coordinator)?	☐
Computer coordinator of any school (including years as computer coordinator in this school)?	☐

5. Please indicate whether you are:

   ☑ Tick one.

   ☐ Male

   ☐ Female

6. In what year were you born?

   Year of birth: 19 ☐

USE OF ICT

7. Do your students or teachers (in grades *-*) use e-mail or the World Wide Web (WWW) for instructional purposes?

- [ ] No, *proceed to question 14*
- [ ] Yes, *proceed to question 8*

8. In what year were e-mail and World Wide Web (WWW) first used by your school for teaching and/or learning purposes in grades *-*?

E-mail use started in: [ ] WWW use started in: [ ]

9. What percentage of students (will) have used e-mail and/or WWW by the end of grade *?

✓ *Tick one.*

- [ ] None
- [ ] Under 10%
- [ ] 11 - 25%
- [ ] 26 - 50%
- [ ] 51 - 75%
- [ ] 76 - 100%

10. What percentage of teachers (who teach in grades *-*) use e-mail and/or the World Wide Web (WWW) in their teaching in some way?

✓ *Tick one.*

- [ ] None
- [ ] Under 10%
- [ ] 11 - 25%
- [ ] 26 - 50%
- [ ] 51 - 75%
- [ ] 76 - 100%

11. Does your school have its own home page on World Wide Web?

☐ No, *proceed to question 13*

☐ Yes, *proceed to question 12*

*****International Option*****

What is the URL of the page?
"URL" means: Uniform Resource Locator (that is the WWW-address).

The URL of your home page is (for example, http://utto139.edte.utwente.nl/iea/)

[ ]

12. What has your school put onto the Web in terms of the type of information?

☑ **Tick each type of available information below.**

General information

☐ General information about the school

☐ Special information for parents (e.g. parent meetings, parent teacher conferences)

☐ Information about changes in the time schedule

Information for teachers

☐ Information on staff development activities

☐ Lesson plans

☐ Curriculum guidelines and frameworks

☐ Clickable links to resources for teachers

Information for students

☐ Results of student projects (essays, art, videos)

☐ Tests

☐ Assignments

☐ Clickable links to resources for students

☐ Curriculum materials

☐ Announcements about events

☐ Other

13. Please indicate if a typical student will have done any of the following at the school by the end of grade *.

☑ *Tick all that apply.*

	Internet related activities done by students by the end of grade *	Done this
1.	Communicating via e-mail with teachers within and/or outside the school for learning purposes	☐
2.	Communicating via e-mail with peers from other schools within and/or outside the country	☐
3.	Using e-mail or bulletin boards for group projects/collaboration within the school and/or with other schools	☐
4.	Using external databases to retrieve and extract information from different sites across the Internet and/or WWW	☐
5.	Designing and maintaining Web sites	☐
6.	Disseminating information via the Internet and/or WWW (e.g. publishing projects)	☐
7.	Discussing, debating issues and exploring ideas by video conferencing with others (e.g. schools or experts) outside the school	☐
8.	Other	☐

☑ **Tick here if none of the above applies.**

14. Please indicate whether a typical student will have used any of the following technology applications at school by the end of grade *.

☑ *Tick all that apply.*

Technology applications	Used this
1. Simulations of natural or man made systems (e.g. work environments, human and animal populations, etc.)	☐
2. Dynamic modeling and graphical modeling of mathematical functions	☐
3. Software for simple data manipulation and statistical analysis	☐
4. Word processing / desk top publishing	☐
5. Hard- and software for real time data collection (data logging) and data manipulation for science investigations	☐
6. Spreadsheets packages	☐
7. Software supporting creative works (music/ arts)	☐
8. Computer aided design/ Computer aided manufacturing	☐
9. An interactive multimedia encyclopedia on CD ROM	☐
10. Software for learning programming skills	☐

☑ **Tick here if none of the above applies.**

T E ICT RESOURCES IN OUR SC OOL

For questions 15, 18, and 20, please (unless otherwise specified):
Count terminals (if it has a keyboard and a screen) as computers
Exclude computers which are not in use
Exclude computers which are only used as servers
Exclude computers which are only used for teachers and/or administrative purposes
Exclude graphical calculators
Exclude personally owned computers brought to school by teachers and/or students

15. How many computers are available for use by students in the *entire* school?

    TOTAL number of computers ☐

16. What is the total number of students in the *entire* school?

    TOTAL number of students ☐

17. How many students in the *entire* school are using the computers listed in question 15?

    TOTAL number of computer using students ☐

18. How many computers are available in the *entire* school for administration and teachers **only** ?

    TOTAL number of computers available for administration **only** ☐

    TOTAL number of computers available for teachers **only** ☐

19. What percentage of students from the *entire* school bring their own laptops to the school?

    ☑ *Tick one.*

    ☐ None
    ☐ Under 10%
    ☐ 11 - 25%
    ☐ 26 - 50%
    ☐ 51 - 75%
    ☐ 76 - 100%

20. Please list the number of computers, which can be used by **students in grades** *-*, for educational use in different locations.

If none, write 'none' or '0'.

Location of computers	**Total number of computers**
Fixed location	
1. In computer rooms (computer labs)	
2. In classrooms	
3. In other instructional rooms (science lab, reading lab, library, etc.)	
4. In other locations (for students or teachers) Not fixed location	
Not Fixed location	
5. Laptops, Notebooks and other portable computers (e.g. on trolleys)	
TOTAL number of computers	

21. How many of the total number of computers from question 20 are in a local network?

Number of computers in local network ______

22. How many students from grades *-* are using the computers listed in question 20?

Number of students from grades *-* ______

23. How many of the available computers for students in grades *-* (as listed in question 20) belong to each of the following performance groups?

If none, write 'none' or '0'.

Performance groups with typical examples of reference processors	**Number of computers**
1. Equivalent to Pentium, Mac 603 and higher, SUN, Alpha, etc.	
2. 386/486 SX/DX, Macintosh SE, Mac II up to 68030, Atari ST, Amiga, etc.	
3. 16-bit computers, such as AT/XT 80286	
4. 8-bit computers, Apple II/IIe, Apple II clones, C64, and other old 8-bit	
TOTAL number of computers (same as in question 20)	

24. How many computers in your school that are available to students in grades *-* (as listed in question 20) use the following operating system(s):

If none, write 'none' or '0'.

System/operating system	Number of computers
1. Windows 95/98, Win NT, or MacOs 7.5 and higher	
2. Windows 3.0/3.1 or OS/2 or MacOs lower than 7.5	
3. MS DOS (from 3.1 to 7.0) without Windows/no graphical system	
4. Other systems	

25. Does your school have any computers (in addition to the computers listed in questions 15 and 18) which are not currently in use by teachers and/or students for teaching and/or learning purposes?

If none, write 'none' or '0' and proceed to question 26.

Number of computers not in use: ☐

Why are they not in use?

☑ *Please tick all that apply.*

- ☐ Computers are out dated
- ☐ They are not compatible with other computers
- ☐ They are broken
- ☐ Teachers/students do not know how to use them
- ☐ Other reason

26. *With respect to the total number of computers from question 20: How many are multimedia computers (equipped with a CD-ROM and a sound card)?*

Number of multimedia computers ☐

27. *Does your school have access to the Internet for instructional purposes?*

If only one computer at a time can use the Internet connection: write '1'.

Internet Access:

☐ No → When do you expect that the school will get Internet access:

In (year) ☐

☑ **Tick here if not yet planned.**

☐ Yes → How many of the computers listed in question 20 can have access to e-mail at the same time? ☐

How many of the computers listed in question 20 can have access to World Wide Web at the same time? ☐

28. **Which of the following peripherals are available at your school (for educational use in grades *-*)?**

☑ *Tick all that apply (that is, at least one of the listed devices is available for educational use).*

☐ Laser printer

☐ CD-ROM drive

☐ Devices for mentally and/or physically disabled students

☐ Devices for digital image or video processing

☐ Color printer

☐ CD-Writer (CD-R, DVD)

☐ Graphic tablet

☐ Video-projector

☐ Scanner

☐ LCD-panel

☑ **Tick here if none of the above is available.**

*****International Option*****

29. In your school, how many printers are available for use by teachers and/or students in grades *-*?

Laser printers	☐	Ink jet printers	☐
Dot matrix printer	☐	Other printers	☐

30. In your school, which of the following types of software are available for teaching and learning (in grades *-*) on at least one computer?

☑ *Tick all that are available.*

☐ Word processing, desktop publishing
☐ Spreadsheet
☐ Database
☐ Graphics: presentation, no professional drawing
☐ CAD (computer aided design), CAM (computer aided manufacturing)
☐ Statistical/mathematical programs
☐ Programming languages
☐ Accounting, book keeping, financial software
☐ Drill and practice programs
☐ Tutorial programs (for self learning)
☐ Simulations (e.g. real world simulations)
☐ Educational games
☐ Recreational games/other games
☐ For exams/tests/constructing tests/administrating tests
☐ Internet browser
☐ E-mail software
☐ Encyclopedia on CD-ROM
☐ Video/audio/authorware
☐ Music composition
☐ Presentation software (e.g. PowerPoint)
☐ Software supporting Microcomputer Based Laboratories

☑ **Tick here if none of the above is available.**

31. For which of the following subjects (or subject areas) is educational software available in your school for use in grades *-*?

Exclude programming languages or office programs (like word processing and spreadsheet programs) as educational software.

☑ *Tick all subjects (or subject areas) for which software is available (including software for multidisciplinary approaches).*

☐ Mathematics
☐ Physics
☐ Chemistry
☐ Biology/life science
☐ Earth science
☐ Language/mother tongue
☐ Foreign language(s)
☐ Creative arts (music, visual arts)
☐ History
☐ Civics
☐ Economics
☐ Geography
☐ Vocational subjects
☐ Computer education/informatics
☐ Multidisciplinary projects or activities

☑ **Tick here if none of the above is available.**

STAFF DE ELOP ENT

32. How does the transfer of knowledge on ICT in education take place between teachers in your school?

☑ *Tick all that apply.*

☐ Via informal contacts/communication
☐ Via the school's working group or committee for ICT in education
☐ The use of ICT/computers in education is a regular item on the agenda of staff meetings
☐ Via a regular newsletter (printed or electronically)
☐ A teacher who has attended a course usually repeats this course at school for other teachers
☐ Via courses by an external agency or expert
☐ Via in-school courses
☐ Via the computer coordinator or technical assistant
☐ There is no organized structure for the exchange of information
☐ Other

*****International Option*****

33. Which of the following (in-house and/or external) training courses are available/conducted for your teachers in grades *-*.

☑ *You may tick more than one answer for each item.*

		In-house	External
1.	General introductory course (how to use a computer, principles of soft- and hardware, functions of mouse, printer)	☐	☐
2.	General introductory course (history of ICT, relevance, consequences of computer use, etc.)	☐	☐
3.	Introductory course for applications/standard tools (basic word-processing, spreadsheet, databases, etc.)	☐	☐
4.	Introductory course for Internet use (retrieve information, send/receive e-mails, etc.)	☐	☐
5.	Introductory technical course for operating and maintaining computer systems	☐	☐
6.	Advanced course for applications/standard tools (e.g. advanced word-processing, complex relational databases)	☐	☐
7.	Advanced course for Internet use (e.g. creating websites/develop a home page, advanced use of Internet, video conferencing)	☐	☐
8.	Advanced technical course for operating and maintaining computer systems (e.g. networks, special equipment)	☐	☐
9.	General course about didactical/pedagogical principles of computer use	☐	☐
10.	Subject-specific training (with subject-specific learning software, e.g. tutorials or drill and practice software)	☐	☐
11.	Programming course, where teachers can learn how to create their own software (also with authorware)	☐	☐
12.	Special course with digital video- and audio-equipment	☐	☐

34. Do you consider yourself adequately prepared in each of the following areas for your work in supporting ICT activities in your school?

☑ *Tick 'Yes' or 'No'. Tick 'Not applicable' if the area is not relevant for your work.*

	Yes	**No**	**Not applicable**
General			
MS-Windows	☐	☐	☐
MacOs	☐	☐	☐
MS-DOS	☐	☐	☐
Word processing	☐	☐	☐
Databases	☐	☐	☐
Spreadsheets	☐	☐	☐
Instructional processes			
Subject specific applications	☐	☐	☐
Application of student progress tracking software	☐	☐	☐
Didactical and organizational integration of computers in subjects	☐	☐	☐
The use of specific programs for subjects	☐	☐	☐
Evaluation and selection of instructional software	☐	☐	☐
Use of computers for individualized learning programs	☐	☐	☐
The use of multimedia application	☐	☐	☐
Adaptation of software to fit school purposes	☐	☐	☐
E-mail, Internet, WWW			
The use of e-mail for educational purposes	☐	☐	☐
The use of the Internet/WWW for educational purposes	☐	☐	☐
Presentation			
The use of software for making presentations	☐	☐	☐

ICT SUPPORT AND NEEDS

International Option

35. Please indicate the extent to which your school considers each of the following a priority for further external support.

☑ *For each area tick one answer.*

	External support areas	Do not need	Low priority	High priority
1.	Availability of software	☐	☐	☐
2.	Quality of software or materials	☐	☐	☐
3.	Availability of in-service training courses	☐	☐	☐
4.	On line services for curriculum purposes	☐	☐	☐
5.	Other	☐	☐	☐

OBSTACLES WIT REGARD TO ICT IN OUR SC OOL

36. *Which of the following do you consider as major obstacles affecting the realization of your school's computer related goals for students in grades *-*?*

☑ **Tick all that apply.**

Hardware

1. Insufficient number of computers ☐
2. Insufficient peripherals (printers, scanners, transviewers) ☐
3. Outdated or lack of school network or LAN ☐

Software

4. Not enough copies of software for instructional purposes ☐
5. Software too complicated for teachers and/or students to use ☐
6. Software not specific enough and/or not adaptable for use in subjects ☐
7. Lack of information about software or its quality prior to purchasing ☐
8. Most of the software is not in the language of instruction ☐
9. Cultural incompatibility of imported instructional software ☐
10. Curricular incompatibility of imported instructional software ☐

Internet/WWW

11. Insufficient computers with simultaneous access to the Internet/WWW ☐
12. Slow or unreliable network performance ☐
13. Too complicated to connect to the network ☐
14. Generally the material found on the Internet is of poor quality ☐
15. Not enough technical support available ☐
16. Difficult for teachers and/or students to find specific information ☐
17. Information overload – too much to know what to do with ☐
18. Electronic mail in-baskets are overloaded ☐
19. Not enough connections can be made at the same time for a class to use ☐

Other

20. Not enough technical assistance for operating and maintaining computers and/or insufficient help for solving technical problems with ICT ☐
21. Inadequate administrative support or initiative at the school level ☐
22. Teachers feel uncomfortable because some students are more competent with ICT than they are ☐
23. The quality of available teacher training courses is insufficient ☐
24. Insufficient plans/resources to prevent theft and vandalism of computers ☐
25. Weak infrastructure (telecommunications, electricity, available room space, etc.) ☐

☑ **Tick here if none of the above applies.**

36a. Which obstacles from the list above do you consider as most serious?

Please list a maximum of 4 numbers from the list above: ☐ ☐ ☐ ☐

This is the end of the questionnaire.

Thank you very much for your cooperation.

Please put the questionnaire in the stamped, addressed envelope and put it in the mail.

APPENDI D ESTI ATING STANDARD ERRORS OF PERCENTAGES

In principle, standard errors are reported for all statistics in this book. In order to save space, the standard errors for simple percentages are not shown. Instead, the next page contains guidelines for estimating these standard errors. As explained in the footnotes for tables and figures, a standard error is used to determine within which interval the statistics are estimated to fall for the population (that is, all students in the country who belong to the target population). It should be noted that standard errors are calculated, in principle, by using the formula SD/SQRT(n), SD being the standard deviation of the statistic, SQRT the square root and n the number of valid observations. For countries where a finite population correction can be applied (that is, countries with a complete or nearly complete enumeration of all schools), an adapted formula should be used, which leads to smaller standard errors. This formula does not take into account the fact that most countries used a stratified sample. In theory, stratification leads to somewhat more accurate population estimates. This means that the standard errors reported in this book may be slightly inflated.

Table D.1 Number of cases per questionnaire and population

	Primary Education: # principals	Primary Education: # technic. resp.	Lower Secondary: # principals	Lower Secondary: # technic. resp.	Upper Secondary: # principals	Upper Secondary: # technic. resp.
Belgium-French*	~	~	128	123	131	127
Bulgaria	~	~	207	206	225	223
Canada*	1332	1227	820	768	738	696
China Hong Kong	206	205	297	299	297	299
Chinese Taipei	204	208	206	207	227	226
Cyprus	26	25	33	31	29	31
Czech Republic	~	~	250	232	233	231
Denmark	~	~	219	221	~	~
Finland*	185	183	192	196	~	~
France*	308	275	295	278	288	277
Hungary	~	~	254	254	~	~
Iceland	137	127	103	97	27	25
Israel*	127	124	103	116	101	112
Italy*	204	187	185	178	182	178
Japan	212	213	202	203	208	210
Latvia*	~	~	~	~	107	116
Lithuania	~	~	237	232	540	539
Luxembourg	~	~	16	17	19	21
New Zealand*	200	174	223	213	~	~
Norway	1238	1181	768	767	375	380
Russian Federation*	~	~	105	93	105	93
Singapore	192	192	145	145	30	30
Slovak Republic*	~	~	~	~	157	155
Slovenia*	125	128	125	128	109	119
South Africa*	~	~	92	94	98	98
Thailand	~	~	419	416	~	~

Notes: *: country did not satisfy all sampling criteria for one or more educational levels. ~: no data collected.

Table D.2 Look-up table for estimating standard errors based on the number of cases and observed percentages

N\%	5;95%	10;90%	20;80%	30;70%	40;60%	50%
25	4.4	6.0	8.0	9.2	9.8	10.0
50	3.1	4.2	5.7	6.5	6.9	7.1
100	2.2	3.0	4.0	4.6	4.9	5.0
200	1.5	2.1	2.8	3.2	3.5	3.5
300	1.3	1.7	2.3	2.6	2.8	2.9
400	1.1	1.5	2.0	2.3	2.4	2.5

Notes: Cells show standard errors in relation to the number of cases (rows) and the observed percentages (columns). If in a country (almost) the whole population of schools participated, the standard error is much smaller than the one presented. A finite sample correction should then be applied as follows:
SE(corrected)=SE(incorrected)*sqrt((N-n)/(N-1))
where:
N = total number of cases in the population
n = number of valid cases in the data for a particular variable.

Example:
If a percentage of 20% is observed and the number of cases is 100 (from a large population), the standard error is 4.0
This means that the 95% confidence interval for the population ranges from 12%–28% (that is, the observed percentage ±2*SE).
If, in this example, the whole population consists of only 110 cases, the corrected standard error is 4.0*sqrt ((110-100)/(110-1))=1.2

APPENDI E CO POSITE INDICATORS

This appendix contains the definitions of composite indicators for which statistics were presented in Chapters 3 to 6.

For each composite the numbers of tables and figures, in which each composite is used, are given.

The composite is defined in terms of the numbers of the questionnaire items, which are shown in Appendix C.

The reliabilities are summarized for each educational level in terms of: (i) the reliability resulting from analyses on the whole data set (from all countries); (ii) the number of countries where the reliability was less than 0.40; (iii) the number of countries where the reliability was between 0.41 and 0.70; and (iv) the number of countries where the reliability was higher than 0.70.

Name	Table and/or Figure reference	Underlying items (see Appendix C for questionnaire items: P12-3 meaning Principal questionnaire, question 12, item 3)	Alpha Primary Education	Alpha Lower Secondary Education	Alpha Upper Secondary Education
Emerging pedagogical practice paradigm Scale 35	Figure 3.2, Figure 3.3, Figure 3.9, Table F.1.1-Table F.1.3	Items: P7-1,P7-2,P7-3,P7-4,P7-8,P7-9,P7-10,P7-13 (presence) Answer categories: 1=not at all, 2=to some extent, 3=a lot Calculation: 100*(mean.8(BcgPri1,BcgPri2,BcgPri3,BcgPri4,BcgPri8, BcgPri9,BcgPri10,BcgPri13)-1)/2	Overall:.83 Countries: 14 <0.40: 0 0.41-0.70: 4 >0.70: 10	Overall: .78 Countries: 24 <0.40: 0 0.41-0.70: 10 >0.70: 14	Overall: .77 Countries: 21 <0.40: 0 0.41-0.70: 9 >0.70: 12
Traditional pedagogical practice paradigm Scale 36	Figure 3.2, Figure 3.3, Figure 3.9, Table F.1.1-Table F.1.3	Items: P7-5,P7-6,P7-7 (presence) Answer categories: 1=not at all, 2=to some extent, 3=a lot Calculation: 100*(mean.3(BcgPri5,BcgPri6,BcgPri7)-1)/2	Overall:.48 Countries: 14 <0.40: 10 0.41-0.70: 3 >0.70: 1	Overall: .50 Countries: 24 <0.40: 9 0.41-0.70: 14 >0.70: 1	Overall: .55 Countries: 21 <0.40: 8 0.41-0.70: 13 >0.70: 0
Emerging important objectives Scale 33	Figure 3.4, Figure 3.5, Table F.2.1-Table F.2.3	Items: P6-3 to P6-6 Answer categories:1=not important 2=important 3=very important Calculation: 100*(mean.4(BcgImp3 to BcgImp6)-1)/2	Overall:.68 Countries: 14 <0.40: 1 0.41-0.70: 7 >0.70: 6	Overall: .71 Countries: 24 <0.40: 0 0.41-0.70: 16 0.41-0.70: 16	Overall: .71 Countries: 21 <0.40: 0 0.41-0.70: 13 >0.70: 8
Traditionally important objectives Scale 33a	Figure 3.4, Figure 3.5, Table F.2.1-Table F.2.3	Items: P6-1, P6-2, P6-7 Answer categories: 1=not important 2=important 3=very important Calculation: 100*(mean.3(BcgImp1,BcgImp2,BcgImp7)-1)/2	Overall:.45 Countries: 14 <0.40: 7 0.41-0.70: 7 >0.70: 0	Overall: .41 Countries: 24 <0.40: 16 0.41-0.70: 8 >0.70: 0	Overall: .46 Countries: 21 <0.40: 8 0.41-0.70: 13 >0.70: 0
Emerging ICT-related opportunities Scale 37a	Figure 3.7, Table F.5.1-Table F.5.3	Items: P7-1,P7-2,P7-3,P7-4,P7-8,P7-9,P7-10,P7-13 (realized) Answer categories: 1=not at all, 2=to some extent, 3=a lot Calculation: 100*(mean.8(BcgPrc1,BcgPrc2,BcgPrc3,BcgPrc4,BcgPrc8, BcgPrc9,BcgPrc10,BcgPrc13)-1)/2	Overall: .88 Countries: 14 <0.40: 0 0.41-0.70: 0 >0.70: 14	Overall: .84 Countries: 24 <0.40: 0 0.41-0.70: 1 >0.70: 23	Overall: .84 Countries: 21 <0.40: 0 0.41-0.70: 1 >0.70: 20

Name	Table and/or Figure reference	Underlying items (see Appendix C for questionnaire items: P12-3 meaning Principal questionnaire, question 12, item 3)	Alpha Primary Education	Alpha Lower Secondary Education	Alpha Upper Secondary Education
Emerging ICT-related opportunities Scale 37b	Figure 3.8, Table F.5.1-Table F.5.3	Items: P7-5,P7-6,P7-7 (realized) Answer categories: 1=not at all, 2=to some extent, 3=a lot Calculation: 100*(mean.3(BcgPrc5,BcgPrc6,BcgPrc7)-1)/2	Overall:.69 Countries: 14 <0.40: 0 0.41-0.70: 10 >0.70: 4	Overall: .64 Countries: 24 <0.40: 2 0.41-0.70: 16 >0.70: 6	Overall: .65 Countries: 21 <0.40: 2 0.41-0.70: 15 >0.70: 4
ICT skill coverage Scale 34	Table 3.3.1-Table 3.3.3	Items: P8-1 to P8-7 Answer categories:1=checked 2=not checked Calculation: 100*(mean.7(BcgAcq1 to BacAcq7)-1)	Overall:.69 Countries: 14 <0.40: 1 0.41-0.70: 10 >0.70: 3	Overall: .67 Countries: 24 <0.40: 0 0.41-0.70: 19 >0.70: 5	Overall: .64 Countries: 21 <0.40: 1 0.41-0.70: 16 >0.70: 4
Application coverage Scale 32	Table 3.4.1-Table 3.4.3	Items: T14-1 to T14-10 (for primary education: without T14-2, T14-8) Answer categories: 1=checked 2=not checked Calculation: Count NYes32=bqguap1 to bqguap10(2). Count Nvalid32=bqguap1 to bqguap10(1,2). if (Nvalid32=10) Scale 32=NYes32/Nvalid32*100.	Overall:.68 Countries: 14 <0.40: 1 0.41-0.70: 10 >0.70: 3	Overall: .65 Countries: 24 <0.40: 3 0.41-0.70: 18 >0.70: 3	Overall: .63 Countries: 21 <0.40: 1 0.41-0.70: 18 >0.70: 2
Student: computer ratio	Figure 4.1, Figure 4.2, Figure 4.3	Explained in footnotes of figures	Nap	Nap	Nap
Types of computers	Table 4.1.1-Table 4.1.3, Figure 4.4, Figure 4.5	Number of a particular type divided by the total number of computers available for students in the grade range	Nap	Nap	Nap

Name	Table and/or Figure reference	Underlying items (see Appendix C for questionnaire items: P12-3 meaning Principal questionnaire, question 12, item 3)	Alpha Primary Education	Alpha Lower Secondary Education	Alpha Upper Secondary Education
Traditional ICT-related opportunities Scale 37b Figure 3.8,	Figure 3.8, Table F.5.1- Table F.5.	Items: P7-5,P7-6,P7-7 (realized) Answer categories: 1=not at all, 2=to some extent, 3=a lot Calculation: 100*(mean.3(BcgPrc5,BcgPrc6,BcgPrc7)-1)/2	Overall:.69 Countries: 14 <0.40: 0 0.41-0.70: 10 >0.70: 4	Overall: .64 Countries: 24 <0.40: 2 0.41-0.70: 16 >0.70: 6	Overall: .65 Countries: 21 <0.40: 2 0.41-0.70: 15 >0.70: 4
ICT skill coverage Scale 34 Table 3.3.1-	Table 3.3.1- Table 3.3.3	Items: P8-1 to P8-7 Answer categories:1=checked 2=not checked Calculation:	Overall:.69 Countries: 14 <0.40: 1 0.41-0.70: 10 >0.70: 3	Overall: .67 Countries: 24 <0.40: 0 0.41-0.70: 19 >0.70: 5	Overall: .64 Countries: 21 <0.40: 1 0.41-0.70: 16 >0.70: 4
Application coverage Scale 32	Table 3.4.1- Table 3.4.3	Items: T14-1 to T14-10 (for primary education: without T14-2, T14-8) Answer categories: 1=checked 2=not checked Calculation: Count NYes32=bqguap1 to bqguap10(2). Count Nvalid32=bqguap1 to bqguap10(1,2). if (Nvalid32=10) Scale 32=NYes32/Nvalid32*100.	Overall:.68 Countries: 14 <0.40: 1 0.41-0.70: 10 >0.70: 3	Overall: .65 Countries: 24 <0.40: 3 0.41-0.70: 18 >0.70: 3	Overall: .63 Countries: 21 <0.40: 1 0.41-0.70: 18 >0.70: 2
Student: computer ratio	Figure 4.1, Figure 4.2, Figure 4.3	Explained in footnotes of figures	Nap	Nap	Nap
Types of computers	Table 4.1.1- Table 4.1.3, Figure 4.4, Figure 4.5,	Number of a particular type divided by the total number of computers available for students in the grade range	Nap	Nap	Nap

Name	Table and/or Figure reference	Underlying items (see Appendix C for questionnaire items: P12-3 meaning Principal questionnaire, question 12, item 3)	Alpha Primary Education	Alpha Lower Secondary Education	Alpha Upper Secondary Education
Availability of types of software Scale Softdiv	Figure 4.10	Items: T30-1 to T30-21 (for primary education without T30-5, T30-8). Answer categories: 1=checked 2=not checked Calculation: Count SoftDiv=BqgSof1 to BqgSof21(2). Compute SoftDiv=SoftDiv*100/21. Count Mis15 =BqgSof1 to BqgSof21(missing). do if Mis15>0. Recode SoftDiv (else=missing). End if.	Overall:.83 Countries: 14 <0.40: 0 0.41-0.70: 2 >0.70: 12	Overall: .84 Countries: 24 <0.40: 0 0.41-0.70: 5 >0.70: 19	Overall: .81 Countries: 21 <0.40: 0 0.41-0.70: 2 >0.70: 19
Software coverage for school subjects Scale SoftCovSu	Figure 4.11	Items: T31-1 to T31-15 Answer categories: 1=checked 2=not checked Calculation: Count SofCovSu=BqgLso1 to BqgLso15(2). Count Mis18 =BqgLso1 to BqgLso15(missing). do if (Mis18>0). Recode SofCovSu(else=sysmis). End if.	Overall:.80 Countries: 12 <0.40: 1 0.41-0.70: 1 >0.70: 10	Overall: .86 Countries: 20 <0.40: 0 0.41-0.70: 2 >0.70: 18	Overall: .81 Countries: 18 <0.40: 0 0.41-0.70: 2 >0.70: 16
Percent available peripherals from a list of 10 Scale PerifDiv	Table G.2.1- Table G.2.3	Items: T28-1 to T28-10 Answer categories: 1=checked 2=not checked Calculation: Count PerifDiv=BqgPer1 to BqgPer10(2). do if (Mis13>0). Recode PerifDiv(0=sysmis). End if.	Overall:.68 Countries: 14 <0.40: 1 0.41-0.70: 9 >0.70: 4	Overall: .77 Countries: 24 <0.40: 1 0.41-0.70: 19 >0.70: 3	Overall: .79 Countries: 20 <0.40: 0 0.41-0.70: 19 >0.70: 1

Name	Table and/or Figure reference	Underlying items (see Appendix C for questionnaire items: P12-3 meaning Principal questionnaire, question 12, item 3)	Alpha Primary Education	Alpha Lower Secondary Education	Alpha Upper Secondary Education
Self-assessment general ICT preparedness Scale IctGen	Figure 5.3	Items: T34-1, T34-3 to T34-6 Answer categories: 1=yes, 2=no, 3=not applicable Calculation: Count IctMis=BqgSuf1 to BqgSuf17(8,9,sysmis). Count IctGen=BqgSuf1 BqgSuf3 to BqgSuf6(1). Compute IctGen=IctGen*100/5. Count IctPed=BqgSuf7 to BqgSuf14(1). Compute IctPed=IctPed*100/8. do if IctMis=17. Recode IctGen IctPed(else=sysmis). End if.	Overall:.70 Countries: 14 <0.40: 0 0.41-0.70: 10 >0.70: 4	Overall: .75 Countries: 24 <0.40: 0 0.41-0.70: 8 >0.70: 16	Overall: .77 Countries: 21 <0.40: 0.41-0.70: >0.70:
Self-assessment instructional ICT-preparedness Scale IctPed	Figure 5.3	Items: T34-7 to T34-14 Answer categories: : 1=yes, 2=no, 3=not applicable Calculation: See IctPed above	Overall:.84 Countries: 14 <0.40: 0 0.41-0.70: 0 >0.70: 14	Overall: .83 Countries: 24 <0.40: 0 0.41-0.70: 0 >0.70: 24	Overall: .82 Countries: 21 <0.40: 0 0.41-0.70: 0 >0.70: 21

Name	Table and/or Figure reference	Underlying items (see Appendix C for questionnaire items: P12-3 meaning Principal questionnaire, question 12, item 3)	Alpha Primary Education	Alpha Lower Secondary Education	Alpha Upper Secondary Education
Principal's attitude toward ICT *4 subscales: Att_ict1 to Att_ict4* *1 overall scale: Att_ict*	Table 6.1	Items P15-1 to P15-24 Four subscales and one overall scale. Answer categories: 1 = strongly disagree, 2 = slightly disagree, 3 = uncertain, 4 = slightly agree, 5 = strongly agree Subscale 1 (P15-1,10,16,18,23) Subscale 2 (P15-5,6,7,9,19,24) Subscale 3 (P15-2,3,4,15,21) Subscale 4 (P15-8,11,12,13,14,20) Overall scale (P15-1 to P15-24) Calculation: reliability.	Subscales: 1) all: .83 Countries: 14 <0.40: 0 0.41-0.70: 0 >0.70: 14 2) all: .79 Countries: 14 <0.40: 0 0.41-0.70: 2 >0.70: 12 3) all: .79 Countries: 14 <0.40: 0 0.41-0.70: 4 >0.70: 10 4) all:.84 Countries: 14 <0.40: 0 0.41-0.70: 0 >0.70: 14 Overall scale: .93 Countries: 14 <0.40: 0 0.41-0.70: 0 >0.70: 14	Subscales: 1) all: .84 Countries: 24 <0.40: 0 0.41-0.70: 2 >0.70: 22 2) all: .76 Countries: 23 <0.40: 0 0.41-0.70: 8 >0.70: 15 3) all: .75 Countries: 24 <0.40: 0 0.41-0.70: 11 >0.70: 13 4) all:.82 Countries: 24 <0.40: 0 0.41-0.70: 0 >0.70: 24 Overall scale: .92 Countries: 23 <0.40: 0 0.41-0.70: 0 >0.70: 23	Subscales: 1) all: .84 Countries: 21 <0.40: 0 0.41-0.70: 3 >0.70: 18 2) all: .77 Countries: 20 <0.40: 2 0.41-0.70: 4 >0.70: 14 3) all: .76 Countries: 21 <0.40: 0 0.41-0.70: 11 >0.70: 10 4) all:.83 Countries: 21 <0.40: 0 0.41-0.70: 1 >0.70: 19 Overall scale: .93 Countries: 20 <0.40: 0 0.41-0.70: 0 >0.70: 20

Name	**Table and/or Figure reference**	**Underlying items (see Appendix C for questionnaire items: P12-3 meaning Principal questionnaire, question 12, item 3)**	**Alpha Primary Education**	**Alpha Lower Secondary Education**	**Alpha Upper Secondary Education**
Explicitness of policies with regard to the use of computers for educational purposes by students Scale Pol	Table 6.2	Items: P9-1 to P9-8. Answer categories: 1=not checked, 2=checked Calculation: Compute ScalPol =Sum.8(BcgPol1 to BcgPol8)-8.	Overall: .69 Countries: 11 <0.40: 0 0.41-0.70: 8 >0.70: 3	Overall: .74 Countries: 20 <0.40: 0 0.41-0.70: 13 >0.70: 7	Overall: .71 Countries: 17 <0.40: 1 0.41-0.70: 8 >0.70: 8
Amount of regulation/ special measures Scale Spm	Table 6.4	Items: P10-3 to P10-8. Answer categories: 1=not checked, 2=checked Calculation: Compute ScalSpm =Sum.6(BcgSpm3 to BcgSpm8)-6.	Overall:.70 Countries: 14 <0.40: 2 0.41-0.70: 9 >0.70: 3	Overall: .65 Countries: 24 <0.40: 4 0.41-0.70: 16 >0.70: 4	Overall: .63 Countries: 21 <0.40: 4 0.41-0.70: 15 >0.70: 2
Administrative use of ICT Scale Oft	Table 6.6	Items: P13-2 to P13-6. Answer categories:1= never, 2=a few times, 3=monthly, 4=weekly/daily Calculation: count ValidOft=BcgOft2 to BcgOft6(1,2,3,4). Do if (ValidOft=5). Count ScalOft =BcgOft2 to BcgOft6(2,3,4). End if. (Or) Recode BcgOft2 to BcgOft6(2,3,4=2). Compute ScalOft =Sum.5(BcgOft2 to BcgOft6)-5.	Overall:.69 Countries: 12 <0.40: 2 0.41-0.70: 10 >0.70: 0	Overall: .69 Countries: 21 <0.40: 10 0.41-0.70: 11 >0.70: 0	Overall: .73 Countries: 18 <0.40: 5 0.41-0.70: 13 >0.70: 0

APPENDI F TABLES REFERRED TO IN C APTER

This appendix contains tables that are mentioned in Chapter 3.

*Table F.1.1 Percentages of students whose school principals indicated that pedagogical practices were present **a lot** in the school—primary education*

	1. Independent learning by students	2. Weaker students: addit. instruct.	3. Differences in entrance level	4. Students learn info-search	5. Emphasis on development skills	6. Same materials, same pace	7. Teach. tracks all stud. activities	8. Studs. responsible own learning	9. Students work at own pace	10. Cooperative projects students	11. Studs. determine self-taking test	12. Students learn by doing	13. Parts school subjects combined	Emerging pedagogical practice	Trad. important pedag. practice
Canada*	52	53	39	65	64	18	63	10	29	42	0	65	45	68 (0.4)	71 (0.5)
China Hong Kong	6	21	24	6	9	42	31	1	2	5	2	13	6	38 (0.7)	57 (1.0)
Chinese Taipei	33	25	37	34	38	50	44	23	27	23	6	47	23	57 (1.4)	68 (1.6)
Cyprus	26	57	34	52	44	29	60	15	59	65	9	62	28	70 (1.3)	69 (1.7)
Finland*	30	31	26	68	49	17	81	15	17	20	0	59	38	64 (0.9)	72 (1.1)
France*	32	30	26	48	53	17	63	9	27	29	2	44	31	59 (1.0)	68 (1.1)
Iceland	14	48	43	31	51	16	73	12	47	14	1	8	3	61 (0.7)	68 (1.0)
Israel*	40	47	37	37	37	8	50	14	36	34	3	35	32	63 (1.7)	57 (1.6)
Italy	32	53	33	29	39	13	28	2	16	22	1	34	35	57 (1.4)	56 (1.6)
Japan	3	4	4	4	4	11	10	5	6	6	1	14	5	28 (1.6)	34 (1.9)
New Zealand	59	47	51	70	56	10	56	14	37	51	1	67	54	72 (1.3)	65 (1.5)
Norway	62	65	44	48	23	1	32	15	33	50	0	37	50	71 (0.3)	44 (0.3)
Singapore	5	32	20	15	42	21	46	6	12	28	0	37	6	54 (0.1)	67 (0.1)
Slovenia	33	39	31	33	20	21	36	21	33	22	5	27	35	56 (1.8)	56 (1.7)

Notes: *: country did not satisfy all sampling criteria. Last two columns: average values and standard errors (in brackets) for indicators of the emerging and traditionally important pedagogical practice paradigms. Standard error (se): value ± 2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

*Table F.1.2 Percentages of students whose school principals indicated that pedagogical practices were present **a lot** in the school—lower secondary education*

	1. Independent learning by students	2. Weaker students: addit. instruct.	3. Differences in entrance level	4. Students learn info-search	5. Emphasis on development skills	6. Same materials, same pace	7. Teach. tracks all stud. activities	8. Studs. responsible own learning	9. Students work at own pace	10. Cooperative projects students	11. Studs. determine self-taking test	12. Students learn by doing	13. Parts school subjects combined	Emerging pedagogical practice	Trad. important pedag. practice
Belgium-French*	28	27	10	36	33	18	19	21	16	17	2	10	13	53 (1.3)	50 (1.8)
Bulgaria	45	12	27	46	57	20	47	21	23	22	2	29	15	50 (1.0)	61 (1.1)
Canada*	46	39	29	71	51	25	62	13	18	34	3	46	14	63 (0.5)	71 (0.6)
China Hong Kong	4	14	15	7	8	33	18	1	1	14	1	7	3	36 (0.5)	52 (0.8)
Chinese Taipei	22	17	36	22	37	41	26	15	22	14	7	44	7	51 (1.1)	64 (1.3)
Cyprus	27	30	23	18	37	28	57	20	29	48	0	51	6	49 (3.2)	55 (4.1)
Czech Republic	15	30	31	34	51	20	60	17	23	5	1	31	33	56 (0.9)	69 (1.1)
Denmark	44	72	41	58	56	2	41	3	27	55	3	11	29	69 (0.8)	61 (1.0)
Finland	27	26	20	57	43	23	79	19	14	12	0	44	6	59 (0.7)	73 (0.9)
France	20	37	15	35	38	28	47	5	10	13	2	17	7	51 (0.9)	64 (1.2)
Hungary	65	42	51	55	52	4	50	45	44	13	1	32	29	69 (0.9)	58 (1.1)
Iceland	8	52	41	23	50	16	69	15	39	10	0	6	4	60 (0.7)	67 (1.2)
Israel*	20	40	22	29	24	16	40	10	25	29	3	16	13	57 (1.5)	57 (1.7)
Italy*	24	25	19	31	26	7	25	8	15	12	2	32	16	52 (1.3)	54 (1.4)
Japan	5	1	2	7	11	14	12	3	7	6	1	16	3	29 (1.1)	44 (1.4)
Lithuania	24	18	20	29	53	7	46	13	26	14	2	28	14	51 (1.1)	61 (1.3)
Luxembourg	16	24	29	41	59	38	46	6	11	12	0	24	10	52 (2.5)	72 (3.1)
New Zealand*	39	32	25	68	46	23	56	6	12	26	2	44	7	60 (0.7)	69 (0.9)
Norway	64	57	36	56	21	0	27	16	29	57	1	32	44	71 (0.3)	43 (0.4)
Russian Federation*	31	23	29	35	66	21	51	14	41	15	7	31	14	50 (2.2)	67 (2.4)
Singapore	15	36	22	24	34	46	50	9	5	14	0	21	4	52 (0.3)	69 (0.1)
Slovenia	46	30	27	45	15	20	33	37	28	23	10	30	29	61 (1.5)	56 (1.6)
South Africa*	38	37	21	44	53	29	53	12	11	28	1	38	9	52 (2.3)	67 (2.5)
Thailand	37	20	42	13	51	46	60	24	34	32	1	46	12	58 (0.7)	75 (0.9)

Notes: *: country did not satisfy all sampling criteria. Last two columns: average values and standard errors (in brackets) for indicators of the emerging and traditionally important pedagogical practice paradigms. Standard error (se): value ± 2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.1.3 Percentages of students whose school principals indicated that pedagogical practices were present ***a lot*** *in the school—upper secondary education*

	1. Independent learning by students	2. Weaker students: addit. instruct.	3. Differences in entrance level	4. Students learn info-search	5. Emphasis on development skills	6. Same materials, same pace	7. Teach. tracks all stud. activities	8. Studs. responsible own learning	9. Students work at own pace	10. Cooperative projects students	11. Studs. determine self-taking test	12. Students learn by doing	13. Parts school subjects combined	Emerging pedagogical practice	Trad. important pedag. practice
Belgium-French*	28	26	11	36	31	18	19	21	15	17	2	10	11	52 (1.3)	49 (1.8)
Bulgaria	46	11	31	50	58	25	49	24	28	22	3	30	12	54 (1.2)	67 (1.3)
Canada*	48	37	26	76	55	26	65	12	18	38	3	53	13	63 (0.5)	73 (0.6)
China Hong Kong	4	14	15	7	8	33	18	1	1	14	1	7	3	36 (0.5)	52 (0.8)
Chinese Taipei	43	27	42	50	66	54	50	22	34	25	7	62	12	60 (1.0)	76 (1.3)
Cyprus	48	39	27	54	51	24	56	41	32	35	7	28	17	64 (1.9)	67 (1.8)
Czech Republic	22	15	27	44	72	24	63	28	16	4	0	50	45	57 (0.8)	76 (1.0)
France	34	11	16	54	55	33	49	9	15	21	1	34	13	52 (1.0)	70 (1.1)
Iceland	11	20	40	41	31	13	36	57	12	8	0	0	0	58 (0.8)	51 (2.3)
Israel*	16	31	13	27	17	18	45	9	20	22	9	14	18	51 (1.4)	57 (1.7)
Italy*	20	20	24	34	30	6	8	21	11	13	19	39	18	53 (1.3)	51 (1.8)
Japan	5	9	9	5	17	17	18	2	8	8	1	15	4	28 (1.4)	42 (1.8)
Latvia*	66	22	62	61	84	14	21	82	63	36	2	70	10	72 (1.3)	63 (1.8)
Lithuania	27	16	21	33	57	10	50	17	23	13	2	35	15	53 (0.4)	65 (0.4)
Luxembourg	20	23	27	44	62	37	43	7	10	13	0	27	9	52 (2.2)	72 (2.7)
Norway	66	44	29	60	21	2	30	20	20	49	2	33	38	68 (0.4)	44 (0.6)
Russian Federation*	31	23	29	35	65	21	51	14	41	15	7	31	14	50 (2.2)	66 (2.4)
Singapore	19	71	25	48	55	55	85	20	18	52	0	59	11	65 (0.4)	83 (0.0)
Slovak Republic*	20	9	16	41	64	19	21	28	19	7	4	29	10	52 (1.0)	63 (1.2)
Slovenia*	36	12	15	58	24	37	19	15	11	24	6	44	23	50 (1.6)	56 (1.8)
South Africa*	36	26	20	35	56	25	48	7	17	18	0	39	7	50 (2.0)	67 (2.3)

Notes: *: country did not satisfy all sampling criteria. Last two columns: average values and standard errors (in brackets) for indicators of the emerging and traditionally important pedagogical practice paradigms. Standard error (se): value ± 2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.2.1 Percentages of students whose school principals indicated that particular instructional objectives were very important (A1-A8) and percentages answering that policy goals were present (B1-B8)—primary education

	A1. Prepare students for future jobs	A2. Improve student achievement	A3. Promote active learning	A4. Individualize learning exper.	A5. Encourage cooperative learning	A6. Develop independent learning	A7. Give drill and practice exercises	A8. Make learning more interesting	B1. More computers in every class	B2. Teachs. use comp. for instruc.	B3. Use by retarded students	B4. Encourage independent learning	B5. Use as supportive learning aids	B6. Students use email	B7. Studs. access external databases	B8. Cooperation with other schools	Objective emerging	Objectives traditional import.
Canada*	21	45	58	39	31	39	16	56	82	78	78	73	86	49	76	53	53 (0.6)	69 (0.6)
China Hong Kong	14	31	55	24	13	49	28	64	44	79	57	77	68	39	45	59	55 (0.8)	66 (1.0)
Chinese Taipei	29	43	52	58	35	48	45	63	36	71	53	80	58	51	57	37	66 (1.4)	67 (1.3)
Cyprus	25	34	30	65	32	51	12	60	57	71	71	61	74	43	37	52	48 (1.8)	66 (3.3)
Finland*	26	21	30	31	26	40	14	35	78	98	94	92	99	79	94	84	52 (1.3)	75 (1.0)
France*	10	35	43	36	26	50	23	42	55	85	83	68	83	53	50	53	48 (1.2)	67 (1.3)
Iceland	63	27	38	36	26	41	41	60	89	83	95	82	98	79	92	70	69 (0.8)	70 (1.1)
Israel*	53	57	69	62	57	77	40	73	60	92	74	93	83	46	55	52	70 (2.1)	78 (1.8)
Italy	12	29	62	44	40	36	19	56	32	84	83	55	58	29	25	54	43 (1.8)	63 (2.1)
Japan	6	3	46	48	30	29	9	46	17	75	45	65	53	20	28	35	29 (1.7)	59 (1.8)
New Zealand	14	45	58	30	31	48	4	49	95	91	84	86	93	77	75	62	40 (1.5)	73 (1.2)
Norway	16	17	37	44	20	30	9	46	83	93	99	89	88	51	73	59	45 (0.3)	67 (0.3)
Singapore	56	54	78	57	59	73	8	80	77	97	81	93	91	61	68	70	64 (0.2)	84 (0.3)
Slovenia	9	19	46	40	31	36	19	79	41	94	59	80	89	71	85	76	46 (1.6)	73 (1.4)

Notes: *: country did not satisfy all sampling criteria. Last two columns: average values and standard errors (in brackets) for indicators of the emerging and traditionally important objectives. Standard error (se): value ± 2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.2.2 Percentages of students whose school principals indicated that particular instructional objectives were very important (A1-A8) and percentages answering that policy goals were present (B1-B8)—lower secondary education

	A1. Prepare students for future jobs	A2. Improve student achievement	A3. Promote active learning	A4. Individualize learning exper.	A5. Encourage cooperative learning	A6. Develop independent learning	A7. Give drill and practice exercises	A8. Make learning more interesting	B1. More computers in every class	B2. Teachs. use comp. for instruc.	B3. Use by retarded students	B4. Encourage independent learning	B5. Use as supportive learning aids	B6. Students use email	B7. Studs. access external databases	B8. Cooperation with other schools	Objective emerging	Objectives traditional import.
Belgium-French*	37	14	51	44	26	51	23	32	24	91	83	62	83	41	78	56	51 (1.5)	68 (1.4)
Bulgaria	52	27	30	24	34	48	44	56	35	76	35	71	82	59	62	62	67 (0.8)	65 (0.9)
Canada*	45	42	50	33	22	32	12	51	58	78	72	70	84	59	82	54	57 (0.7)	65 (0.7)
China Hong Kong	32	33	49	22	23	42	17	38	53	87	57	85	85	69	81	65	60 (0.6)	70 (0.6)
Chinese Taipei	30	23	31	45	22	29	38	59	31	80	58	80	68	80	81	44	62 (1.1)	64 (1.3)
Cyprus	36	11	37	54	66	41	28	36	5	33	23	67	51	20	35	27	49 (3.2)	66 (4.7)
Czech Republic	48	12	40	28	9	35	33	40	12	78	60	65	68	31	46	55	61 (1.1)	59 (1.3)
Denmark	38	8	42	40	37	38	34	33	47	88	77	68	89	62	84	50	55 (1.3)	66 (1.3)
Finland	42	17	22	25	19	28	11	26	74	96	87	92	98	94	98	87	52 (1.1)	72 (1.0)
France	21	28	36	35	21	44	30	39	40	94	86	78	91	50	75	57	51 (1.3)	67 (1.3)
Hungary	64	11	15	19	8	36	14	28	37	89	60	82	91	76	85	84	60 (1.1)	65 (1.2)
Iceland	66	22	34	34	31	42	37	55	89	82	96	82	97	85	93	70	68 (1.0)	70 (1.2)
Israel*	49	53	55	48	57	67	39	66	27	97	79	92	89	58	71	56	71 (1.8)	77 (2.0)
Italy*	50	28	43	23	29	28	47	25	35	93	50	72	87	46	72	58	66 (1.4)	65 (1.7)
Japan	10	2	54	44	18	29	6	37	11	81	38	67	59	23	36	31	32 (1.4)	58 (1.5)
Lithuania	76	35	46	43	36	53	41	54	34	80	56	89	84	69	63	76	74 (1.0)	75 (1.1)
Luxembourg	32	0	14	24	26	37	15	29	74	86	72	62	100	86	100	86	41 (3.6)	67 (2.7)
New Zealand*	31	57	54	27	16	42	7	39	47	87	78	75	95	74	88	56	55 (0.9)	67 (1.1)
Norway	26	15	33	38	22	26	5	40	63	93	99	87	93	71	90	69	45 (0.4)	68 (0.4)
Russian Federation*	35	19	32	28	18	24	18	49	53	37	57	33	35	62	62	43	58 (1.7)	46 (2.0)
Singapore	64	36	69	46	55	63	5	65	61	95	64	89	95	70	82	62	59 (0.2)	80 (0.3)
Slovenia	43	29	59	48	43	51	38	77	49	93	66	90	93	79	89	78	65 (1.7)	80 (1.2)
South Africa*	55	31	26	18	25	37	18	37	20	71	47	66	71	49	57	51	55 (2.6)	54 (2.9)
Thailand	55	33	53	65	36	49	19	49	16	70	36	62	63	26	42	69	63 (0.9)	70 (0.9)

Notes: *: country did not satisfy all sampling criteria. Last two columns: average values and standard errors (in brackets) for indicators of the emerging and traditionally important objectives. Standard error (se): value ± 2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.2.3 Percentages of students whose school principals indicated that particular instructional objectives were very important (A1-A8) and percentages answering that policy goals were present (B1-B8)—upper secondary education

	A1. Prepare students for future jobs	A2. Improve student achievement	A3. Promote active learning	A4. Individualize learning exper.	A5. Encourage cooperative learning	A6. Develop independent learning	A7. Give drill and practice exercises	A8. Make learning more interesting	B1. More computers in every class	B2. Teachs. use comp. for instruc.	B3. Use by retarded students	B4. Encourage independent learning	B5. Use as supportive learning aids	B6. Students use email	B7. Studs. access external databases	B8. Cooperation with other schools	Objective emerging	Objectives traditional import.
Belgium-French*	39	13	50	43	28	53	22	31	24	88	82	66	84	39	78	57	51 (1.4)	70 (1.5)
Bulgaria	60	23	17	21	33	42	46	54	39	75	34	67	74	55	60	58	68 (1.2)	60 (1.3)
Canada*	54	48	56	36	26	45	12	48	53	81	81	68	87	60	86	62	61 (0.6)	69 (0.7)
China Hong Kong	32	33	49	22	23	42	17	38	53	87	57	85	85	69	81	65	60 (0.6)	70 (0.6)
Chinese Taipei	67	34	32	43	27	41	48	49	32	85	49	89	83	93	95	59	74 (1.1)	70 (1.1)
Cyprus	52	20	57	50	66	57	33	33	48	78	41	77	85	54	46	45	57 (1.8)	69 (2.4)
Czech Republic	77	13	34	18	12	41	30	30	18	88	27	70	83	66	79	71	66 (1.1)	65 (1.2)
France	67	21	38	32	20	54	31	30	50	96	67	77	88	56	84	54	62 (1.2)	65 (1.2)
Iceland	75	23	34	31	24	53	26	31	71	67	95	82	100	95	95	92	63 (1.1)	72 (1.3)
Israel*	49	46	55	38	54	61	42	72	31	97	67	97	97	71	88	60	71 (1.7)	78 (1.6)
Italy*	51	23	38	17	30	26	28	46	41	96	58	73	89	51	75	66	63 (1.5)	67 (1.6)
Japan	36	9	38	23	16	25	8	28	10	75	19	56	43	17	34	23	43 (1.5)	48 (1.7)
Latvia*	67	13	51	33	24	35	43	49	45	88	50	90	91	66	74	78	67 (1.7)	74 (1.4)
Lithuania	75	35	46	41	35	48	42	55	37	81	55	91	87	71	66	77	74 (0.3)	75 (0.4)
Luxembourg	35	0	20	27	28	38	14	29	73	87	69	62	98	85	98	85	42 (3.2)	67 (2.7)
Norway	54	17	28	14	22	24	7	38	45	93	96	91	97	81	99	74	52 (0.6)	67 (0.5)
Russian Federation*	35	19	32	28	18	24	18	49	53	37	57	33	35	62	62	43	58 (1.7)	46 (2.0)
Singapore	81	40	76	35	59	65	27	45	80	95	40	91	95	90	95	65	70 (0.0)	81 (0.6)
Slovak Republic*	81	26	28	29	17	49	23	46	70	20	90	44	28	33	27	36	66 (1.3)	46 (1.4)
Slovenia	57	15	34	26	24	27	33	52	48	95	50	85	93	92	94	95	60 (1.6)	72 (1.3)
South Africa*	63	24	26	22	31	38	12	27	23	66	45	71	69	49	55	51	54 (2.2)	59 (2.5)

Notes: *: country did not satisfy all sampling criteria. Last two columns: average values and standard errors (in brackets) for indicators of the emerging and traditionally important objectives. Standard error (se): value ± 2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.3.1 Percentages of students whose schools (technical respondents) indicated which percentages of teachers (from the grade range) and students (at the end of the target grade) would have used email—primary education

	% Teachers using email: none	% Teachs. using email: under 10%	% Teachers using email: 11-25%	% Teachers using email: 26-50%	% Teachers using email: 51-75%	% Teachers using email: 76-100%	% Students using email: none	% Students using email: under 10%	% Students using email: 11-25%	% Students using email: 26-50%	% Students using email: 51-75%	% Students using email: 76-100%
Canada*	30	9	3	10	10	38	29	7	7	8	9	41
China Hong Kong	94	1	4	1	0	0	94	4	0	1	0	1
Chinese Taipei	81	9	3	3	1	2	83	6	4	1	0	6
Cyprus	82	14	2	2	0	0	79	12	0	7	0	3
Finland*	18	5	10	16	18	33	18	6	7	8	15	46
France*	85	5	2	2	2	4	86	3	1	1	2	6
Iceland	70	5	2	9	6	9	70	8	2	5	4	11
Israel*	83	11	2	2	1	2	85	7	2	1	1	5
Italy	90	7	2	1	0	0	90	4	1	2	1	2
Japan	86	5	2	3	1	4	88	2	0	1	0	9
New Zealand	36	15	9	17	9	14	34	19	9	11	10	18
Norway	50	20	13	9	4	4	57	22	9	4	1	6
Singapore	52	17	13	12	3	3	56	18	10	7	4	6
Slovenia	74	20	4	2	1	0	74	20	5	0	0	2

Notes: *: country did not satisfy all sampling criteria. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.3.2 Percentages of students whose schools (technical respondents) indicated which percentages of teachers (from the grade range) and students (at the end of the target grade) would have used email—lower secondary education

	% Teachers using email: none	% Teachs. using email: under 10%	% Teachers using email: 11-25%	% Teachers using email: 26-50%	% Teachers using email: 51-75%	% Teachers using email: 76-100%	% Students using email: none	% Students using email: under 10%	% Students using email: 11-25%	% Students using email: 26-50%	% Students using email: 51-75%	% Students using email: 76-100%
Belgium-French*	65	18	12	4	0	0	69	10	9	5	4	2
Bulgaria	78	17	4	1	0	0	79	11	7	1	1	1
Canada*	18	23	20	17	14	9	18	4	8	14	16	41
China Hong Kong	68	16	7	1	4	4	69	7	7	4	3	10
Chinese Taipei	44	25	7	5	4	14	46	13	5	11	3	22
Cyprus	91	9	0	0	0	0	91	6	2	0	0	1
Czech Republic	80	11	7	2	0	0	78	2	3	4	3	10
Denmark	15	21	22	21	13	7	16	12	12	9	16	35
Finland	5	12	30	27	20	7	5	1	2	10	21	63
France	59	29	9	2	0	0	62	12	9	7	3	6
Hungary	69	19	5	6	0	1	67	3	6	4	4	15
Iceland	41	11	12	11	10	16	38	5	4	2	7	43
Israel*	68	21	6	2	1	2	70	11	6	5	2	5
Italy*	44	29	16	6	3	1	54	25	8	6	3	3
Japan	75	19	5	1	0	0	75	8	3	2	1	12
Lithuania	63	32	3	2	0	0	65	19	8	3	2	3
Luxembourg	3	58	26	13	0	0	3	17	31	3	0	45
New Zealand*	27	26	22	17	3	5	27	18	12	10	6	28
Norway	22	19	22	20	13	4	25	15	12	11	12	25
Russian Federation*	~	~	~	~	~	~	~	~	~	~	~	~
Singapore	30	23	12	17	11	7	29	15	10	15	6	25
Slovenia	32	32	25	8	2	1	31	22	33	8	2	5
South Africa*	69	15	6	4	4	1	68	10	3	2	1	16
Thailand	86	11	2	1	0	0	85	8	2	2	1	1

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.3.3 Percentages of students whose schools (technical respondents) indicated which percentages of teachers (from the grade range) and students (at the end of the target grade) would have used email—upper secondary education

	% Teachers using email: none	% Teachs. using email: under 10%	% Teachers using email: 11-25%	% Teachers using email: 26-50%	% Teachers using email: 51-75%	% Teachers using email: 76-100%	% Students using email: none	% Students using email: under 10%	% Students using email: 11-25%	% Students using email: 26-50%	% Students using email: 51-75%	% Students using email: 76-100%
Belgium-French*	44	31	21	3	1	0	45	20	9	8	13	5
Bulgaria	84	13	2	0	0	1	84	5	5	5	0	1
Canada*	8	20	22	20	17	14	8	4	6	11	18	52
China Hong Kong	50	29	10	4	3	5	50	16	10	12	5	7
Chinese Taipei	22	21	17	14	13	13	19	11	9	17	14	30
Cyprus	87	13	0	0	0	0	85	9	6	0	0	0
Czech Republic	40	27	21	8	3	1	39	3	4	7	13	34
France	36	44	13	5	1	1	37	31	15	7	6	4
Iceland	6	18	15	20	26	16	6	10	8	0	23	53
Israel*	50	29	14	5	1	1	48	19	18	5	6	4
Italy*	43	31	18	6	1	1	43	19	19	8	7	3
Japan	69	25	4	1	0	0	71	20	3	3	1	1
Latvia*	63	27	6	1	2	1	67	16	9	2	2	4
Lithuania	39	48	8	4	1	1	38	26	13	8	6	9
Luxembourg	3	50	18	21	8	0	6	23	11	31	15	15
Norway	2	17	32	31	16	2	2	10	8	16	20	45
Russian Federation*	~	~	~	~	~	~	~	~	~	~	~	~
Singapore	2	9	24	9	12	44	2	1	8	7	14	67
Slovak Republic*	41	30	24	4	1	0	39	15	10	17	14	5
Slovenia	12	29	22	19	12	7	12	25	9	11	12	31
South Africa*	56	25	11	4	2	2	56	20	8	3	3	9

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.4.1 Percentages of students whose schools (technical respondents) indicated that typical students by the end of the target grade would have practiced particular Internet/WWW-related activities—primary education

	1. Email teachs. inside/outside school	2. Email peers in/outside country	3. Group projects in/outside school	4. Info. from external databases	5. Design/maintenance web sites	6. Disseminate/publish information	7. Discussion video conferencing	8. Other Internet-related activities
Canada*	25	30	18	55	6	24	3	8
China Hong Kong	4	2	2	6	1	1	0	0
Chinese Taipei	8	3	2	20	2	1	1	0
Cyprus	2	17	10	16	6	17	2	2
Finland*	22	41	10	66	13	8	4	6
France*	2	11	5	13	5	7	0	1
Iceland	3	6	3	16	4	2	0	5
Israel*	2	12	4	13	1	2	2	5
Italy	10	9	6	7	0	2	2	1
Japan	4	7	7	11	1	6	2	0
New Zealand	26	43	21	43	5	29	6	8
Norway	7	15	5	37	2	5	1	4
Singapore	17	18	12	29	4	12	3	5
Slovenia	0	3	4	14	0	0	0	1

Notes: *: country did not satisfy all sampling criteria. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.4.2 Percentages of students whose schools (technical respondents) indicated that typical students by the end of the target grade would have practiced particular Internet/WWW-related activities—lower secondary education

	1. Email teachs. inside/outside school	2. Email peers in/outside country	3. Group projects in/outside school	4. Info. from external databases	5. Design/maintenance web sites	6. Disseminate/publish information	7. Discussion video conferencing	8. Other Internet-related activities
Belgium-French*	16	15	3	28	8	5	4	1
Bulgaria	8	15	10	10	4	5	1	2
Canada*	28	37	19	66	19	26	3	10
China Hong Kong	11	10	4	27	11	6	1	0
Chinese Taipei	21	11	7	53	12	7	0	2
Cyprus	1	2	1	5	0	1	0	0
Czech Republic	7	16	7	13	8	3	4	3
Denmark	16	44	23	84	12	8	3	16
Finland	29	49	12	79	48	12	4	10
France	10	23	17	28	11	8	2	3
Hungary	12	22	4	27	1	2	0	6
Iceland	12	39	19	49	21	9	3	18
Israel*	9	16	9	22	3	2	5	5
Italy*	23	18	12	28	7	12	4	4
Japan	5	6	5	18	1	9	0	0
Lithuania	18	22	14	13	3	1	4	5
Luxembourg	39	38	37	64	12	14	7	16
New Zealand*	25	36	14	53	12	18	6	7
Norway	8	23	14	66	6	6	3	12
Russian Federation*	~	~	~	~	~	~	~	~
Singapore	34	54	21	55	40	24	7	10
Slovenia	31	40	33	51	28	23	9	9
South Africa*	14	20	8	16	4	5	0	1
Thailand	5	7	2	10	2	4	0	1

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.4.3 Percentages of students whose schools (technical respondents) indicated that typical students by the end of the target grade would have practiced particular Internet/WWW-related activities—upper secondary education

	1. Email teachs. inside/outside school	2. Email peers in/outside country	3. Group projects in/outside school	4. Info. from external databases	5. Design/maintenance web sites	6. Disseminate/publish information	7. Discussion video conferencing	8. Other Internet-related activities
Belgium-French*	28	35	16	49	18	22	11	3
Bulgaria	5	11	4	9	4	2	1	3
Canada*	43	56	35	80	50	36	9	12
China Hong Kong	30	22	10	36	25	16	2	0
Chinese Taipei	58	41	13	84	43	29	1	1
Cyprus	3	10	10	10	3	10	0	0
Czech Republic	21	45	15	46	25	16	10	10
France	23	29	21	53	18	14	4	7
Iceland	55	52	23	77	17	4	13	18
Israel*	16	32	11	50	14	9	9	10
Italy*	37	26	19	38	19	18	8	4
Japan	6	9	4	15	2	4	1	0
Latvia*	12	29	17	31	9	4	4	13
Lithuania	32	43	24	27	12	6	8	12
Luxembourg	55	64	41	60	43	22	9	17
Norway	17	46	21	85	11	8	11	15
Russian Federation*	~	~	~	~	~	~	~	~
Singapore	77	90	40	93	38	27	14	20
Slovak Republic*	32	18	36	26	37	35	15	14
Slovenia	44	44	34	70	31	17	5	14
South Africa*	23	29	10	27	11	12	2	1

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.5.1 Percentages of students whose school principals indicated per instructional activity that it had been realized a lot with the help of ICT—primary education

	1. Independent learning by students	2. Weaker students: addit. instruct.	3. Differences in entrance level	4. Students learn info-search	5. Emphasis on development skills	6. Same materials, same pace	7. Teachs. track all stud. activities	8. Studs. responsible own learning	9. Students work at own pace	10. Cooperative projects students	11. Studs. determine self-taking test	12. Students learn by doing	13. Parts school subjects combined	ICT opportunities emerging	ICT opportunities trad. important
Canada*	25	19	17	52	29	8	21	9	26	27	3	45	26	56 (0.5)	52 (0.5
Chinese Taipei	21	16	25	28	31	34	29	24	25	16	9	37	21	51 (1.6)	59 (1.8)
Cyprus	64	34	49	63	49	7	53	40	55	40	7	76	29	68 (2.9)	62 (2.0)
Finland*	10	12	8	35	14	9	18	8	20	16	0	35	22	53 (1.1)	47 (1.5)
France*	17	10	13	30	25	8	15	11	24	20	2	36	22	46 (1.3)	43 (1.4)
China Hong Kong	10	10	11	16	12	11	8	4	12	9	8	19	13	30 (1.4)	36 (1.5)
Iceland	5	19	17	18	21	9	18	6	23	7	4	11	2	43 (1.5)	43 (1.7)
Israel*	33	24	26	27	30	14	25	18	39	36	4	30	31	54 (2.5)	46 (2.6)
Italy	11	26	15	21	13	4	12	6	16	19	3	29	31	41 (2.2)	32 (2.1)
Japan	9	6	3	14	6	4	6	9	17	7	2	12	8	25 (1.9)	24 (1.7)
New Zealand	25	10	13	50	22	10	17	8	15	24	10	36	25	57 (1.2)	51 (1.7)
Norway	13	49	14	39	11	3	2	7	15	16	1	23	13	52 (0.3)	33 (0.3)
Singapore	29	26	16	39	35	18	32	26	35	33	6	45	25	61 (0.3)	62 (0.2)
Slovenia	20	9	21	30	16	18	31	26	38	23	5	30	32	46 (2.2)	46 (2.3)

Notes: *: country did not satisfy all sampling criteria. Last two columns: average values and standard errors (in brackets) for indicators of the emerging and traditionally important ICT opportunities. Standard error (se): value ± 2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.5.2 Percentages of students whose school principals indicated per instructional activity that it had been realized a lot with the help of ICT—lower secondary education

	1. Independent learning by students	2. Weaker students: addit. instruct.	3. Differences in entrance level	4. Students learn info-search	5. Emphasis on development skills	6. Same materials, same pace	7. Teachs. track all stud. activities	8. Studs. responsible own learning	9. Students work at own pace	10. Cooperative projects students	11. Studs. determine self-taking test	12. Students learn by doing	13. Parts school subjects combined	ICT opportunities emerging	ICT opportunities trad. important
Belgium-French*	7	7	5	24	7	4	3	12	16	9	2	9	6	37 (1.6)	25 (1.7)
Bulgaria	21	9	18	36	45	13	30	21	27	26	6	38	17	41 (1.2)	50 (1.3)
Canada*	28	19	11	68	24	8	48	12	20	24	4	34	16	56 (0.6)	57 (0.6)
Chinese Taipei	13	9	24	19	28	21	15	10	19	13	9	33	9	47 (1.2)	56 (1.3)
Cyprus	30	1	9	26	23	16	30	13	23	35	8	34	13	44 (3.5)	43 (3.9)
Czech Republic	40	12	32	48	44	14	40	24	46	14	8	43	36	51 (1.7)	55 (1.8)
Denmark	24	30	18	58	26	2	8	5	33	45	3	26	24	62 (0.9)	46 (1.0)
Finland	16	4	9	47	22	8	26	12	21	11	0	38	9	51 (1.0)	51 (1.3)
France	15	20	10	26	13	6	12	7	19	14	3	21	12	44 (1.3)	42 (1.4)
China Hong Kong	13	6	10	24	13	9	13	7	14	16	15	19	8	40 (0.9)	42 (0.9)
Hungary	39	9	30	72	31	11	24	20	40	24	2	38	30	56 (1.4)	47 (1.6)
Iceland	5	22	19	19	19	8	22	8	26	8	3	11	2	47 (1.4)	46 (1.9)
Israel*	34	33	24	39	29	15	33	21	37	36	4	30	19	58 (2.1)	52 (2.3)
Italy*	10	13	5	35	23	6	12	4	11	15	4	33	21	41 (1.7)	43 (1.7)
Japan	12	4	3	19	17	8	17	9	18	11	1	17	4	31 (1.5)	41 (1.6)
Lithuania	16	3	9	26	28	6	20	7	16	11	1	24	9	36 (1.3)	42 (1.6)
Luxembourg	12	0	18	64	33	19	29	6	17	19	6	39	22	46 (3.1)	56 (3.7)
New Zealand*	12	11	7	53	14	4	32	6	13	10	2	20	9	53 (1.1)	53 (0.9)
Norway	16	45	9	55	7	2	2	5	11	21	1	20	15	53 (0.4)	32 (0.4)
Russian Federation*	13	5	21	28	40	11	29	9	35	14	6	28	10	40 (2.6)	50 (3.1)
Singapore	25	12	13	42	29	21	27	16	15	27	4	25	13	53 (0.5)	57 (0.3)
South Africa	15	15	10	35	41	15	21	14	28	24	3	45	8	41 (2.6)	49 (3.0)
Thailand	16	6	18	10	24	22	25	14	18	16	2	29	7	47 (0.9)	57 (1.0)
Slovenia	45	8	28	46	21	15	35	40	44	26	10	34	31	56 (2.0)	50 (2.2)

Notes: *: country did not satisfy all sampling criteria. Last two columns: average values and standard errors (in brackets) for indicators of the emerging and traditionally important ICT opportunities. Standard error (se): value ± 2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table F.5.3 Percentages of students whose school principals indicated per instructional activity that it had been realized a lot with the help of ICT—upper secondary education

	1. Independent learning by students	2. Weaker students: addit. instruct.	3. Differences in entrance level	4. Students learn info-search	5. Emphasis on development skills	6. Same materials, same pace	7. Teachs. track all stud. activities	8. Studs. responsible own learning	9. Students work at own pace	10. Cooperative projects students	11. Studs. determine self-taking test	12. Students learn by doing	13. Parts school subjects combined	ICT opportunities emerging	ICT opportunities trad. important
Belgium-French*	7	5	4	24	6	4	4	10	14	9	2	8	6	36 (1.6)	25 (1.6)
Bulgaria	20	1	16	36	44	12	28	19	25	19	3	28	16	43 (1.4)	53 (1.5)
Canada*	34	19	16	76	32	9	48	13	23	27	4	44	21	59 (0.6)	60 (0.6)
Chinese Taipei	30	18	28	40	57	35	36	18	23	27	6	53	14	56 (1.2)	68 (1.3)
Cyprus	39	19	36	57	54	18	52	28	50	48	15	50	32	58 (2.7)	65 (1.8)
Czech Republic	44	8	25	66	58	24	42	25	40	20	5	54	44	56 (1.4)	62 (1.7)
France	28	9	13	41	36	14	22	10	18	19	3	29	12	46 (1.3)	54 (1.4)
China Hong Kong	13	6	10	24	13	9	13	7	14	16	15	19	8	40 (0.9)	42 (0.9)
Iceland	5	4	4	30	12	0	15	8	11	8	0	0	0	47 (1.1)	47 (1.8)
Israel*	26	21	22	45	19	13	26	16	29	42	8	27	21	52 (2.1)	48 (2.2)
Italy*	11	9	9	35	19	7	7	11	8	13	16	36	17	42 (1.7)	42 (2.2)
Japan	13	5	3	12	33	9	16	6	10	13	1	16	4	27 (1.5)	42 (1.8)
Latvia*	57	17	44	58	59	19	21	51	69	46	13	71	30	67 (2.1)	57 (2.5)
Lithuania	18	3	9	33	32	8	21	7	20	11	3	31	10	40 (0.5)	47 (0.5)
Luxembourg	11	0	17	63	34	21	27	6	19	21	6	40	21	46 (2.8)	56 (3.4)
Norway	21	29	10	73	10	3	6	8	18	29	1	27	18	57 (0.4)	36 (0.6)
Russian Federation*	13	5	21	28	40	11	29	9	35	14	6	28	10	40 (2.6)	50 (3.1)
Singapore	21	23	0	64	23	18	69	6	31	48	4	25	4	58 (0.0)	67 (0.0)
Slovak Republic*	26	4	15	47	52	17	12	32	31	15	5	43	14	49 (1.6)	55 (1.6)
South Africa*	18	16	12	36	34	11	29	12	20	20	2	42	16	45 (2.5)	52 (2.6)

Notes: *: country did not satisfy all sampling criteria. Last two columns: average values and standard errors (in brackets) for indicators of the emerging and traditionally important ICT-opportunities. Standard error (se): value ± 2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

APPENDI G TABLES REFERRED TO IN C APTER

This appendix contains tables that are mentioned in Chapter 4.

References to Tables G.7.1–G.7.3 and G.8.1–G.8.3 are also made in other chapters.

Table G.1.1 Alternative indices of student:computer ratios in primary education (see notes for explanation)

	Stud.: comp. ratio country aggreg.	Stud.: comp. grade range using stud.		Stud.: comp. ratio grade r. all stud.		Student: comp. ratio whole school		% using students (whole school)	
Canada*	8	2.5	(0.1)	3.6	(0.2)	11.1	(0.2)	93	(0.5)
China Hong Kong	25	9.2	(0.9)	36.2	(5.8)	53.3	(5.0)	39	(3.1)
Chinese Taipei	81	7.6	(0.7)	67.7	(3.8)	74.3	(6.2)	42	(1.9)
Cyprus	183	24.0	(4.3)	32.7	(4.8)	49.5	(4.5)	64	(6.7)
Finland*	12	8.7	(0.4)	8.5	(0.4)	16.3	(0.6)	89	(1.4)
France*	25		~		~	37.9	(2.3)	71	(1.9)
Iceland	13	3.0	(0.3)	3.3	(0.3)	20.5	(1.0)	84	(2.3)
Israel*	16	4.4	(0.8)	24.1	(6.9)	23.1	(2.5)	86	(2.7)
Italy	88	8.4	(0.8)	101.5	(9.6)	157.7	(14.4)	25	(2.2)
Japan	28	16.5	(1.5)	62.1	(6.0)	58.6	(4.6)	47	(3.2)
New Zealand	14	12.3	(0.6)	12.8	(0.7)	20.2	(1.0)	95	(1.1)
Norway	13	8.2	(0.2)	10.3	(0.3)	22.9	(0.6)	67	(1.0)
Singapore	12	5.9	(0.2)	6.0	(0.1)	16.9	(0.4)	94	(1.2)
Slovenia	23	8.1	(0.6)	10.4	(0.6)	41.3	(2.0)	70	(2.7)

Calculations:
Column 1: total number of students divided by total number of computers in all schools in a country (computer-using as well as non-using).
Column 2: total number of students in the grade range USING the available equipment divided by total number of computers accessible for the grade range. Mean values per country across computer-using schools. Standard errors in brackets.
Column 3: total number of students in the grade range divided by total number of computers accessible for the grade range. Mean values per country across computer-using schools. Standard errors in brackets.
Column 4: total number of students in the school divided by total number of computers in the school. Mean values per country across computer-using schools. Standard errors in brackets.
Column 5: percentage of students using computers divided by total number of students per school. Mean values per country across computer-using schools. Standard errors in brackets.

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. Standard error (se): value ±2*se provides 95% confidence interval for the population.

Table G.1.2 Alternative indices of student:computer ratios in lower secondary education (see notes for explanation)

	Stud.: comp. ratio country aggreg.	Stud.: comp. grade range using stud.	Stud.: comp. ratio grade r. all stud.	Student: comp. ratio whole school	% using students (whole school)
Belgium-French*	25	8.4 (0.6)	15.7 (1.1)	29.7 (1.6)	43 (1.8)
Bulgaria	238	8.2 (0.4)	28.5 (1.0)	80.5 (2.7)	33 (1.0)
Canada*	7	2.1 (0.1)	3.0 (0.1)	8.8 (0.1)	75 (0.9)
China Hong Kong	23	20.3 (0.9)	26.9 (2.7)	35.7 (0.5)	77 (1.0)
Chinese Taipei	25	11.1 (0.4)	35.9 (1.2)	35.3 (1.8)	43 (1.2)
Cyprus	216	112.2 (8.5)	222.0 (10.9)	210.1 (10.3)	71 (3.7)
Czech Republic	34	12.6 (0.6)	15.8 (0.6)	43.7 (1.4)	45 (1.8)
Denmark	9	3.8 (0.1)	3.8 (0.1)	11.7 (0.4)	93 (0.8)
Finland	10	10.2 (0.3)	12.1 (0.4)	13.5 (0.4)	86 (1.1)
France	17	10.1 (0.5)	11.7 (0.5)	24.3 (0.9)	91 (1.3)
Hungary	25	2.8 (0.1)	8.1 (0.4)	35.6 (1.6)	48 (1.4)
Iceland	12	2.1 (0.1)	2.2 (0.1)	18.8 (0.5)	84 (1.7)
Israel*	14	4.5 (0.4)	13.4 (1.3)	18.2 (2.3)	83 (2.6)
Italy*	16	4.6 (0.3)	10.4 (2.0)	30.1 (6.4)	67 (2.4)
Japan	14	11.5 (0.7)	24.8 (2.5)	21.4 (0.9)	67 (2.5)
Lithuania	90	10.6 (0.9)	37.5 (2.4)	133.5 (8.0)	28 (1.3)
Luxembourg	12	6.5 (1.1)	10.3 (1.6)	15.6 (0.8)	70 (4.1)
New Zealand*	8	3.5 (0.1)	4.5 0.2)	10.3 (0.2)	79 (1.2)
Norway	9	7.6 (0.1)	10.2 (0.2)	13.8 (0.2)	79 (0.6)
Russian Federation	122	6.5 (1.1)	44.1 (10.2)	127.3 (31.7)	25 (1.8)
Singapore	8	4.3 (0.1)	5.6 (0.0)	11.8 (0.1)	82 (0.4)
Slovenia	25	9.8 (0.5)	11.2 (0.8)	39.5 (1.7)	71 (2.4)
South Africa*	123	3.5 (0.4)	9.4 (1.6)	41.6 (6.0)	47 (3.9)
Thailand	62	9.6 (0.5)	41.1 (5.8)	52.2 (1.8)	41 (1.3)

Calculations:
Column 1: total number of students divided by total number of computers in all schools in a country (computer-using as well as non-using).
Column 2: total number of students in the grade range USING the available equipment divided by total number of computers accessible for the grade range. Mean values per country across computer-using schools. Standard errors in brackets.
Column 3: total number of students in the grade range divided by total number of computers accessible for the grade range. Mean values per country across computer-using schools. Standard errors in brackets.
Column 4: total number of students in the school divided by total number of computers in the school. Mean values per country across computer-using schools. Standard errors in brackets.
Column 5: percentage of students using computers divided by total number of students per school. Mean values per country across computer-using schools. Standard errors in brackets.

Notes: *: country did not satisfy all sampling criteria. Standard error (se): value ±2*se provides 95% confidence interval for the population.

Table G.1.3 Alternative indices of student:computer ratios in upper secondary education (see notes for explanation)

	Stud.: comp. ratio country aggreg.	Stud.: comp. grade range using stud.	Stud.: comp. ratio grade r. all stud.	Student: comp. ratio whole school	% using students (whole school)
Belgium-French*	26	2.9 (0.2)	6.0 (0.7)	33.2 (2.4)	42 (1.9)
Bulgaria	54	14.3 (0.7)	36.5 (2.6)	74.3 (4.4)	31 (1.5)
Canada*	6	1.7 (0.1)	3.6 (0.1)	8.0 (0.1)	77 (0.9)
China Hong Kong	22	7.9 (0.3)	15.4 (0.3)	35.6 (0.5)	77 (1.0)
Chinese Taipei	9	3.4 (0.3)	28.9 (7.7)	14.7 (0.7)	67 (1.7)
Cyprus	18	12.9 (0.3)	26.9 (1.9)	22.3 (0.3)	59 (0.7)
Czech Republic	10	2.6 (0.1)	8.9 (0.4)	17.4 (0.7)	79 (1.5)
France	7	2.3 (0.1)	3.6 (0.2)	10.9 (0.7)	73 (1.7)
Iceland	11	4.0 (0.3)	4.7 (0.3)	17.0 (0.6)	79 (1.9)
Israel*	14	1.9 (0.2)	9.4 (1.0)	15.0 (0.8)	73 (2.4)
Italy*	14	3.1 (0.4)	16.5 (2.1)	24.4 (1.9)	68 (2.5)
Japan	12	5.1 (0.6)	33.5 (6.0)	34.1 (5.4)	32 (2.1)
Latvia*	33	9.0 (0.8)	12.6 (1.0)	52.9 (2.8)	32 (1.5)
Lithuania	76	8.5 (0.2)	14.8 (0.4)	136.9 (3.7)	27 (0.5)
Luxembourg	12	5.2 (0.8)	4.8 (0.6)	16.3 (0.9)	72 (3.5)
Norway	4	4.0 (0.1)	5.8 (0.1)	5.8 (0.1)	85 (0.6)
Russian Federation*	121	12.5 (1.1)	22.4 (4.5)	131.6 (31.9)	24 (1.8)
Singapore	3	2.5 (0.1)	4.5 (0.4)	7.0 (0.0)	92 (0.3)
Slovak Republic*	16	13.6 (0.5)	21.9 (1.1)	23.9 (0.8)	~
Slovenia*	11	12.8 (1.0)	22.6 (1.7)	23.2 (1.7)	75 (2.2)
South Africa*	111	1.3 (0.2)	6.1 (0.8)	35.3 (2.6)	43 (3.4)

Calculations:
Column 1: total number of students divided by total number of computers in all schools in a country (computer-using as well as non-using).
Column 2: total number of students in the grade range USING the available equipment divided by total number of computers accessible for the grade range. Mean values per country across computer-using schools. Standard errors in brackets.
Column 3: total number of students in the grade range divided by total number of computers accessible for the grade range. Mean values per country across computer-using schools. Standard errors in brackets.
Column 4: total number of students in the school divided by total number of computers in the school. Mean values per country across computer-using schools. Standard errors in brackets.
Column 5: percentage of students using computers divided by total number of students per school. Mean values per country across computer-using schools. Standard errors in brackets.

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. Standard error (se): value ±2*se

Table G.2.1 Percentages of students whose schools possessed particular peripherals for use at the grade range—primary education

	1. Laser printer	2. CD-ROM drive	3. Devices for disabled students	4. Devices digital image processing	5. Color printer	6. CD writer	7. Graphic tables	8. Video projector	9. Scanner	10. LCD panel	% available periph. from list of 10
Canada*	79	97	16	33	65	4	1	17	47	13	37 (0.5)
China Hong Kong	52	79	0	9	79	9	2	27	71	6	34 (1.4)
Chinese Taipei	24	44	0	1	50	2	2	4	14	0	14 (1.1)
Cyprus	5	93	0	0	88	0	0	8	17	0	21 (1.3)
Finland*	79	98	13	25	73	7	2	9	58	1	37 (1.1)
France*	20	80	0	8	71	1	2	5	40	0	23 (0.8)
Iceland	80	89	16	23	65	2	0	77	65	1	42 (1.5)
Israel*	28	77	9	9	87	3	4	16	58	3	29 (1.5)
Italy	20	76	16	29	73	26	7	13	66	4	33 (1.6)
Japan	38	68	0	30	71	5	9	32	57	4	32 (1.5)
New Zealand	33	98	21	48	91	6	1	12	52	1	36 (1.1)
Norway	56	86	34	15	72	2	4	6	37	3	32 (0.5)
Singapore	44	100	0	52	98	16	1	75	72	56	51 (1.2)
Slovenia	72	84	1	22	79	6	8	29	53	46	40 (1.8)

Notes: *: country did not satisfy all sampling criteria. Last column: average percentage (standard errors in brackets) of available peripherals across schools. Standard error (se): value ±2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.2.2 Percentages of students whose schools possessed particular peripherals for use at the grade range—ower secondary education

	1. Laser printer	2. CD-ROM drive	3. Devices for disabled students	4. Devices digital image processing	5. Color printer	6. CD writer	7. Graphic tables	8. Video projector	9. Scanner	10. LCD panel	% available periph. from list of 10
Belgium-French*	29	70	2	10	49	4	6	15	36	10	23 (1.4)
Bulgaria	26	44	0	1	20	1	1	0	14	0	11 (0.5)
Canada*	91	95	22	55	65	19	11	48	67	28	50 (0.6)
China Hong Kong	83	91	0	21	86	12	7	56	85	66	51 (0.7)
Chinese Taipei	44	57	1	5	75	6	0	12	40	0	24 (1.0)
Cyprus	8	56	0	0	77	0	0	5	0	0	15 (0.7)
Czech Republic	31	79	2	3	51	3	1	10	27	7	21 (0.9)
Denmark	96	98	9	65	78	21	2	18	94	7	49 (0.9)
Finland	99	98	8	43	87	19	3	19	91	4	47 (0.7)
France	37	97	1	27	90	15	23	13	77	9	39 (0.8)
Hungary	35	88	2	9	48	4	0	3	41	3	23 (0.8)
Iceland	86	93	15	24	70	1	0	75	74	1	44 (0.8)
Israel*	42	90	10	19	91	9	11	36	78	6	39 (1.6)
Italy*	55	89	15	36	77	42	15	55	74	21	48 (1.7)
Japan	63	79	4	43	76	12	14	50	70	6	42 (1.4)
Lithuania	10	59	0	2	23	2	1	5	16	0	12 (0.7)
Luxembourg	100	100	0	45	86	34	39	94	100	74	67 (1.9)
New Zealand*	92	94	16	53	66	10	10	29	74	9	45 (0.9)
Norway	82	89	28	26	72	6	2	21	65	12	40 (0.3)
Russian Federation*	13	37	0	0	20	0	0	8	10	0	9 (1.2)
Singapore	82	99	3	56	97	34	7	82	96	44	60 (0.0)
Slovenia	75	92	3	25	89	11	14	36	61	54	46 (1.4)
South Africa*	47	67	0	10	47	6	2	15	38	7	24 (2.0)
Thailand	19	52	1	18	34	4	0	15	22	9	17 (0.7)

Notes: *: country did not satisfy all sampling criteria. Last column: average percentage (standard errors in brackets) of available peripherals across schools. Standard error (se): value ±2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.2.3 Percentages of students whose schools possessed particular peripherals for use at the grade range—upper secondary education

	1. Laser printer	2. CD-ROM drive	3. Devices for disabled students	4. Devices digital image processing	5. Color printer	6. CD writer	7. Graphic tables	8. Video projector	9. Scanner	10. LCD panel	% available periph. from list of 10
Belgium-French*	50	86	0	9	54	6	6	17	46	16	29 (1.2)
Bulgaria	19	36	0	1	21	1	1	1	9	0	9 (0.7)
Canada*	97	98	26	74	77	33	17	54	83	34	59 (0.6)
China Hong Kong	94	96	0	25	92	15	6	57	92	70	55 (0.5)
Chinese Taipei	42	70	4	6	69	11	6	34	46	8	30 (1.1)
Cyprus	99	99	2	0	26	0	0	28	40	6	30 (0.5)
Czech Republic	79	90	1	11	70	15	11	27	70	24	40 (1.1)
France	68	98	2	27	85	19	30	33	75	32	47 (1.1)
Iceland	100	95	26	25	60	25	0	71	70	0	47 (1.2)
Israel*	49	89	13	16	91	17	6	56	76	6	42 (1.4)
Italy*	63	92	17	48	85	56	24	61	84	20	55 (1.6)
Japan	84	87	0	35	66	21	6	43	66	5	41 (1.5)
Latvia*	62	90	1	5	67	4	0	10	45	3	29 (1.1)
Lithuania	14	58	0	3	22	2	1	3	13	1	12 (0.2)
Luxembourg	94	98	0	41	84	35	36	91	94	74	65 (1.9)
Norway	96	92	37	43	77	30	23	66	85	62	61 (0.5)
Russian Federation*	13	37	0	0	20	0	0	8	10	0	9 (1.2)
Singapore	96	96	0	82	84	61	30	98	100	67	71 (0.0)
Slovak Republic*	42	87	1	6	56	1	2	8	35	16	25 (1.0)
Slovenia*	97	100	0	23	85	14	2	47	77	82	53 (1.0)
South Africa*	58	70	1	5	51	5	0	15	44	6	25 (1.8)

Notes: *: country did not satisfy all sampling criteria. Last column: average percentage (standard errors in brackets) of available peripherals across schools. Standard error (se): value ±2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.3.1 Percentages of students whose schools had access to the Internet for instructional purposes, percentages that had planned to acquire access before 2001, percentages with no plans before 2001, average percentages of computers (standard errors in brackets) with simultaneous access to email and/or to WWW—primary education

	Access to the Internet	Acc. Internet planned before 2001	Acc. Internet not before 2001	% simultaneous access email		% simultaneous access WWW	
Canada*	88	8	4	51	(1.2)	55	(1.1)
China Hong Kong	10	56	34	35	(9.9)	38	(9.4)
Chinese Taipei	55	29	17	69	(3.9)	67	(4.0)
Cyprus	17	50	32	11	(2.5)	12	(2.3)
Finland*	87	11	2	56	(2.6)	59	(2.5)
France*	24	31	45		~		~
Iceland	98	2	0	55	(1.9)	58	(1.8)
Israel*	35	38	27	26	(4.1)	30	(4.1)
Italy	28	71	0	24	(3.2)	24	(3.3)
Japan	69	4	28	24	(5.6)	32	(5.7)
New Zealand	77	17	6	21	(2.1)	21	(1.9)
Norway	56	34	10	20	(0.6)	21	(0.6)
Singapore	100	0	0	13	(0.4)	15	(0.4)
Slovenia	84	15	1	53	(3.6)	54	(3.6)

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. Standard error (se): value ±2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.3.2 Percentages of students whose schools had access to the Internet for instructional purposes, percentages that had planned to acquire access before 2001, percentages with no plans before 2001, average percentages of computers (standard errors in brackets) with simultaneous access to email and/or to WWW—lower secondary education

	Access to the Internet	Acc. Internet planned before 2001	Acc. Internet not before 2001	% simultaneous access email	% simultaneous access WWW
Belgium-French*	41	44	15	33 (4.9)	36 (4.9)
Bulgaria	26	39	35	19 (3.1)	19 (3.1)
Canada*	98	2	0	55 (1.2)	61 (1.1)
China Hong Kong	80	15	5	45 (2.1)	49 (2.0)
Chinese Taipei	62	32	6	67 (2.7)	68 (2.4)
Cyprus	11	44	46	39 (21.0)	50 (21.1)
Czech Republic	33	39	28	39 (4.9)	40 (4.9)
Denmark	85	14	1	39 (2.5)	43 (2.4)
Finland	96	4	1	67 (1.8)	71 (1.5)
France	55	34	11	15 (1.8)	18 (1.9)
Hungary	41	24	35	46 (3.5)	45 (3.3)
Iceland	100	0	0	67 (2.1)	71 (2.0)
Israel*	53	23	24	37 (4.3)	36 (4.1)
Italy*	73	27	0	16 (1.9)	18 (2.1)
Japan	58	6	36	14 (3.0)	20 (3.8)
Lithuania	56	25	19	18 (1.9)	16 (1.6)
Luxembourg	79	21	0	35 (7.4)	50 (6.3)
New Zealand*	89	10	1	39 (2.1)	32 (1.9)
Norway	81	16	3	38 (0.8)	41 (0.8)
Russian Federation*	4	15	81	7 (5.9)	7 (5.2)
Singapore	100	0	0	23 (0.4)	25 (0.3)
Slovenia	85	15	1	51 (3.4)	52 (3.4)
South Africa*	52	26	22	47 (6.3)	34 (6.0)
Thailand	25	36	39	30 (3.4)	30 (3.4)

Notes: *: country did not satisfy all sampling criteria. Standard error (se): value ±2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.3.3 Percentages of students whose schools had access to the Internet for instructional purposes, percentages that had planned to acquire access before 2001, percentages with no plans before 2001, average percentages of computers (standard errors in brackets) with simultaneous access to email and/or to WWW—upper secondary education

	Access to the Internet	Acc. Internet planned before 2001	Acc. Internet not before 2001	% simultaneous access email		% simultaneous access WWW	
Belgium-French*	59	31	10	30	(3.4)	32	(3.4)
Bulgaria	15	40	45	17	(3.4)	18	(3.5)
Canada*	97	2	1	50	(1.2)	57	(1.1)
China Hong Kong	85	11	4	44	(1.8)	47	(1.8)
Chinese Taipei	93	6	1	62	(2.2)	63	(2.1)
Cyprus	15	81	4	13	(5.2)	14	(5.3)
Czech Republic	68	25	7	37	(3.0)	38	(2.9)
France	73	23	4	12	(1.3)	14	(1.3)
Iceland	100	0	0	91	(1.7)	81	(2.2)
Israel*	72	22	6	42	(3.5)	44	(3.5)
Italy*	73	26	1	16	(2.0)	18	(2.1)
Japan	50	4	45	23	(3.8)	24	(3.7)
Latvia*	4	39	57	21	(2.5)	23	(2.6)
Lithuania	93	4	4	22	(1.1)	17	(1.0)
Luxembourg	76	24	0	38	(6.4)	51	(5.4)
Norway	98	1	0	64	(0.9)	66	(0.9)
Russian Federation*	4	15	81	7	(5.2)	7	(5.2)
Singapore	100	0	0	65	(0.0)	66	(0.0)
Slovak Republic*	62	22	16	29	(2.9)	30	(2.9)
Slovenia*	88	11	0	62	(3.3)	63	(3.2)
South Africa*	60	20	19	31	(5.0)	25	(4.5)

Notes: *: country did not satisfy all sampling criteria. Standard error (se): value ±2*se provides 95% confidence interval for the population. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.4.1 Percentages of students whose schools had particular content available on their home page (percentages based on the subgroup that used email/WWW for instructional purposes at the grade range and having own home page)—primary education

	1. General information about school	2. Special information parents	3. Changes in the time schedule	4. Staff development for teachers	5. Lesson plans for teachers	6. Curriculum guidelines for teachers	7. Clickable links for teachers	8. Results student projects	9. Tests for students	10. Assignments for students	11. Links resources students	12. Curriculum materials students	13. Announcement events students	14. Other Web content
Canada*	99	43	16	9	10	9	39	29	6	7	40	11	46	18
China Hong Kong	100	57	0	15	10	35	41	57	0	0	42	20	42	0
Chinese Taipei	100	50	67	36	31	15	96	88	3	11	79	39	77	44
Cyprus	100	48	48	32	32	32	52	20	0	68	32	52	52	52
Finland*	100	27	22	0	2	55	43	37	0	4	37	20	34	33
France*	70	11	0	0	0	0	0	41	0	11	28	10	41	47
Iceland	95	35	5	37	13	53	52	12	1	14	33	19	37	50
Israel*	100	63	13	13	25	13	38	75	13	25	50	50	75	25
Italy	100	31	31	0	31	64	33	0	0	0	33	31	100	33
Japan	72	3	0	16	15	16	25	35	0	0	50	42	6	13
New Zealand	100	18	4	0	0	4	18	35	0	4	22	13	25	25
Norway	93	17	8	6	4	11	38	32	0	7	32	12	16	39
Singapore	97	43	29	49	6	16	30	30	3	3	24	11	69	38
Slovenia	100	60	26	15	15	9	33	58	9	24	28	15	76	53

Notes: *: country did not satisfy all sampling criteria.

Table G.4.2 Percentages of students whose schools had particular content available on their home page (percentages based on the subgroup that used email/WWW for instructional purposes at the grade range and having own home page)—lower secondary education

	1. General information about school	2. Special information parents	3. Changes in the time schedule	4. Staff development for teachers	5. Lesson plans for teachers	6. Curriculum guide-lines for teachers	7. Clickable links for teachers	8. Results student projects	9. Tests for students	10. Assignments for students	11. Links resources students	12. Curriculum materials students	13. Announcement events students	14. Other Web content
Belgium-French*	100	38	3	10	2	26	21	31	2	0	22	18	46	30
Bulgaria	95	5	9	10	16	38	29	59	5	0	14	19	38	54
Canada*	99	47	24	9	11	24	43	28	7	12	50	25	64	34
China Hong Kong	100	37	5	5	3	20	26	26	2	3	37	9	50	9
Chinese Taipei	99	32	52	20	12	8	68	51	6	14	62	16	57	15
Cyprus	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Czech Republic	100	47	3	7	3	13	7	47	13	7	27	17	63	33
Denmark	94	27	2	11	10	23	34	29	6	8	35	13	31	32
Finland	99	26	17	3	6	56	34	33	1	4	34	33	38	36
France	97	11	0	12	3	5	21	52	0	0	22	5	69	32
Hungary	90	15	0	6	10	9	18	47	6	12	15	9	59	46
Iceland	100	33	5	32	13	50	44	9	1	17	33	26	35	49
Israel*	100	12	0	12	0	12	18	65	6	6	29	24	35	24
Italy*	96	21	5	14	37	47	26	52	0	0	17	38	50	30
Japan	85	7	16	27	0	7	7	56	0	0	10	10	30	11
Lithuania	100	12	0	0	6	12	12	29	6	6	12	0	24	41
Luxembourg	100	26	7	27	0	30	6	79	0	0	56	28	70	58
New Zealand*	100	37	5	4	4	26	24	17	6	13	21	26	42	32
Norway	95	15	4	4	2	9	42	36	1	7	30	13	15	40
Russian Federation*	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Singapore	100	29	17	37	12	13	43	31	2	5	36	18	73	39
Slovenia	98	54	26	11	10	5	22	43	7	20	25	10	75	32
South Africa*	100	42	0	8	8	17	33	25	8	17	42	17	17	58
Thailand	97	32	30	57	0	6	33	50	6	3	33	3	82	6

Notes: *: country did not satisfy all sampling criteria. ~: no data collected.

Table G.4.3 Percentages of students whose schools had particular content available on their home page (percentages based on the subgroup that used email/WWW for instructional purposes at the grade range and having own home page)—upper secondary education

	1. General information about school	2. Special information parents	3. Changes in the time schedule	4. Staff development for teachers	5. Lesson plans for teachers	6. Curriculum guide-lines for teachers	7. Clickable links for teachers	8. Results student projects	9. Tests for students	10. Assignments for students	11. Links resources students	12. Curriculum materials students	13. Announcement events students	14. Other Web content
Belgium-French*	99	34	3	9	1	25	20	32	3	0	20	15	41	29
Bulgaria	92	13	0	3	0	8	22	31	8	0	22	8	41	56
Canada*	99	45	28	8	14	28	42	25	4	20	56	33	63	39
China Hong Kong	100	37	5	5	3	20	26	26	2	3	37	9	50	9
Chinese Taipei	99	26	54	29	25	29	79	53	12	15	78	19	64	16
Cyprus	100	0	0	0	0	0	60	60	0	0	0	0	60	0
Czech Republic	99	24	2	7	5	26	8	29	3	2	13	19	52	33
France	95	22	0	22	5	14	21	38	3	4	28	14	50	17
Iceland	100	13	7	35	0	72	52	36	19	55	51	56	56	63
Israel*	100	30	3	6	12	27	42	45	21	18	48	30	30	24
Italy*	93	22	11	23	38	45	9	41	1	1	14	34	59	21
Japan	91	22	9	20	3	16	12	24	0	0	16	5	25	8
Latvia*	100	0	0	12	19	1	37	31	18	35	37	24	29	66
Lithuania	98	11	5	10	8	16	10	33	7	4	10	3	27	55
Luxembourg	100	27	6	31	3	27	11	72	0	0	57	31	69	62
Norway	98	5	4	4	4	13	41	20	2	5	33	19	9	31
Russian Federation*	~	~	~	~	~	~	~	~	~	~	~	~	~	~
Singapore	100	16	36	43	42	66	71	39	10	56	74	86	90	59
Slovak Republic*	100	19	2	31	16	15	18	43	7	6	26	24	22	43
Slovenia*	97	43	17	15	5	14	33	44	12	8	31	25	72	46
South Africa*	100	30	5	10	0	25	10	20	0	0	0	15	40	15

Notes: *: country did not satisfy all sampling criteria. ~: no data collected.

Table G.5.1 Percentages of students whose schools possessed particular types of software for use at the grade range—primary education

	1. Word proc./desktop publish.	2. Spreadsheet software	3. Database software	4. Graphics: presentation	5. Computer-aided design/manifact.	6. Statist./mathematical programs	7. Programming languages	8. Accounting, book-keeping, finance	9. Drill and practice programs	10. Tutorial program, self-learning	11. Real world simulations	12. Educational games	13. Recreational/other games	14. Exams/tests/test construction	15. Internet browser	16. Email software	17. Encyclopedia on CD-ROM	18. Video/audio authorware	19. Music composition	20. Presentation (e.g. PowerPoint)	21 Software microcomp. based lab.
Canada*	99	87	82	72	6	33	12	10	79	60	38	92	53	18	83	71	92	18	13	46	4
China Hong Kong	78	67	38	38	~	9	8	~	26	41	6	71	33	12	32	27	35	17	5	50	3
Chinese Taipei	69	31	17	39	~	1	1	~	22	33	5	60	47	8	49	41	13	10	15	31	2
Cyprus	96	72	66	93	~	60	15	~	48	27	4	88	56	8	23	23	72	35	12	41	0
Finland*	99	79	41	86	~	28	6	~	62	39	4	92	49	5	85	77	91	20	24	39	2
France*	96	66	50	41	~	5	6	~	49	25	4	67	39	10	24	21	54	2	0	16	1
Iceland	98	91	57	94	2	75	16	3	77	83	10	90	61	17	90	92	50	27	21	90	2
Israel*	91	70	41	57	~	18	10	~	47	54	19	72	49	11	32	26	41	22	9	52	16
Italy	66	56	37	38	~	12	13	~	29	40	5	60	31	4	29	28	47	18	14	39	4
Japan	79	68	38	55	~	48	10	~	58	12	27	46	34	5	25	17	37	19	39	13	0
New Zealand	100	95	88	76	~	48	9	~	52	42	33	91	61	6	69	71	96	25	16	41	1
Norway	96	90	58	58	0	48	5	7	85	37	6	95	66	3	48	57	81	25	11	62	0
Singapore	96	64	46	77	~	38	6	~	98	92	60	96	51	49	52	42	94	18	17	93	10
Slovenia	85	63	27	67	~	39	52	~	59	27	18	75	72	16	62	62	50	7	3	58	4

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.5.2 Percentages of students whose schools possessed particular types of software for use at the grade range—lower secondary education

	1. Word proc./desktop publish.	2. Spreadsheet software	3. Database software	4. Graphics: presentation	5. Computer-aided design/manifact.	6. Statist./mathematical programs	7. Programming languages	8. Accounting, book-keeping, finance	9. Drill and practice programs	10. Tutorial program, self-learning	11. Real world simulations	12. Educational games	13. Recreational/other games	14. Exams/tests/test construction	15. Internet browser	16. Email software	17. Encyclopedia on CD-ROM	18. Video/audio authorware	19. Music composition	20. Presentation (e.g. PowerPoint)	21 Software microcomp. based lab.
Belgium-French*	86	67	50	38	8	19	26	8	61	37	8	26	18	8	45	39	44	32	1	34	1
Bulgaria	86	63	49	48	1	6	64	4	15	19	5	25	66	10	27	27	15	9	6	19	11
Canada*	100	97	90	81	48	44	54	38	68	63	35	55	34	41	94	72	90	31	29	79	14
China Hong Kong	93	91	81	65	5	7	84	2	13	24	4	28	28	7	81	71	36	8	3	76	2
Chinese Taipei	96	71	37	61	9	1	8	1	24	26	1	44	38	8	78	66	4	9	6	66	1
Cyprus	75	15	5	82	13	0	11	0	13	9	11	17	31	0	10	11	18	1	0	12	5
Czech Republic	96	86	55	67	4	18	39	16	65	81	9	64	76	42	39	37	42	4	6	32	5
Denmark	100	100	92	80	3	79	12	18	89	55	38	76	56	13	85	79	90	34	34	59	18
Finland	100	100	88	93	16	33	88	13	51	30	11	60	47	11	97	89	84	31	31	66	13
France	99	96	76	69	60	27	15	6	52	33	13	32	19	15	54	48	86	14	12	51	20
Hungary	96	91	53	62	2	17	51	9	39	54	4	45	68	14	50	45	38	34	16	61	2
Iceland	100	99	64	94	1	79	22	4	80	87	16	91	78	16	96	94	53	22	16	91	5
Israel*	96	94	55	66	24	44	33	10	39	63	30	65	40	10	45	39	54	22	9	73	36
Italy*	91	90	62	35	28	65	72	26	38	26	16	14	10	11	54	53	51	27	8	57	19
Japan	97	95	71	66	9	46	54	3	54	18	37	38	27	11	39	35	43	21	33	28	5
Lithuania	79	44	27	68	1	12	47	5	46	49	2	71	64	23	29	41	22	7	11	25	1
Luxembourg	96	96	87	69	24	37	48	15	25	0	11	21	28	5	87	59	81	23	15	73	20
New Zealand	100	99	95	84	59	57	51	43	61	53	48	69	41	29	82	80	96	23	60	77	15
Norway	98	99	73	69	1	48	14	8	89	39	7	87	66	5	70	77	85	32	26	79	1
Russian Federation*	43	30	27	41	1	10	42	0	46	30	2	40	48	27	1	4	4	0	5	10	1
Singapore	100	96	84	92	49	60	27	33	86	82	41	89	61	41	86	72	90	52	20	98	25
Slovenia	99	92	40	84	56	56	71	13	74	43	48	79	77	30	88	86	73	12	8	84	12
South Africa*	86	82	74	51	16	30	48	22	40	31	13	44	47	17	41	45	53	6	9	40	1
Thailand	92	75	68	43	4	14	5	0	17	40	1	19	52	17	22	17	12	19	8	60	3

Notes: *: country did not satisfy all sampling criteria. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.5.3 Percentages of students whose schools possessed particular types of software for use at the grade range—upper secondary education

	1. Word proc./desktop publish.	2. Spreadsheet software	3. Database software	4. Graphics: presentation	5. Computer-aided design/ manifact.	6. Statist./mathematical programs	7. Programming languages	8. Accounting, book-keeping, finance	9. Drill and practice programs	10. Tutorial program, self-learning	11. Real world simulations	12. Educational games	13. Recreational/other games	14. Exams/tests/test construction	15. Internet browser	16. Email software	17. Encyclopedia on CD-ROM	18. Video/audio authorware	19. Music composition	20. Presentation (e.g. PowerPoint)	21 Software microcomp. based lab.
Belgium-French*	98	91	84	52	26	35	37	52	32	26	20	19	13	10	71	58	54	38	3	61	3
Bulgaria	85	75	47	52	9	7	61	14	23	19	6	20	58	16	17	20	10	3	3	16	8
Canada*	100	99	95	91	67	69	88	75	71	68	44	54	36	53	95	78	96	53	46	89	25
China Hong Kong	98	99	96	63	6	13	92	2	13	23	6	27	26	8	86	76	40	6	2	78	3
Chinese Taipei	97	91	72	55	34	5	79	20	47	30	1	16	8	31	92	81	4	22	1	80	4
Cyprus	100	100	100	92	14	17	99	19	14	42	26	38	56	6	22	22	25	19	0	99	3
Czech Republic	100	99	84	74	29	22	48	71	45	62	9	31	54	32	71	66	58	10	4	72	16
France	99	98	85	66	35	45	33	65	42	27	18	11	15	19	70	60	83	17	5	80	29
Iceland	100	100	88	89	31	84	75	57	51	65	33	31	25	16	98	92	75	23	9	94	9
Israel*	97	97	58	64	32	47	81	31	35	44	33	45	29	10	62	58	57	29	10	73	43
Italy*	89	92	74	47	37	59	68	37	37	34	18	17	15	17	63	62	51	29	5	69	25
Japan	96	96	59	46	13	19	56	12	26	9	6	17	21	15	42	41	29	13	11	32	2
Latvia*	98	98	90	82	8	19	82	17	58	37	14	56	75	29	59	61	51	27	15	80	11
Lithuania	91	79	51	81	2	17	76	11	54	69	6	71	74	35	44	64	27	8	19	36	2
Luxembourg	96	100	100	78	44	70	87	73	24	11	44	20	25	5	91	71	79	42	14	94	56
Norway	100	100	95	81	46	69	59	44	82	44	40	42	47	9	92	94	84	45	18	97	8
Russian Federation	78	82	71	77	2	24	84	2	72	51	5	58	71	40	8	13	10	1	15	24	1
Singapore	100	100	95	94	64	73	88	65	68	84	74	58	39	61	100	98	81	94	34	100	78
Slovak Republic*	96	100	95	72	19	15	68	60	29	12	4	31	61	33	58	55	27	2	4	46	4
Slovenia*	98	100	79	80	31	60	66	53	28	21	21	27	58	12	96	92	60	13	7	93	28
South Africa*	91	89	80	44	11	31	59	25	30	36	5	39	44	10	48	54	55	5	4	42	0

Notes: *: country did not satisfy all sampling criteria. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.6.1 Percentages of students whose schools possessed software for school subjects for use at the grade range—primary education

	1. Mathematics	2. Physics	3. Chemistry	4. Biology/Life science	5. Earth science	6. Language/Mother tongue	7. Foreign language	8. Creative arts	9. History	10. Civics	11. Economics	12. Geography	13. Vocational subjects	14. Comp. education/Informatics	15. Multidisciplinary projects
Canada*	87	7	6	44	47	56	24	36	41	5	3	64	3	22	40
China Hong Kong	59	10	5	10	30	53	37	18	35	15	~	17	~	37	10
Chinese Taipei	36	2	1	8	8	33	16	15	2	4	~	3	~	46	7
Cyprus	99	0	0	4	0	89	5	59	91	0	~	58	~	7	7
Finland*	95	10	6	75	~	85	82	30	54	6	~	54	~	17	19
France*	72	1	0	29	25	78	9	20	28	10	~	40	~	6	8
Iceland	90	24	5	32	15	85	67	27	16	33	2	58	0	34	28
Israel*	67	9	3	44	32	65	58	19	23	9	~	37	~	8	24
Italy	40	3	2	25	18	51	46	36	32	10	~	32	~	16	31
Japan	69	~	~	~	~	54	~	59	~	~	~	~	~	27	17
New Zealand	86	5	4	30	31	65	8	47	42	4	~	51	~	20	33
Norway	95	13	5	24	5	95	56	31	34	39	5	63	1	7	11
Singapore	100	87	70	84	60	99	4	82	89	68	~	51	~	18	47
Slovenia	84	4	2	13	4	51	22	19	1	1	~	4	~	26	4

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.6.2 Percentages of students whose schools possessed software for school subjects for use at the grade range—lower secondary education

	1. Mathematics	2. Physics	3. Chemistry	4. Biology/ Life science	5. Earth science	6. Language/ Mother tongue	7. Foreign language	8. Creative arts	9. History	10. Civics	11. Economics	12. Geography	13. Vocational subjects	14. Comp. education/ Informatics	15. Multidisciplinary projects
Belgium-French*	52	13	10	29	15	72	36	6	10	0	8	20	23	36	6
Bulgaria	19	14	9	15	4	2	17	11	3	0	2	9	1	37	2
Canada*	77	29	26	50	33	39	32	34	36	9	12	57	27	53	31
China Hong Kong	44	37	24	31	9	36	30	15	23	14	7	23	6	63	6
Chinese Taipei	13	15	11	9	9	7	19	14	1	1	0	1	23	72	6
Cyprus	4	0	0	0	0	1	4	5	4	0	0	1	13	13	27
Czech Republic	86	75	67	71	11	75	67	17	40	7	2	78	7	49	4
Denmark	96	76	59	41	15	93	82	47	24	46	11	60	3	27	29
Finland	67	54	57	49	~	42	86	24	29	18	16	30	14	47	15
France	68	23	15	40	28	53	40	22	33	8	3	35	13	36	15
Hungary	44	36	30	26	11	21	44	23	23	3	1	29	2	52	5
Iceland	89	34	17	37	25	90	88	26	26	41	5	63	4	55	28
Israel*	79	51	28	58	39	59	66	25	47	15	5	47	22	23	22
Italy*	81	51	28	19	14	36	45	19	16	8	16	14	26	47	24
Japan	76	~	~	~	~	39	47	50	~	1	~	~	77	40	6
Lithuania	71	72	20	18	~	58	50	16	16	2	9	44	1	82	2
Luxembourg	53	18	15	23	~	15	0	13	8	0	3	54	18	43	18
New Zealand*	72	41	34	47	30	52	46	52	33	3	43	43	~	39	18
Norway	85	26	18	27	5	86	70	26	29	37	5	51	16	19	10
Russian Federation*	28	23	10	9	1	12	23	10	13	0	1	10	5	38	4
Singapore	99	99	99	91	74	98	13	72	98	63	~	98	64	66	43
Slovenia	69	91	70	71	70	85	74	38	40	2	2	57	13	48	13
South Africa*	51	18	16	26	11	24	6	5	16	0	1	24	17	27	12
Thailand	18	10	10	10	8	9	26	6	3	11	1	4	4	40	8

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.6.3 Percentages of students whose schools possessed software for school subjects for use at the grade range—upper secondary education

	1. Mathematics	2. Physics	3. Chemistry	4. Biology/Life science	5. Earth science	6. Language/ Mother tongue	7. Foreign language	8. Creative arts	9. History	10. Civics	11. Economics	12. Geography	13. Vocational subjects	14. Comp. education/ Informatics	15. Multidisciplinary projects
Belgium-French*	55	29	32	30	12	38	39	11	20	2	31	27	38	41	13
Bulgaria	19	13	6	7	3	2	12	6	1	0	8	4	21	55	4
Canada*	79	61	58	68	35	46	39	61	44	11	25	64	39	75	43
China Hong Kong	43	47	30	37	7	30	26	11	19	12	6	26	5	69	6
Chinese Taipei	7	6	5	5	5	6	12	4	4	1	0	4	29	72	8
Cyprus	15	95	17	14	1	0	6	6	30	0	0	10	4	30	0
Czech Republic	42	38	29	24	4	33	64	9	23	7	38	31	34	71	8
France	56	50	39	45	37	25	42	19	27	6	30	28	65	50	12
Iceland	83	43	30	54	56	56	76	21	26	27	5	25	1	75	4
Israel*	60	55	39	45	21	31	49	24	38	21	9	25	17	16	25
Italy*	75	42	20	16	11	40	42	18	22	7	22	12	36	50	34
Japan	38	~	~	~	~	19	25	13	~	~	~	~	34	19	3
Latvia*	31	25	12	2	7	36	10	34	33	32	32	29	4	50	9
Lithuania	64	67	25	25	~	51	49	13	15	2	13	39	2	78	8
Luxembourg	81	61	67	27	~	21	6	0	7	0	48	17	35	30	22
Norway	49	52	34	27	5	58	59	20	13	47	38	15	42	47	11
Russian Federation*	38	30	19	15	3	11	22	14	15	1	10	14	3	69	3
Singapore	82	62	49	62	15	85	11	23	36	27	72	35	75	94	64
Slovak Republic*	25	35	23	10	3	12	39	7	6	1	22	25	44	76	9
Slovenia*	70	67	37	17	39	24	34	14	17	0	8	20	53	80	5
South Africa*	51	18	17	27	14	15	7	9	13	0	3	20	11	43	7

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.7.1 Percentages of students whose school principals reported that a particular problem was a major obstacle in realizing the school's ICT-related objectives for students in the grade range—primary education

	1. Not enough computers available	2. Not enough copies software	3. Not enough variety of software	4. Insufficient teacher time	5. Difficult to integrate in instruc.	6. Not enough supervision staff	7. Scheduling comp. time	8. Difficult use low-achieving studs.	9. WWW: no time school schedule	10. WWW: no time teach. explore	11. Not enough space to locate	12. Lack of interest of teachers	13. Teachers lack knowledge/skills	14. Not enough training opportun	15. No plan prevent theft/vandals.	16. Lack support school board	17. Telecom infrastructure weak	18. Major obstacles: other
Canada*	66	46	60	77	54	51	52	15	26	64	29	18	67	62	7	22	28	8
China Hong Kong	81	87	79	80	62	64	54	30	50	56	57	24	76	80	25	23	25	5
Chinese Taipei	83	67	50	58	60	67	56	27	34	33	42	23	56	59	29	28	26	2
Cyprus	86	58	70	89	79	49	86	22	37	28	52	27	66	17	18	15	20	0
Finland*	67	44	46	54	36	54	52	16	22	53	23	31	72	43	5	19	18	6
France*	80	69	63	60	59	57	55	16	26	41	28	22	79	71	17	5	23	11
Iceland	71	39	47	52	27	44	67	11	41	55	36	25	45	38	3	11	24	4
Israel*	80	45	52	53	31	40	53	20	29	35	19	13	60	29	21	9	26	13
Italy	76	56	20	38	44	31	21	13	21	27	27	29	49	47	31	10	25	5
Japan	65	51	60	62	33	58	26	6	36	2	20	29	56	44	7	31	30	0
New Zealand	68	36	39	67	58	43	41	24	26	64	34	20	58	49	7	3	11	11
Norway	82	37	54	52	51	33	33	13	34	34	28	18	69	54	10	26	18	~
Singapore	56	37	63	66	37	45	66	26	54	63	70	21	38	11	22	1	27	7
Slovenia	75	45	63	27	47	45	54	45	50	34	35	20	64	13	6	1	16	5

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.7.2 Percentages of students whose school principals reported that a particular problem was a major obstacle in realizing the school's ICT-related objectives for students in the grade range—lower secondary education

	1. Not enough computers available	2. Not enough copies software	3. Not enough variety of software	4. Insufficient teacher time	5. Difficult to integrate in instruc.	6. Not enough supervision staff	7. Scheduling comp. time	8. Difficult use low-achieving stud.	9. WWW: no time school schedule	10. WWW: no time teach. explore	11. Not enough space to locate	12. Lack of interest of teachers	13. Teachers lack knowledge/skills	14. Not enough training opportun.	15. No plan prevent theft/vandals.	16. Lack support school board	17. Telecom infrastructure weak	18. Major obstacles: other
Belgium-French*	85	75	55	47	67	65	60	16	56	51	37	27	73	37	19	1	22	4
Bulgaria	95	63	77	33	52	41	49	16	30	31	23	17	71	61	11	9	20	14
Canada*	69	46	55	69	57	41	68	12	21	61	27	21	64	62	8	17	32	6
China Hong Kong	80	88	77	83	57	59	73	24	56	60	58	21	62	69	26	14	31	6
Chinese Taipei	60	70	57	59	71	69	46	38	25	25	20	26	59	54	26	18	21	2
Cyprus	90	49	55	72	88	77	58	32	51	46	56	19	75	44	18	33	44	7
Czech Republic	83	36	52	57	67	52	52	13	34	32	28	45	69	19	14	29	11	12
Denmark	65	34	53	17	65	39	40	32	37	52	31	7	65	41	18	8	5	2
Finland	72	37	48	49	46	40	70	13	21	42	28	30	79	38	6	14	7	3
France	72	66	54	48	76	55	58	20	47	45	27	41	85	48	9	3	18	11
Hungary	70	55	56	46	57	44	49	13	35	39	26	18	68	41	6	0	29	8
Iceland	63	32	52	50	32	50	74	4	37	51	23	25	40	39	4	14	19	5
Israel*	65	62	67	60	42	42	65	20	45	32	28	26	63	29	33	8	28	7
Italy*	54	50	11	57	57	49	42	17	53	51	31	26	45	50	18	9	26	6
Japan	63	51	67	70	42	60	45	10	41	3	15	29	60	49	12	25	41	4
Lithuania	92	72	~	32	52	28	60	23	46	41	17	46	78	46	16	9	18	11
Luxembourg	65	33	14	41	81	83	62	53	70	23	46	59	80	29	22	17	9	26
New Zealand*	64	38	34	76	70	26	71	13	26	63	34	18	69	54	6	1	11	10
Norway	77	34	52	54	66	39	42	12	28	36	17	17	70	49	14	27	14	~
Russian Federation*	92	69	80	37	53	46	68	~	~	~	42	25	69	41	8	65	26	8
Singapore	63	46	76	78	43	62	66	15	57	66	44	18	42	17	23	1	21	5
Slovenia	71	52	64	37	39	47	63	37	54	36	33	15	60	14	6	4	17	5
South Africa*	76	64	57	59	58	51	42	45	40	29	52	57	58	34	11	14	9	4
Thailand	90	75	79	57	40	77	64	35	42	34	21	20	71	65	24	64	35	6

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.7.3 Percentages of students whose school principals reported that a particular problem was a major obstacle in realizing the school's ICT-related objectives for students in the grade range—upper secondary education

	1. Not enough computers available	2. Not enough copies software	3. Not enough variety of software	4. Insufficient teacher time	5. Difficult to integrate in instruc.	6. Not enough supervision staff	7. Scheduling comp. time	8. Difficult use low-achieving stud.	9. WWW: no time school schedule	10. WWW: no time teach. explore	11. Not enough space to locate	12. Lack of interest of teachers	13. Teachers lack knowledge/skills	14. Not enough training opportun.	15. No plan prevent theft/vandals.	16. Lack support school board	17. Telecom infrastructure weak	18. Major obstacles: other
Belgium-French*	77	73	50	46	62	60	59	10	50	45	40	27	70	34	15	1	21	4
Bulgaria	95	58	78	29	53	35	46	16	28	24	16	16	62	64	10	5	17	17
Canada*	72	53	53	73	57	46	73	8	25	64	31	18	61	66	11	16	29	8
China Hong Kong	79	87	79	81	61	57	68	23	59	59	56	21	62	67	25	11	31	7
Chinese Taipei	38	45	45	51	72	48	46	24	21	19	28	23	45	51	18	17	11	2
Cyprus	78	44	60	90	81	58	66	30	57	46	27	53	94	70	10	26	49	9
Czech Republic	63	39	55	59	70	30	53	7	31	26	21	31	53	22	13	20	18	16
France	58	56	42	42	70	59	56	27	55	44	35	28	73	43	27	2	17	14
Iceland	80	61	61	46	34	64	51	2	26	29	39	8	56	49	0	11	10	0
Israel*	57	37	66	63	54	47	68	28	64	43	24	33	67	26	27	9	19	6
Italy*	55	51	13	54	65	56	40	17	51	49	26	26	54	47	19	4	27	2
Japan	51	39	49	58	34	56	48	8	37	1	19	29	53	55	9	18	40	3
Latvia*	87	79	73	67	48	48	62	22	34	48	32	6	78	39	10	27	33	19
Lithuania	93	76	~	28	53	28	61	28	42	45	17	49	75	42	17	11	17	14
Luxembourg	56	38	17	47	61	60	58	25	72	39	42	26	47	36	17	16	14	27
Norway	61	27	30	53	75	39	62	13	25	35	28	22	58	47	17	28	5	~
Russian Federation	92	69	80	36	53	46	68	~	~	~	43	24	69	42	8	65	26	7
Singapore	48	28	46	88	56	38	36	17	32	37	39	30	65	25	11	3	18	6
Slovak Republic*	92	68	77	47	61	36	44	15	45	44	37	22	57	44	27	17	21	8
Slovenia	80	64	57	52	40	49	83	30	41	39	44	15	59	19	17	2	16	9
South Africa*	67	59	52	54	66	54	71	31	54	59	29	29	68	56	20	17	12	11

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.8.1 Percentages of students whose technology coordinators reported that a particular problem was a major obstacle in realizing the school's ICT-related objectives for students in the grade range—primary education

	1. Insufficient number of computers	2. Insufficient peripherals	3. Outdated local school network	4. Not enough copies of software	5. Software too complicated to use	6. Software not adaptable enough	7. Lack info. about software	8. Software not in language instruct.	9. Software culturally incompatible	10. Software curriculum incompatible	11. WWW: not enough simult. acc.	12. WWW: slow network performance	13. WWW: complicated to connect	14. Materials WWW poor quality	15. WWW: insuffic. techn. support	16. WWW: difficult finding info.	17. WWW: Information overload	18. WWW: mail baskets overload	19. WWW: not enough connections	20. Lack technical assistance	21. Lack administrative assistance	22. Studs. know more than teachers	23. Quality teacher training too low	24. No plans prevent theft/vandal.	25. Weak infrastructure (telecomm.)
Canada*	68	53	32	57	13	30	42	5	4	13	53	42	9	9	49	32	37	3	41	64	13	35	39	6	29
China Hong Kong	76	47	50	81	10	54	53	52	45	65	41	14	8	3	47	7	6	2	25	83	37	17	56	19	39
Chinese Taipei	74	63	50	81	9	35	35	18	5	34	40	62	6	20	21	12	9	1	32	42	26	2	17	13	57
Cyprus	67	66	71	72	19	33	31	49	29	47	53	8	5	5	23	5	11	0	30	68	10	44	47	3	53
Finland*	69	53	24	56	14	17	31	13	12	13	48	21	4	20	35	36	36	4	58	56	26	12	28	4	24
France*	80	61	44	70	6	18	65	3	4	5	63	13	5	3	21	22	10	4	13	53	27	16	59	16	23
Iceland	59	35	33	38	10	16	31	34	8	10	39	23	4	7	34	29	21	3	44	37	33	24	21	4	27
Israel*	60	61	45	41	5	53	28	11	6	5	61	23	8	10	23	19	15	3	38	50	8	31	47	21	28
Italy	76	50	32	61	7	21	34	15	3	5	34	8	7	2	12	8	6	1	11	35	48	34	24	32	41
Japan	73	53	45	65	11	25	32	3	3	3	61	11	6	3	29	18	12	1	24	51	29	1	7	7	43
New Zealand	66	47	48	43	13	28	36	5	15	21	66	19	8	12	38	36	31	7	38	56	22	28	40	3	26
Norway	77	61	59	39	15	13	27	4	6	7	67	17	7	6	23	26	22	2	45	51	9	27	34	10	28
Singapore	58	55	63	26	9	56	25	6	37	52	71	43	11	6	31	26	33	18	34	42	22	32	37	30	52
Slovenia	60	39	43	35	3	26	44	26	22	20	54	31	2	6	15	14	17	1	47	23	7	37	32	6	36

Notes: *: country did not satisfy all sampling criteria. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.8.2 Percentages of students whose technology coordinators reported that a particular problem was a major obstacle in realizing the school's ICT-related objectives for students in the grade range—lower secondary education

	1. Insufficient number of computers	2. Insufficient peripherals	3. Outdated local school network	4. Not enough copies of software	5. Software too complicated to use	6. Software not adaptable enough	7. Lack info. about software	8. Software not in language instruct.	9. Software culturally incompatible	10. Software curriculum incompatible	11. WWW: not enough simult. acc.	12. WWW: slow network performance	13. WWW: complicated to connect	14. Materials WWW poor quality	15. WWW: insuffic. techn. support	16. WWW: difficult finding info.	17. WWW: Information overload	18. WWW: mail baskets overload	19. WWW: not enough connections	20. Lack technical assistance	21. Lack administrative assistance	22. Studs. know more than teachers	23. Quality teacher training too low	24. No plans prevent theft/vandal.	25. Weak infrastructure (telecomm.)
Belgium-French*	73	56	53	66	6	26	55	12	10	22	65	23	16	6	25	32	20	3	31	38	5	34	25	17	33
Bulgaria	90	82	80	47	6	40	30	26	6	11	48	24	13	2	19	12	6	1	24	48	6	20	29	9	23
Canada*	62	42	29	53	13	30	36	4	4	15	40	52	8	10	51	21	32	3	26	68	16	49	48	13	33
China Hong Kong	66	56	67	84	12	51	42	44	37	61	66	52	9	8	59	17	16	3	54	83	39	20	51	24	50
Chinese Taipei	60	68	51	76	9	39	32	16	6	28	32	67	1	22	32	10	9	0	30	42	29	3	18	17	42
Cyprus	96	77	67	52	12	28	27	41	4	14	57	3	2	2	23	5	5	2	11	35	23	23	35	39	49
Czech Republic	76	66	41	35	5	14	35	7	2	2	59	24	10	2	15	5	6	5	29	30	3	39	13	9	21
Denmark	60	43	30	34	11	14	41	8	23	16	45	16	6	20	20	44	34	3	32	44	16	55	33	16	20
Finland	70	47	20	50	16	22	37	11	14	16	34	19	2	15	25	32	49	6	30	47	19	14	34	16	17
France	72	67	57	71	14	16	59	5	5	7	72	27	9	8	38	23	22	2	34	60	11	33	46	16	25
Hungary	66	58	49	69	4	27	40	30	12	17	35	18	4	6	45	12	3	1	36	47	6	17	19	8	34
Iceland	60	35	23	40	11	10	29	33	9	11	26	21	3	6	33	15	11	3	29	40	31	21	25	11	20
Israel*	62	54	45	43	8	54	28	10	10	11	57	34	11	12	28	24	17	3	37	45	6	35	47	32	30
Italy*	52	39	35	52	11	27	29	13	6	6	54	22	7	8	35	19	16	4	37	44	46	43	43	24	36
Japan	60	54	56	65	16	29	30	1	2	1	66	13	10	6	31	24	18	1	34	50	33	2	14	13	57
Lithuania	87	70	60	57	7	42	48	56	16	24	71	33	15	7	52	15	8	6	53	35	8	29	26	19	31
Luxembourg	55	32	30	38	0	0	41	20	12	18	24	0	0	9	29	12	29	0	24	72	11	28	20	43	15
New Zealand*	69	45	33	48	13	27	38	3	10	24	56	31	7	15	47	31	39	3	41	62	24	50	47	9	31
Norway	71	57	45	46	16	18	30	4	7	8	56	26	5	9	30	36	38	2	49	53	10	36	39	19	25
Russian Federation*	86	91	65	53	4	35	37	14	8	15	~	~	~	~	~	~	~	~	~	63	20	18	13	5	30
Singapore	61	36	60	48	13	67	36	1	26	53	75	51	11	9	60	34	39	24	42	77	22	32	30	34	50
Slovenia	59	47	48	37	3	27	48	24	22	22	63	32	3	6	16	14	17	1	52	23	7	55	33	8	37
South Africa*	69	53	49	49	13	32	39	22	15	26	59	30	9	9	34	20	20	8	29	49	31	33	51	13	16
Thailand	91	89	76	76	22	27	45	32	14	24	62	33	16	6	43	20	7	3	33	70	31	6	16	23	35

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table G.8.3 Percentages of students whose technology coordinators reported that a particular problem was a major obstacle in realizing the school's ICT-related objectives for students in the grade range—upper secondary education

	1. Insufficient number of computers	2. Insufficient peripherals	3. Outdated local school network	4. Not enough copies of software	5. Software too complicated to use	6. Software not adaptable enough	7. Lack info. about software	8. Software not in language instruct.	9. Software culturally incompatible	10. Software curriculum incompatible	11. WWW: not enough simult. acc.	12. WWW: slow network performance	13. WWW: complicated to connect	14. Materials WWW poor quality	15. WWW: insuffic. techn. support	16. WWW: difficult finding info.	17. WWW: Information overload	18. WWW: mail baskets overload	19. WWW: not enough connections	20. Lack technical assistance	21. Lack administrative assistance	22. Studs. know more than teachers	23. Quality teacher training too low	24. No plans prevent theft/ vandal.	25. Weak infrastructure (telecomm.)
Belgium-French*	67	57	50	70	4	25	52	10	9	20	66	23	18	6	25	34	21	2	34	38	7	42	26	18	32
Bulgaria	95	90	83	55	3	42	23	22	6	11	49	16	11	1	20	11	4	2	12	52	10	29	33	11	26
Canada*	61	48	24	56	14	33	44	3	9	20	38	51	6	9	57	25	41	3	27	72	15	50	53	19	31
China Hong Kong	65	56	67	84	11	50	43	42	35	58	68	51	10	8	60	17	14	3	53	85	41	22	53	22	49
Chinese Taipei	41	55	22	56	9	26	20	17	3	20	31	57	2	19	29	10	20	1	10	31	24	5	20	19	27
Cyprus	70	80	85	20	3	42	45	32	15	13	75	18	14	14	33	20	14	8	27	49	23	20	83	17	65
Czech Republic	56	55	36	42	7	19	23	10	1	1	56	35	9	3	18	10	9	6	41	25	8	30	17	11	22
France	46	48	50	56	12	18	52	7	5	9	65	32	10	6	43	33	27	4	38	70	14	34	45	24	21
Iceland	53	47	11	19	16	29	15	35	11	5	14	13	0	2	21	15	31	6	16	25	26	28	21	19	2
Israel*	55	53	33	32	12	56	32	18	14	21	48	27	9	8	19	31	27	4	31	32	10	45	55	36	26
Italy*	51	48	36	52	7	22	22	19	5	8	54	19	11	9	26	19	17	4	37	42	45	46	40	24	31
Japan	60	45	50	55	12	30	33	2	2	3	63	12	6	7	23	16	10	1	40	45	28	2	10	16	62
Latvia*	80	70	37	68	3	30	36	43	9	18	63	38	10	7	24	21	8	4	34	33	17	32	33	18	26
Lithuania	86	77	63	54	9	49	52	56	18	30	71	37	23	10	52	19	11	6	55	33	12	29	27	15	30
Luxembourg	58	41	32	43	8	5	37	15	4	16	27	0	0	8	30	16	27	0	22	72	12	49	42	47	19
Norway	49	41	36	39	16	12	17	3	5	9	23	38	3	8	21	33	38	3	15	43	15	42	34	21	18
Russian Federation*	86	91	65	52	4	35	37	14	8	15	~	~	~	~	~	~	~	~	~	63	20	18	13	5	30
Singapore	45	40	33	21	10	57	38	0	11	54	47	46	5	10	52	27	65	32	44	43	17	31	49	20	40
Slovak Republic*	86	86	51	64	7	28	34	17	12	25	70	43	18	1	41	12	8	6	18	55	28	31	54	15	32
Slovenia*	69	71	50	45	4	33	40	27	14	21	55	37	12	4	33	16	21	6	42	45	15	45	37	30	34
South Africa*	58	54	48	51	9	25	31	21	8	22	66	34	7	6	24	13	13	6	34	44	34	36	41	18	17

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

APPENDI TABLES REFERRED TO IN C APTER

This appendix contains tables that are mentioned in Chapter 5.

Table H.1.1 Percentages of students whose schools (technical respondents) indicated that they were adequately prepared for supporting ICT activities in particular areas in the school—primary education

	1. MS Windows	2. Mac Operating System	3. MS DOS	4. Word processing	5. Databases	6. Spreadsheets	7. Subject-specific applications	8. Application student progress soft.	9. Didactical integration of ICT	10. Use specific progr. for subjects	11. Eval./select. instruct. softw.	12. Use for individualized learning	13. Use of multimedia applications	14. Adaptation of software	15. Use of email for instruction	16. Use Internet for instruction	17. Use of softw. for presentations
Canada*	63	38	27	92	55	58	68	34	40	65	61	43	60	49	71	76	51
China Hong Kong	85	3	62	90	47	63	24	9	26	14	39	33	52	8	26	32	54
Chinese Taipei	94	4	85	99	57	81	49	36	52	58	66	58	79	27	85	91	71
Cyprus	90	8	55	97	47	62	56	17	60	44	49	24	36	47	53	53	46
Finland*	82	6	49	89	31	47	67	11	41	78	59	27	48	17	68	70	28
France*	56	7	33	79	40	53	30	20	15	32	29	24	43	23	20	19	27
Iceland	79	31	43	96	53	64	46	42	41	58	50	62	69	46	80	78	58
Israel*	82	7	42	90	64	38	57	28	66	69	70	57	55	66	44	51	72
Italy	85	3	40	80	40	51	35	11	59	52	50	41	54	31	41	39	38
Japan	46	10	30	68	22	43	39	28	19	38	15	23	24	21	18	23	21
New Zealand	71	40	25	96	64	72	52	30	74	60	61	48	65	42	73	68	53
Norway	70	2	40	87	22	43	41	29	19	31	37	32	43	17	44	45	30
Singapore	100	12	48	96	48	68	79	38	50	78	93	71	81	71	81	83	96
Slovenia	96	6	76	98	52	86	70	29	67	76	55	54	62	59	83	86	69

Notes: *: country did not satisfy all sampling criteria. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table H.1.2 Percentages of students whose schools (technical respondents) indicated that they were adequately prepared for supporting ICT activities in particular areas in the school—lower secondary education

	1. MS Windows	2. Mac Operating System	3. MS DOS	4. Word processing	5. Databases	6. Spreadsheets	7. Subject- specific applications	8. Application student progress soft.	9. Didactical integration of ICT	10.Use specific progr. for subjects	11. Eval./select. instruct. softw.	12. Use for individualized learning	13. Use of multimedia applications	14. Adaptation of software	15. Use of email for instruction	16. Use Internet for instruction	17. Use of softw. for presentations
Belgium-French*	88	6	75	94	62	74	23	18	20	24	26	22	43	28	59	57	39
Bulgaria	75	17	85	89	70	82	37	21	23	34	56	27	41	38	38	33	26
Canada*	82	29	64	94	78	84	61	44	41	55	59	34	70	54	79	88	75
China Hong Kong	95	9	89	97	85	89	54	10	32	41	50	57	64	25	71	72	83
Chinese Taipei	95	2	93	97	58	74	47	25	44	46	58	43	68	26	82	84	72
Cyprus	70	6	47	70	30	24	78	19	23	20	9	11	29	13	28	33	11
Czech Republic	89	8	79	93	50	78	58	29	33	43	57	49	53	33	36	35	28
Denmark	93	5	64	97	65	89	54	15	41	58	55	45	65	44	72	76	53
Finland	89	3	88	95	76	92	46	13	25	50	33	22	46	23	70	74	49
France	78	4	63	90	53	80	40	26	12	23	20	30	51	26	37	41	43
Hungary	96	4	95	98	74	92	64	69	53	40	59	67	66	41	53	57	51
Iceland	85	29	51	98	55	79	44	46	43	53	51	61	73	46	80	79	68
Israel*	77	8	55	91	79	60	48	37	56	53	53	50	62	64	50	52	77
Italy*	92	6	77	89	59	83	57	16	50	59	53	27	72	48	67	73	60
Japan	58	12	60	77	41	70	48	55	16	38	22	27	28	29	27	30	26
Lithuania	93	8	83	91	57	78	64	26	35	52	50	69	45	57	70	47	45
Luxembourg	88	0	89	87	69	87	27	12	18	21	27	5	24	34	78	81	69
New Zealand*	82	35	60	97	81	88	48	39	67	44	53	30	60	42	80	77	67
Norway	72	2	51	88	32	65	26	13	13	21	27	22	36	11	54	58	38
Russian Federation*	70	7	76	88	73	87	54	35	36	50	67	66	29	48	26	20	28
Singapore	98	6	62	100	59	85	76	34	44	61	88	74	75	64	85	85	97
Slovenia	96	6	76	98	52	86	71	28	68	75	55	54	62	58	83	86	69
South Africa*	81	5	77	92	78	88	48	22	24	44	43	24	47	32	56	55	49
Thailand	63	4	53	68	37	50	18	4	4	4	9	19	10	10	10	11	23

Notes: *: country did not satisfy all sampling criteria. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table H.1.3 Percentages of students whose schools (technical respondents) indicated that they were adequately prepared for supporting ICT activities in particular areas in the school—upper secondary education

	1. MS Windows	2. Mac Operating System	3. MS DOS	4. Word processing	5. Databases	6. Spreadsheets	7. Subject- specific applications	8. Application student progress soft.	9. Didactical integration of ICT	10. Use specific progr. for subjects	11. Eval./select. instruct. softw.	12. Use for individualized learning	13. Use of multimedia applications	14. Adaptation of software	15. Use of email for instruction	16. Use Internet for instruction	17. Use of softw. for presentations
Belgium-French*	89	5	78	95	63	77	24	19	21	26	30	24	47	31	63	62	42
Bulgaria	75	10	85	89	66	80	39	20	25	39	48	27	30	36	27	24	21
Canada*	83	33	68	96	82	90	58	51	40	55	63	45	68	57	86	92	77
China Hong Kong	95	9	89	97	85	89	54	10	32	41	50	57	64	25	71	72	83
Chinese Taipei	98	6	96	96	80	90	56	23	41	50	60	38	76	41	93	95	90
Cyprus	93	16	88	96	93	93	69	28	23	13	28	32	64	37	45	42	55
Czech Republic	98	6	97	99	76	97	42	21	26	32	53	34	60	42	65	65	57
France	80	7	70	88	59	79	40	15	14	26	24	27	52	28	47	50	48
Iceland	100	36	97	100	95	100	35	63	48	55	53	36	60	67	75	80	85
Israel*	77	5	70	94	72	62	43	28	53	44	45	40	55	57	63	63	71
Italy*	94	8	79	88	62	85	58	20	53	61	54	24	67	46	58	62	56
Japan	59	8	60	74	46	71	32	47	18	22	17	18	20	29	27	28	22
Latvia*	87	8	57	89	58	74	29	24	26	32	33	35	48	38	48	51	56
Lithuania	93	7	82	95	57	82	65	28	36	52	50	68	43	55	66	46	44
Luxembourg	89	5	90	88	69	87	24	14	18	21	29	7	23	33	80	83	68
Norway	75	4	73	86	51	80	27	9	11	19	18	13	32	9	69	69	56
Russian Federation*	70	5	78	87	72	86	53	34	34	48	67	66	29	48	25	20	27
Singapore	99	23	78	99	85	94	78	48	67	80	70	65	76	58	92	92	97
Slovak Republic*	92	9	90	98	86	90	27	17	27	32	18	37	49	47	55	51	31
Slovenia*	100	2	90	99	76	97	34	18	30	31	37	31	70	43	91	89	89
South Africa*	80	1	77	86	73	81	41	20	25	40	41	35	43	29	48	51	52

Notes: *: country did not satisfy all sampling criteria. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table H.2.1 Percentages of students whose schools (technical respondents) indicated that in-house ICT courses were available for teachers of the targeted grade range—primary education

	1. General technical introduction	2. Introduction, history, relevance	3. Introduction in applications	4. Introduction use of the Internet	5. Introduction maintenance	6. Advanced application use	7. Advanced Internet use	8. Advanced maintenance	9. General didactical principles	10. Subject-specific training	11. Programming own software	12. Digital video/audio equipment
Canada*	67	21	56	59	11	12	12	4	9	31	2	13
China Hong Kong	50	25	33	10	9	5	3	3	9	8	4	6
Chinese Taipei	~	~	~	~	~	~	~	~	~	~	~	~
Cyprus	29	19	25	5	0	10	0	0	16	19	5	0
Finland*	56	7	39	54	6	8	12	5	8	21	1	8
France*	~	~	~	~	~	~	~	~	~	~	~	~
Iceland	43	2	35	31	1	3	4	0	4	16	1	1
Israel*	65	11	64	16	5	22	5	2	20	30	2	4
Italy	68	46	45	21	16	9	3	0	25	13	7	3
Japan	58	41	11	21	34	7	4	2	15	33	3	9
New Zealand	79	28	70	56	20	15	9	3	8	20	2	17
Norway	~	~	~	~	~	~	~	~	~	~	~	~
Singapore	54	28	36	32	27	6	10	5	18	44	1	38
Slovenia	81	24	76	50	6	31	10	2	15	35	5	2

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table H.2.2 Percentages of students whose schools (technical respondents) indicated that in-house ICT courses were available for teachers of the targeted grade range—lower secondary education

	1. General technical introduction	2. Introduction, history, relevance	3. Introduction in applications	4. Introduction use of the Internet	5. Introduction maintenance	6. Advanced application use	7. Advanced Internet use	8. Advanced maintenance	9. General didactical principles	10. Subject-specific training	11. Programming own software	12. Digital video/audio equipment
Belgium-French*	~	~	~	~	~	~	~	~	~	~	~	~
Bulgaria	32	15	22	13	6	5	3	1	4	3	4	2
Canada*	65	20	58	69	9	15	15	3	10	25	2	10
China Hong Kong	53	23	63	48	11	17	6	5	6	4	3	8
Chinese Taipei	~	~	~	~	~	~	~	~	~	~	~	~
Cyprus	28	15	14	0	5	5	0	0	19	14	0	0
Czech Republic	58	16	45	18	4	13	3	1	6	25	1	2
Denmark	67	15	65	63	9	12	11	5	8	18	2	15
Finland	41	5	35	51	6	7	15	3	4	9	5	3
France	~	~	~	~	~	~	~	~	~	~	~	~
Hungary	46	14	41	22	15	10	2	2	2	4	3	0
Iceland	30	2	26	22	2	4	5	0	1	13	1	1
Israel*	51	11	47	26	6	18	8	1	11	21	6	3
Italy*	77	46	67	43	15	12	21	3	11	18	16	6
Japan	48	45	11	22	32	9	6	4	8	19	6	7
Lithuania	65	35	51	38	13	10	5	1	14	18	5	2
Luxembourg	~	~	~	~	~	~	~	~	~	~	~	~
New Zealand*	74	20	68	71	17	27	19	6	9	27	7	17
Norway	~	~	~	~	~	~	~	~	~	~	~	~
Russian Federation*	12	0	5	1	4	0	0	0	2	4	1	2
Singapore	57	28	53	41	24	16	24	4	28	50	17	26
Slovenia	81	26	78	54	8	38	12	5	17	37	5	3
South Africa*	69	26	69	39	11	10	10	5	8	5	7	3
Thailand	78	51	73	14	24	21	4	3	27	14	7	7

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table H.2.3 Percentages of students whose schools (technical respondents) indicated that in-house ICT courses were available for teachers of the targeted grade range—upper secondary education

	1. General technical introduction	2. Introduction, history, relevance	3. Introduction in applications	4. Introduction use of the Internet	5. Introduction maintenance	6. Advanced application use	7. Advanced Internet use	8. Advanced maintenance	9. General didactical principles	10. Subject-specific training	11. Programming own software	12. Digital video/audio equipment
Belgium-French*	~	~	~	~	~	~	~	~	~	~	~	~
Bulgaria	33	11	22	6	4	5	1	1	4	8	2	1
Canada*	60	19	56	64	13	22	22	7	11	31	8	16
China Hong Kong	51	23	61	46	12	17	7	6	6	5	2	7
Chinese Taipei	~	~	~	~	~	~	~	~	~	~	~	~
Cyprus	9	9	7	5	0	9	9	0	0	0	9	0
Czech Republic	73	27	66	43	10	24	12	4	4	13	4	3
France	~	~	~	~	~	~	~	~	~	~	~	~
Iceland	50	5	68	84	0	20	35	0	5	6	9	9
Israel*	53	8	60	41	5	17	9	4	9	13	3	1
Italy*	78	42	71	47	11	19	24	4	19	25	20	11
Japan	47	43	8	23	20	7	5	1	10	13	5	6
Latvia*	75	29	75	40	18	35	11	4	15	18	10	7
Lithuania	60	29	47	35	10	9	4	1	11	17	5	2
Luxembourg	~	~	~	~	~	~	~	~	~	~	~	~
Norway	~	~	~	~	~	~	~	~	~	~	~	~
Russian Federation*	12	0	5	1	4	0	0	0	2	4	1	1
Singapore	79	55	86	92	54	46	75	23	64	60	67	52
Slovak Republic*	50	13	45	33	1	7	3	1	1	5	3	0
Slovenia*	67	31	71	60	11	46	24	5	13	14	5	7
South Africa*	68	17	60	37	9	20	7	3	6	13	1	1

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table H.3.1 Percentages of students whose schools (technical respondents) indicated that external ICT courses were available for teachers of the targeted grade range—primary education

	1. General technical introduction	2. Introduction, history, relevance	3. Introduction in applications	4. Introduction use of the Internet	5. Introduction maintenance	6. Advanced application use	7. Advanced Internet use	8. Advanced maintenance	9. General didactical principles	10. Subject-specific training	11. Programming own software	12. Digital video/audio equipment
Canada*	53	29	60	56	33	43	49	27	30	33	19	26
China Hong Kong	67	55	76	66	49	43	36	35	45	41	48	35
Chinese Taipei	~	~	~	~	~	~	~	~	~	~	~	~
Cyprus	79	16	72	45	12	29	12	7	14	35	32	14
Finland*	42	18	47	48	32	35	45	28	24	16	16	19
France*	~	~	~	~	~	~	~	~	~	~	~	~
Iceland	58	22	61	68	29	38	56	24	35	19	13	13
Israel*	36	7	35	30	6	17	12	4	16	10	7	4
Italy	34	25	24	19	4	8	8	2	14	7	4	1
Japan	76	79	63	68	58	60	53	44	56	47	49	40
New Zealand	27	13	26	31	13	21	24	13	9	7	4	16
Norway	~	~	~	~	~	~	~	~	~	~	~	~
Singapore	75	44	94	91	42	29	33	17	47	71	11	21
Slovenia	30	8	35	33	30	29	26	20	28	34	15	13

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table H.3.2 Percentages of students whose schools (technical respondents) indicated that external ICT courses were available for teachers of the targeted grade range—lower secondary education

	1. General technical introduction	2. Introduction, history, relevance	3. Introduction in applications	4. Introduction use of the Internet	5. Introduction maintenance	6. Advanced application use	7. Advanced Internet use	8. Advanced maintenance	9. General didactical principles	10. Subject-specific training	11. Programming own software	12. Digital video/audio equipment
Belgium-French*	~	~	~	~	~	~	~	~	~	~	~	~
Bulgaria	37	22	34	30	11	15	11	7	15	11	17	7
Canada*	44	27	49	46	30	36	42	26	21	34	20	23
China Hong Kong	37	31	47	46	31	37	39	28	25	32	35	25
Chinese Taipei	~	~	~	~	~	~	~	~	~	~	~	~
Cyprus	61	19	67	40	0	13	8	0	40	31	14	8
Czech Republic	28	10	31	20	8	14	10	8	5	7	7	2
Denmark	36	26	51	44	38	33	34	38	33	38	14	34
Finland	38	12	43	44	23	25	36	23	19	18	15	16
France	~	~	~	~	~	~	~	~	~	~	~	~
Hungary	47	21	53	45	26	37	27	24	22	25	18	13
Iceland	66	41	68	73	46	48	63	40	38	31	21	21
Israel*	29	17	38	39	6	19	11	7	18	16	6	3
Italy*	19	14	16	19	2	8	9	8	8	11	8	4
Japan	72	73	63	69	50	51	55	46	54	42	54	44
Lithuania	68	44	61	61	30	30	32	21	46	48	24	18
Luxembourg	~	~	~	~	~	~	~	~	~	~	~	~
New Zealand*	13	12	22	21	13	17	17	18	13	17	11	12
Norway	~	~	~	~	~	~	~	~	~	~	~	~
Russian Federation*	42	24	43	24	27	5	4	5	24	25	34	4
Singapore	52	29	84	78	42	35	48	21	30	48	41	25
Slovenia	31	11	39	40	37	37	37	26	34	38	21	16
South Africa*	23	13	28	20	13	10	15	11	3	3	7	2
Thailand	24	16	28	17	18	16	11	11	18	17	13	8

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

Table H.3.3 Percentages of students whose schools (technical respondents) indicated that external ICT courses were available for teachers of the targeted grade range—upper secondary education

	1. General technical introduction	2. Introduction, history, relevance	3. Introduction in applications	4. Introduction use of the Internet	5. Introduction maintenance	6. Advanced application use	7. Advanced Internet use	8. Advanced maintenance	9. General didactical principles	10. Subject-specific training	11. Programming own software	12. Digital video/audio equipment
Belgium-French*	~	~	~	~	~	~	~	~	~	~	~	~
Bulgaria	38	21	44	28	14	21	13	9	15	17	13	9
Canada*	45	23	51	47	31	44	46	30	22	32	29	24
China Hong Kong	36	32	48	47	35	41	39	30	29	33	39	26
Chinese Taipei	~	~	~	~	~	~	~	~	~	~	~	~
Cyprus	54	28	75	33	17	29	22	17	37	17	17	28
Czech Republic	18	9	19	16	10	20	16	15	10	12	10	6
France	~	~	~	~	~	~	~	~	~	~	~	~
Iceland	36	17	31	40	51	34	54	35	28	24	37	19
Israel*	26	14	43	34	8	23	23	14	23	25	12	9
Italy*	14	10	11	16	3	9	6	6	12	12	6	6
Japan	54	64	56	64	45	50	50	44	45	35	47	35
Latvia*	28	15	26	21	13	17	17	13	7	7	9	9
Lithuania	68	44	55	62	29	30	34	25	42	46	25	18
Luxembourg	~	~	~	~	~	~	~	~	~	~	~	~
Norway	~	~	~	~	~	~	~	~	~	~	~	~
Russian Federation	41	23	42	23	26	5	4	5	23	25	34	4
Singapore	39	29	56	52	48	64	65	73	25	37	66	44
Slovak Republic*	22	9	28	27	8	24	18	10	9	9	9	1
Slovenia*	37	16	39	36	37	38	35	35	36	39	25	24
South Africa*	26	7	21	14	12	13	7	7	9	6	9	7

Notes: *: country did not satisfy all sampling criteria. ~: no data collected. See Appendix D for rules of thumb for estimating the standard errors for percentages.

APPENDI I

DATABASE CONSTRUCTION

nut Schwi ert, Ursula It linger, and laas Bos

O ER IEW

This appendix elucidates the data processing for the Second Information Technology in Education Study (SITES). Two major topics are described in 'General Idea of the International Data Processing'. The first concerns the special problems that large-scale international comparative surveys have compared to other studies. The second topic is about the general aim of data-processing in large-scale international comparative surveys. In section 3, 'Special Issues for SITES', we discuss issues concerning the data processing. One of the biggest challenges in SITES was the use of electronic mail as the main medium for exchanging data files and other materials. We give not only examples of the advantages of the use of the World Wide Web but also of the disadvantages. In section 4 we present a step-by-step description of the five phases of SITES data processing. These were the pilot phase, the review of the pilot data, the data collected in the main study, the review of the main study, and the creation of the international database. In the final part of this appendix, we make some recommendations for future studies.

GENERAL IDEA OF T E INTERNATIONAL DATA PROCESSING

Conducting large-scale international comparative surveys is a challenge. One of the most difficult parts of these studies is the construction of a questionnaire or a set of questionnaires that are appropriate for answering the main research questions. Developing questionnaires is not only the task of experts in the survey field; questionnaires should also be developed in accordance with standards set by data-processing experts. Theoretically, several questions can be constructed to measure one concept. Piloting these questions is necessary to find out whether the psychometrics of the questions are sufficient and whether the questions are valid in terms of their contents related to the concept they are supposed to measure. In SITES this was done by means of a pilot in many of the participating countries. Thus, all interesting potential questions were provided to respondents to check the instruments. Following the finalization of the first draft of the questionnaires, the staff of the IEA Data Processing Center (DPC) developed codebooks according to the questionnaires. After data collection and data entry were completed in the participating countries, the data sets delivered by the participating countries were examined by the DPC. Earlier IEA studies showed that although the format of the data sets were strictly defined, almost as many formats arrived at the DPC as there were participating countries. In general, the differences were caused mainly because of necessary national adaptations and partly because of data entry errors. After data receipt the DPC created a meta-database containing all information

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of all participating countries and taking into account the special national needs. Cleaning the national data sets was a matter of cooperation between the national data managers, the International Coordinating Center (ICC) of SITES, and the DPC team. Once all individual files had been cleaned, the first analysis was run. On the basis of its results, subject-matter experts decided if single questions or sets of questions were appropriate.

SPECIAL ISSUES FOR SITES

SITES was the first IEA Study to be organized entirely via the World Wide Web. This new medium offered new possibilities, but problems as well. The advantages of using this medium was that the time needed for sending and receiving materials, letters, programs, or data files decreased dramatically compared to regular mail facilities. Whereas courier or regular mail had taken at least days or weeks, now ‘shipping’ became a matter of minutes. This advantage was enormous if, for example, data files were corrupted. After a short message to the sender a new copy could soon be available. One of the main disadvantages of the availability of the Web was that deadlines that had been agreed upon were not taken as seriously as previously. For the national research coordinators (NRCs) it was easy to send a draft or a pre-draft version of the data to the DPC. In some cases in which files had not been marked as drafts, the data-processing process was started and completed (taking some hours of work at the DPC) sometimes only minutes before an updated version of a data file arrived at the center. Some countries used more of the DPC’s time than was necessary, sending the materials ‘step-wise’. Fortunately, this problem occurred in the pilot phase of the study and therefore it was possible to intervene before the main study started. The data-sending discipline from the NRCs improved during the main run. The lesson for future studies is that NRCs should be aware of the agreements about data delivery (including deadlines). Also, the existence of widely varying competencies in and heterogeneous experience of data-handling skills were observed in the different countries. For some country representatives it was an easy task, because they and their staff could rely on experience from former IEA studies. Other countries had difficulties in understanding and adapting their country-specific needs to the international study (i.e. the data-entry files provided by the DPC) without loss of information. Additionally, some countries took part with little experience in data processing so that not only the subject-matter work was new for them but also the data processing.

FI E P ASES OF SITES DATA PROCESSING

This section describes the five major phases of the SITES data processing. The central aim of this section is to describe the cleaning process in general (see Figure I.1 below). Before presenting the step-by-step description of the SITES data processing, we would like to clarify that the word ‘cleaning’ is properly understood. The aim of processing the data is not to make the data ‘cleaner than they are’. Only obvious errors or information that can be reconstructed are replaced by other values. Obvious wrong figures that cannot be replaced by ‘original’ codes are omitted from the database (i.e. treated as missing). This ensures that the data processing is really a process of enhancing the data quality, but it is by no means a manipulation of the data. Although the country representative (usually the NRC) had the final word about recoding the national data, in very rare cases the DPC in cooperation with the ICC resisted the impetus to code highly implausible values if the NRC was not able to explain these values in a convincing way.

Pilot

The pilot phase of a study constitutes the foundation of the whole study. In this phase general problems regarding the organization of the study, the data processing and the construction of questionnaires can be detected and corrected before the main study starts. In international comparative studies the results of the pilot form the basis for the evaluation of the special needs of a study. In general, the procedure of pilot testing for all IEA studies follows the same rules (see: *IEA Guidelines*, in press). However, every study has its own characteristics that make specific adaptations necessary. As nobody can think in advance of all the different kinds of problems in all participating countries, a pilot is useful for finding the 'problems' of each study.

An important aim of the pilot phase of a study is to try to get a global view of specific country-related problems. All participating countries can learn from all problems that occur in the pilot. Problems discussed at NRC meetings help all countries to avoid identified problems in the future. The international study staff (the DPC and ICC) identify those problems that are 'of general interest' as well as those problems that are of interest only to one single country. The latter are discussed in specific sessions with the country representative and the international study staff. Not all countries have the same expertise and experience, and it is therefore important to develop procedures for all countries, despite the different levels of technology and 'study skills' available. Hence, the focus of the pilot can differ for each country. Countries that are participating for the first time in an international comparative study are interested both in the general procedures of the study and the data processing. The general procedures are tested in a so-called field trial. Such a special phase was not necessary for the SITES. The instrument-pilot and the field trial were performed in one step. Those countries that were well trained regarding such procedures focused on testing the instruments.

The purpose of the SITES pilot was also to test manuals, data files, and software tools that help to enhance the data quality. The individual countries got a rough impression about the quality and 'shape' of the national pilot data compared to the international data set. On the basis of the pilot phase, the ICC and the DPC were able to estimate the time needed to process the data and to propose timelines for the main survey. An overview was obtained of problems that could be explained by the national adaptations, including those occurring during the translation of the questionnaires or the implementation of different procedures for, for example, sampling, translation verification, or reviewing feedback from the national centers.

A pilot is also useful for detecting and solving specific data-handling problems. Countries were trained to code the questionnaires in such a way that international comparisons were possible. (A critical point in all studies is the handling of *missing* data.) A special emphasis was placed by the DPC on the definition of different missing codes, their meaning and how they had to be coded. Hence, a minimum of information was lost. In general, pilot instruments contain more questions than necessary so that the best questions can be identified and selected. Based on the pilot results, problematic questions in terms of their contents or psychometric characteristics can be eliminated.

In the following section the pilot phase of SITES is described in three steps:

- The general international data-cleaning loop that was also applied in the main run.
- Single cleaning steps that were adapted from the former IEA Computers in Education Study (CompEd, Pelgrum, Janssen Reinen, & Plomp, 1993).
- The detailed description of the different cleaning steps.

Finally, a short description of the first data analysis is provided.

The International Data-cleaning Loop

The data-processing phases can be seen as a loop. At the beginning, the data were placed into the loop and the standard cleaning procedures were applied. All 'problems' and 'warnings' were documented in a 'Cleaning Report'. After reviewing the problems that had occurred, the DPC team decided whether an 'in-house' solution of the problem was appropriate or if specific feedback from the country representative was necessary. In cases where the requested documentation (Data Management Forms) was made available to the DPC, an 'in-house' solution very often could be chosen. In these cases the whole data processing was accelerated. If the 'in-house' solution was chosen, general cleaning rules were applied. If an 'out-house' solution was necessary, again two options were possible:

1. If the solution of general problems could be made with a country-specific cleaning program, then only the appropriateness of the basic cleaning procedure was discussed with the country representative.
2. If a certain number of manual corrections were requested for which a review of the questionnaires was essential, the countries were asked to re-send the data containing the requested changes. The use of email made it possible to get most of the requested information within one or a few days.

After all modifications, apart from the general cleaning steps, all data were processed again. In most of the cases all the necessary changes had been made by then. If new problems occurred, the next step was to think again about an 'in-' or 'out-house' solution. So the loop—cleaning, checking the reports, individual corrections, cleaning, etc.—was repeated until all data were consistent with the design of the study and comparable within and between the countries. Once this was ensured, the data could be used for the first analysis.

The cleaning reports that were sent to NRCs contained a 'warning' for each potential error. The warning included the sort of problem, the record number, and the school ID (school identification code), and the variables that were involved. In most cases it was simple to repair the problems at a first glance.

It has to be emphasized that not all warnings were related to problems or even errors. The purpose of the cleaning programs was to identify 'odd things' in all participating countries.

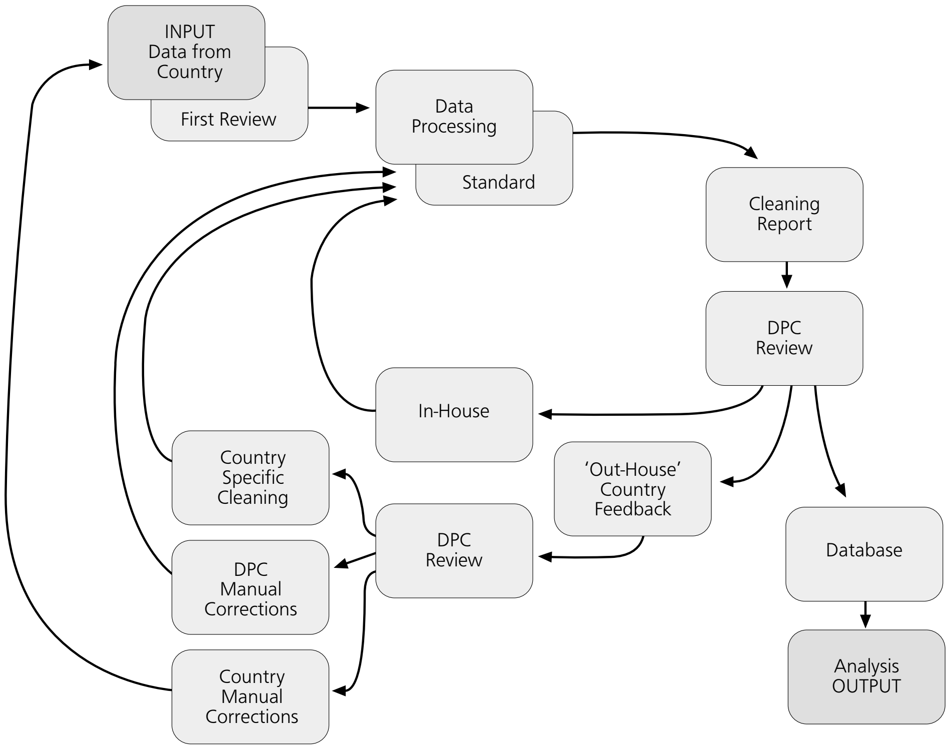

Figure 1 The international data-cleaning loop.

In some cases the cleaning reports identified mainly country-specific deviations from what was internationally defined as 'appropriate'. It was the responsibility of the NRC to explain these values and confirm that they were not due to typographical or other errors (for more details about the warnings and cleaning rules, see Annex 1 to this appendix).

Cleaning Steps

Cleaning programs are used to check the consistency of the data within and between countries. In general, errors can occur in three different stages in the data acquisition process: when questionnaires are completed, when the answers are coded, and when the codes are entered into a database. A set of standard checks was constructed and used for cleaning the SITES data and for identifying special problems that might occur in individual countries. Other cleaning steps were derived from procedures that are considered as IEA standards and are used in other IEA studies. For instance, the checks for unique identification codes (IDs) and identifiers for participation and sampling have been used in all IEA studies since the Reading Literacy Study that was conducted in 1991.

Several cleaning steps were derived from the IEA Second Computers in Education Studies (CompEd) that were conducted in 1989 and 1992. Wherever possible, the cleaning rules from CompEd also were used for SITES. By giving them specific identifying codes, they could be recognized as such. In Module-3 of SITES, it may be useful to use the cleaning output not only of the SITES data cleaning, but also of the CompEd data-cleaning process in order to detect variables that do not 'work' the way they are supposed to do. Ambiguous wording can be avoided and hence the quality of the data improved.

In CompEd, the cleaning process focussed on:

- checking missing data in crucial variables, and
- checking inconsistencies.

In SITES the inconsistency checks of CompEd between related variables were adopted, if applicable. All the cleaning programs in SITES produced an output with four-digit numbers as unique identifiers for each specific warning (see Annex 1). All warnings that are related to the inconsistency cleaning procedures in CompEd start with '61'.

First Univariate Analysis

By running the cleaning programs the DPC staff were able to identify problems within single records. The cleaning procedures, briefly described above, ensure that data are consistent within these records. Some kinds of problems can only be detected if the data can be seen from a 'bird's-eye' view. For example, if in only one case a value is entered, for example for the classroom size, that makes sense from a first look. A second look may consist of a comparison with all other entries of the country's classroom sizes. It then may turn out that the figures of some classrooms seem either too big or too small. To detect these questionable entries, descriptive analysis is performed. Some outliers or weird distributions of scores of some variables can only be detected if they are compared with the statistics of other 'unbiased' countries. After the review of these results such 'outliers' can be detected and—after discussion with the country representative—corrected. The review of this univariate analysis offers a further help to enhance the data quality.

Pilot Review

Three main data-review phases were distinguished. The first review of the data was performed on record-level—a check on single entries. After this review a wider view of the data was taken by reviewing the national univariate statistics and necessary recodings performed. The final step was the review of the data from an international comparative perspective. The phase of the pilot review ended with a stock-taking of the problems and with thinking about ways in which the procedures and questionnaires could be improved for the main study. From the results of the processing of the SITES pilot data, two basic problems emerged that needed to be solved before the main data collection could start. The first one was the way of submitting the data via the Internet. The second one was the handling of missing data. This last problem was so severe that both a special plenary session about missing data was held and country individual sessions were scheduled at an international NRC meeting.

ain Study

The same procedures for enhancing the quality of the main-run data were applied as for the pilot. The main difference between the data cleaning in the pilot and the main study was the treatment of the cleaning reports. In the pilot stage the error reports were used as a basis for revising instruments and procedures. In the main run the error reports were used only for improving the quality of the international database.

Arrival of Data

Although the data of many countries arrived some days before the deadline at the IEA Data Processing Center, some data sets arrived later. This caused a bottleneck situation at the DPC. Although the DPC tried to get some preliminary data from some countries so as to test the cleaning procedures, the test run of the cleaning programs was not finished when the data arrived. Therefore, the cleaning programs had to be finalized and the data had to be cleaned properly at the same time. In some cases, the cleaning routines had to be adapted and the cleaning repeated.[4]

All data arrived by email, mainly without any problems. Comments, reports, and tracking forms were also sent by email. All confirmations of data receipts were sent as well by email by the DPC. A number of problems occurred with regard to the attached files that countries received from the DPC. The email systems of a few countries did not seem to be compatible with the system used by the DPC. Sending (and receiving) compressed data sets was no problem at all.

The communication with most of the countries and with the International Coordination Center was very efficient and effective. Questions, answers, and even new data or new error reports could be exchanged within one working day; it would have been impossible to reach the deadlines of SITES using regular mail or even a courier.

On arrival, the number of files, the file format and the documentation that came with it were put into a meta-database. Within one week of arrival, reports from this database along with documentation of the countries were sent to the ICC. The use of this meta-database ensured that an overview of the actual status was available in some seconds, if necessary. The time and effort that was put into the preparation of such a database before the 'hot phase' of the study started proved its pay-off. The number of countries, the files they sent, the format the files were in, the documentation, and the comments on special findings could be printed in one instant. Use of these reports was made, for example, when data were delayed or materials were not received completely. Using the database, quick reactions were possible even during very busy times.

Within-country Cleaning Programs

The first cleaning step was the application of the within-country cleaning programs. These programs were written mainly to check violations of valid data, but also to check the consistency between some basic variables. In the DataEntryManager Program (DEM), a

4 A test of cleaning programs is always necessary because from the time the Data Processing Center in Hamburg started its work, it has never been possible to 'foresee' all possible problems that might occur.

check for valid data was available as well as a check for unique identification codes (IDs). These programs were provided to the countries (also via the World Wide Web). Countries were expected to run these check programs and clean the reported errors *before* sending their data files to the DPC.

Not all data sets were in a good shape when they arrived at the DPC. In quite a number of cases, the output of the cleaning programs showed that either the programs had not been used by the country or the cleaning had not been done properly. This may be an aspect for further improvement in the next phase of SITES. According to the results of the 'NRC-Questionnaire'[5] in SITES, the manuals should be more detailed. Somewhat sophisticated tasks like the use (and maybe adaptation) of the within-country cleaning programs should be described more precisely in manuals and circulars. When the valid range check procedure resulted in violations, a list was sent to the countries so that they could comment on those data. In some cases, there were reasons for violations: school principals were older than the range check in the data entry program allowed for. In other cases, those invalid values were due to typographical errors, and the values were corrected by the NRCs.

Cleaning Steps Conducted by the DPC

After running the within-country cleaning programs at the DPC, the standard general international cleaning program was applied to check possible mistakes. The DPC cleaning program was programmed in a modular fashion. These modules could be used independently of each other, and could be started by one routine. Therefore, upon arrival of revised data sets from a country, the first program only had to be adapted, and the cleaning loops were run very fast.

ID Check

One of the basic ideas of data cleaning is to ensure that every respondent (in the case of SITES Module-1, only school principals and technical staff members participated) is represented in the database in only one record. The identification (ID) system should ensure that duplicate IDs are impossible. Therefore it is logical to put an emphasis on the check of this ID system. Cases with non-unique IDs were reported in the cleaning report. In some cases (if tracking forms were available) the respondents could be identified without any doubt at the Data Processing Center. If this was not possible, the question about duplicate records was sent back to the national center. Very few cases of duplicate IDs occurred in the SITES main study data files. This is regarded as a very good sign for the overall quality of the data.

Indicator Variables

Indicator variables contain information about the participation status and the status of the data of each respondent. The information in these indicator variables must be consistent with each other, and they must be consistent with the data that are available. Most of the problems in these checks were due to typographical errors or errors of key-punchers and

5 This questionnaire was a short evaluation of structure and processes in the SITES concerning the perception of the work done by the DPC (and its output). It was answered by the majority of the NRCs of the participating countries, most of whom were satisfied about cooperation with the DPC.

could be recoded automatically. Nevertheless, each recoding was recorded, and NRCs were asked to confirm that the recoding was correct. In most cases when the cleaning programs listed warnings concerning these indicator variables, the problem had to do with the incorrect coding of missing data. In some cases, the indicator variables indicated data although no data were available. The latter were mostly due to typographical errors. In other cases, where the cleaning programs detected 'valid data' but no data were expected, it was often the case that the missing code of variables had been changed manually by the national center in a wrong way. The variables contained the correct values, but the programs did not identify these values as missing codes. This could have been solved by a pre-cleaning program that re-inserted/defined the correct missing values.

Filter and Dependent Variables and Lists

- **Filter and dependent questions**: Within this section, it is necessary to explain briefly the different missing codes. For a more detailed description, see Annex 2.

Missing data

When a respondent had not answered a question (did not check a box, or left a space blank) that he or she was intended to answer, this was considered to be 'real missing data'. The value used for these is "9", "99", etc. (depending on the length of the variable) in SPSS and a dot (".") in SAS.

Not Administered Data

If a person was not given the opportunity to answer a question, this variable was filled with the so-called 'Not Administered (NA)-code'. The value for this data is "8", "98" etc. in SPSS and ".A" in SAS.

Some variables in the questionnaire were so-called 'filter questions'. A good example of this kind of question can be found in the Technical Questionnaire, question 7:

7. Do your students or teachers (in grades *-*) use e-mail or the World Wide Web (WWW) for instructional purposes?

   ☐ No, proceed to *question 14*

   ☐ Yes, proceed to *question 8*

In cases where the respondent answered 'no', no data for all variables from questions 8 to 13, the so-called 'dependent variables', were expected. A special code called 'not administered' (NA) code was assigned to these variables. Conversely, if the respondent answered with 'yes', the NA code would not have been assigned to the following variables. In those cases valid data or the missing code were expected.

The coding of these variables seems to have been quite difficult. The distinction between the 'not administered' code—the code for omitted data—and the code for 'not checked' was not always used in the way it was intended by the DPC. In further studies, these rules will be explained in more detail in the respective manuals.

Deviations of the international coding scheme were mostly consistent within the countries, which led to a very large cleaning report (the same error was repeated in many records), but did not require much post-cleaning work because these data could be recoded easily and automatically.

- **Lists:** Some questions contained a list of sub-questions, for example question 22 in the Principal Questionnaire:

> 22. Indicate whether or not you consider each of the following to be major obstacles affecting the realization of your school's computer-related goals for students in grades *-*.
>
> ✓ Tick all that apply.
>
> ***Hardware***
>
> 1. Insufficient number of computers ☐
>
> ***Software***
>
> 2. Not enough copies of software for instructional purposes ☐
> 3. Not enough types (variety) of software ☐
>
> • ☐
> • ☐
> • ☐
>
> 18. Other ☐
>
> ✓ **Tick here if none of the above applies.**

If at least one of the boxes of the sub-questions 1 to 18 was ticked, the 'none of the above applies' box should *not* have been checked but coded to the NA code. On the other hand, if the whole list was left without a tick but the 'none of the above applies' box was checked, the sub-questions should not have been coded as missing or 'not checked', but should have been given the NA code.[6] If the whole list was left empty and no tick at all was made, the complete question 22 should have been treated as missing. In this case, a warning was printed in the cleaning report: 'All these variables are coded to missing. Please check manually.'

Violations of these rules could be recoded mostly automatically. If the recoding could not be done automatically, manual checking by the national center was required. In many cases, these situations occurred because of mispunching or some misunderstanding of the handling of the NA code, missing code, and 'not-checked' code. In some cases the respondents filled in the questionnaires accordingly. If automatic recoding was not possible, it was left to the NRCs to check the data and do the manual recoding.

6 This is the rule that was applied during the first cleaning step. Once the status of the item was sorted out, the sub-questions were recoded again to 'Not checked' if the '✓ **Tick here if none of the above applies**' box was checked in the correct way.

Check for 'Gang-Punched' Data

The punching of data is called 'gang-punched' if the data of a variable were punched with the same value for all records (= for all participants). In some cases, one would expect this to occur—for example for the country ID or for the population ID. In these cases it would be necessary to write a 'watch-out' note to the NRC if these values had *not* been gang-punched. In other cases it provided good information for the NRCs—as well as for the DPC.

Check for 'Not-Administered' Data

This check is very similar to the gang-punched check above. Here, all the variables that are not administered in a country (that should have the NA code for all records) are reported. Again, this is a check that does not necessarily report errors.

Sumcheck

There were questions in both questionnaires that asked for numbers and/or asked for a sum. An example of this is question 3 in the Technical Questionnaire:

3. Approximately how many hours per week (on average) do *you* (and your assistants) spend on providing technology coordination, training, and user support in each of the following ways?

   Think about last week in particular; then adjust if it was different than usual. If you also work at other schools, count only the hours spent for THIS school. Please round to the nearest hour.

1.	Technology-, Training-, Coordination-, User-Support and Activities	☐
2.	Installing, maintaining, repairing/troubleshooting equipment, networks, operating systems, and software	☐
3.	Planning and delivering staff development workshops on ICT	☐
4.	Writing lesson plans/ units that integrate ICT into different curricula with other teachers	☐
5.	Selecting and acquiring computer-related hardware, software, and support materials for the school	☐
6.	Other technology coordination & support	☐
	TOTAL hours per week	☐

One of the checks consisted of summing all the numbers in the six variables and comparing this number with the number that the respondents wrote in the seventh box. By means of another routine, a check was done on whether the value put in the seventh box was plausible.

There were other checks that compared the scores of one variable with the scores of other variables that were assumed to be comparable, for example, the number of computers in a school with the number of processors. The number of computers available for students at the target grade was compared with the total number of computers available for students in this school. The student:teacher ratio was computed and a warning printed if the ratio was below 10. The number of students in the target grades was compared with the total number of students at school, and a warning was printed if the first number was bigger than the second, and so on. These comparisons identified many inconsistencies. In some cases, the inconsistencies were due to a very special situation at a school. For example, there were schools where the number of computers that were not in use was bigger than the number of working computers. The NRCs confirmed that this might be the case.

The student:teacher ratio, computed by dividing the absolute number of students by the absolute number of teachers, would be extraordinarily small in a country with a big proportion of part-time teachers. The finding that the number of operating systems exceeded the number of computers is also not necessarily wrong. In most cases, NRCs noted that the numbers are reported in this way by the participants, and this could well be the case. In most of the cases where the inconsistencies could not be explained, the respondents answered in an inconsistent way because they misinterpreted the questions. For example, they answered some questions with respect to the target grades and other questions by mistakenly identifying them with the whole school. It is hard to know what participants had in mind when they reported the number of students in the target grade as being two times as large as the number of students in the entire school. In this instance, at least one of the numbers must be wrong.

Other problems (which were not thought about in advance) were the inconsistencies between the answers of the principals and the answers of the technical persons, for example concerning the number of students or the number of computers.

Before the questionnaires are used in the next SITES module, it is strongly recommended that an examination is carried out of the error reports that were produced by the DPC across all countries. The questions that led to highly inconsistent data all over the world are clearly identified in these reports.

Linkcheck

In the application of the linkcheck programs, all files of one population of a specific country were included. The identification variables were checked against each other. Examples of 'linkage' errors are as follows: schools which were reported to be non-participating in the principal file but had a questionnaire in the technical file; schools that were present both in the non-user and in the user version of the school questionnaire—here, missing technical questionnaires were listed. NRCs were asked to look at their sample and decide whether schools should be treated as users or non-users, or whether a school should be treated as non-participating or participating (but without the principal questionnaire). In most of the cases, NRCs confirmed the list as it was. In some cases, participation indicator variables had to be changed. Generally, the linkcheck of the files did not result in major problems.

Frequently Asked Questions

When countries received their cleaning reports, they often thought that everything that had been reported should be regarded as an error, and wrote that these warnings were not correct or they recoded the variables in a way they thought would be correct. Another reply that occurred in some countries was to recode all the data that had been recoded automatically and to send the new data files. Again, the use of email turned out to be a tool for efficient communication between the DPC and the NRCs around the world. Frequent use of email in future studies is therefore strongly recommended by the IEA Data Processing Center.

Main Study Review

The phases of review in the main study were similar to the ones in the pilot (see Figure I.1). Firstly, the record-oriented review of the data (review of the cleaning reports) was done. Secondly, the review of the country-based univariate statistics was done, and finally the review of the international univariate statistics was carried out. Again, these three steps were conducted to ensure that the final meta-database contained only those data that were known to be reliable for international comparative analysis.

Preparation of the International Database

The final activity of data processing was to create the '*international database*' in conjunction with the corresponding documentation provided by the NRCs. The preparation of the international database was a matter of merging all data that had been collected for SITES. The database eventually came to contain all the data from the countries that had delivered their data on time or had negotiated a later date. The database that was used for the analysis presented in this report, contained data from 26 countries. Not all counties took part in all three educational levels so that the data sets for the three different target groups are based on different numbers of countries (see Table 1.2 in Chapter 1). Altogether more than 20,000 observations were processed at the Data Processing Center in cooperation with both the country representatives and the International Coordinating Center. About 20,000 potential problems were detected and basically all of them were solved. The solution was made either by the country representative confirming that the given figures or the combination of several answers were reasonable in the specific country or by recoding of the odd values.

RECO ENDATIONS FOR FUTURE STUDIES

The aim of the authors of this chapter was to give on the one hand a brief overview of processing the data for the study and on the other hand a kind of technical guide for the organization of the data processing of such surveys. In regard to the latter it is obvious that all persons participating either at the national or the international level of a study must work very closely together to make the goals of the international study possible.

The data processing of SITES Module-1 went smoothly. Some recommendations for future IEA studies follow.

Internet Electronic ail

The use of electronic mail and a project site on the World Wide Web to exchange study materials and data files between the participating countries, the DPC, and the ICC turned out to be very successful. Continuation of the application of Internet facilities in future IEA studies is strongly recommended. An important condition for an optimal use of email might be the composition of a list of email programs that are being used in the participating countries (e.g. the availability of MIME, encoding system to be used for attachments, etc.).

Enhancement of Com ara ility of International Data Contents of the uestionnaires

Dividing the (long) questionnaires into separate sections (compulsory international items and international options) is advised.

NRCs can decide which international options they would include in their national questionnaire. The use of international options seems to decrease the number of national adaptations. National adaptations in themselves could cause some problems later during the international data processing, and therefore are not of value for international comparisons. Nevertheless, this makes the task of creating comparable data sets more difficult. The aim of having an internationally comparable and meaningful database needs to be given the highest priority, and this should be communicated to all national centers.

Benefits for SITES odule-

A great deal of information will be available for Module-3 of SITES, not only about school systems and schools in the 26 countries that participated in SITES Module-1, but also about the strong and weak points of the questionnaires. The weak points need to be identified in particular and the questionnaires changed accordingly. The international cleaning reports (i.e. a sum of all country-specific cleaning reports) may be useful in this regard. The questions that led to highly inconsistent data all over the world are clearly identified in these reports. International options can also be a good solution for several versions of 'difficult' questions.

In conclusion, the data processing of SITES Module-1 was completed successfully. The international database was finished on time, in good measure because of the good cooperation between NRCs, the ICC and the DPC. Finally, the team from the Data Processing Center of Hamburg is looking forward to cooperating with all participating persons in the future.

ANNE

The following warnings were produced for all files and all populations. Please note that some warnings concern the technical file only; others the principal file only. Some warnings indicate the same logical problem, but refer to other variables. In the country-specific reports, the warnings were listed per file type and population. For reasons of keeping this annex as short as possible, warnings for Population 1 only are shown.

- ID, TOKEN, and Participation checks

1000: Duplicate school ID found: 150 check manually

1001: If more then 3 valid values were found: Token01 is not valid but some variables have valid codes. TOKEN01 rec. to 3 in SCH:1

1002: If no valid values have been found, but Token01 =3: Token01 is not 1 or 2 but no variables have valid codes. TOKEN01 rec. to 1 in SCH:1

1003: Token01 is 2 variables with MISSING-code are recoded to NA in SCH: 88

1004: Token01 is 1 but valid responses found TOKEN01 will be coded to 3 in SCH: 629

1005: Token01 is 2 but less than 4 responses found TOKEN01 var. recoded to NA in SCH: 21303

1006: TOKEN01 is 3 but no valid responses found TOKEN01 recoded to 1 in SCH: 92

1007: TOKEN01 is 1 but missing values found. Responses recoded to NA in SCH: 92

1008: ITPART = 0 but valid data found. ITPART is recoded to 3 in SCH: 2

1009: ITPART = 3 but no valid data found. ITPART is recoded to 0 in SCH: 40

1010: ITPART = 0 but valid data found. ITPART is recoded to 1 in SCH: 3

1011: ITPART = 1 but no valid data found. ITPART is recoded to 0 in SCH: 9

1012: Unexpected value found for IDSCHOOL: 0

- Checks for variables depending on previous questions

2000: Filter ACGNCOT2= 1 recoded to 2(c) because dep. var. ACGNCON2 contains valid data SCH: 5

2001: Filter ACGNCOT2= 2 recoded to 1 (nc) because dependent variable ACGNCON2 contains zero in SCH: 286

2002: Dep.var. ACGNCON2 recoded from miss. to 0 because filter is not checked in SCH: 3

2003: - not used in main study

2004: Filter ACGNCOT1 recoded to 2 because no other coordinates in SCH: 205

2005: Filter ACGNCOT1 recoded to 1(nc) because at least one coordinates in SCH: 113

- Checks for 'none of the above applies' variables

3000: ACGACQNO recoded from 2 to 1(nc) because one of the list above was checked in SCH: 195

3001: ACGACQNO is recoded from . to 1(nc) because one of the items was coded as 1(nc) in SCH: 145

3002: Item1 is recoded from . to 1(nc) because of ACGPRANO was coded as 2(c) in SCH: 198

3003: Item is coded as not admin. Check carefully list above ACGPRANO in SCH: 98

3004: ACGACQ1 to ACGACQ8 is complete coded to missing. Check carefully in SCH: 19

- Checks of filter-dependent variables

4000: Filter in Q#9 will be recoded dependent answers in Q#9a in SCH: 40

4001: Dep. in Q#9a/1 will be recoded from (1) to NA depending on filter in Q#9 in SCH: 12

4002: - not used in main study

4003: Filter in Q#9 indicates answers but no answers are given check manually in SCH: 44

4004: Filter in Q#14A will be recoded dependent answers in Q#14B in SCH: 27

4005: Dep. in Q#14B/1 will be recoded from (.) to NA depending on filter in Q#14A in SCH: 17

4006: Filter in Q#14A indicates answers but no answers are given check manually in SCH: 1726

4007: Filter in Q#19/1 will be recoded dependent answers in Q#19/2-8 in SCH: 1

4008: Dep. in Q#19/2 will be recoded from (A) to NA depending on filter in Q#19/1 in SCH: 69

4009: Filter in Q#19/1 indicates answers but no answers are given check manually in SCH: 68

4010: Filter in Q#26 is inconsistent with data in Q#27 Check manually in SCH: 688

- Checks for not-administered variables or variables with the same value for all observations

5000: Int-Opt: Variable ACGEINV1 is 100% not administered

5001: Int-Opt: Variable ACGOFT3 is 100% missing

5002: Not Int-Opt: Variable ACGTYCOM is gang-punched with the value: 4

- Checks for inconsistencies in sums and comparisons

6000: (Q#1) Sum of cls (14) in defined grades exceeds tot num of cls: BCGNCLST 13 in SCH: 175

6001: (Q#1) Sum of boys (1118) in defined grades exceeds tot num of boys: ACGNBT 117 in SCH: 203

6002: (Q#1) Sum of girls (1100) in defined grades exceeds tot num of girls: ACGNGT 1070 in SCH: 187

6103: Tot num of teachers in #2 equals zero in SCH: 100

6203: number of teachers (m) (5) smaller than number of FTEs (m) (15.0) in SCH: 100

6203: number of teachers (f) (3) smaller than number of FTEs (f) (13.7) in SCH: 100

6104: Tot num of students per teachers is with 5.4 less than 10 in SCH: 1

6204: Tot num of students per FTE is with 5.4 less than 10 in SCH: 1

6105: Years as principal at this school (1) is larger than at any schools (0) in SCH: 142

6205: Years as principal at this school not equal 0 (4) but zero years at any school in SCH: 42

6305: ACGYPRS (4) unequal ACGYPRA (2) in SCH: 42 ACGYPRA is recoded to missing

6106: Years as principal at this school (1) is larger than working as capacity (0) in SCH: 53

6206: Years as principal at this school NE 0 (1) but zero years as capacity (0) in SCH: 33 ACGYPROF is recoded to ACGYPRS

6306: ACGYPRS (5) unequal ACGYPROF (3) in SCH: 33 ACGYPROF is recoded to missing

6007: (Q#3) Sum of hours (12) exceeds tot num of hours: AQGHSUPT (11) in SCH: 13

6207: (Q#3) TOTAL = zero, but sum of hours = 12: AQGHSUPT is recoded to SUM in SCH: 13

6010: (Q#20) Sum of comp. (1) exceeds tot num of comp.: AQGNCOMT (0) in SCH: 116

6310: (Q#20) TOTAL recoded from zero to sum of Q#20/1 to 20/5 (5) in SCH: 13

6210: (Q#20 vs 18) Sum of comp. (4) minus # of comp. for teachers only (2) exceeds tot number of comp. (3) in SCH:13

6610: MISINTERPRETATION? ACGNCOM4 = ACGNTCH in SCH:13

6011: (Q#20-21) # of network computers (12) exceeds tot num of comp.: AQGNCOMT (7) in SCH: 672

6012: (Q#22) # STD. from target grade (0)> # STD. in school (Q#17) (.) in SCH: 144

6013: (Q#23) Sum of diff.comp. (1) exceeds tot num of diff.comp.: AQGTYPT (0) in SCH: 37

6213: (Q#23) Sum of diff.proc. not equal 0 but A in SCH: 13

6014: (Q#24) Sum of diff. OS (10) exceeds tot num of computers: AQGNCOMT (5) in SCH: 10

6015: Tot num of comp.in Q#15 0 is lower than num.of comp.for STD in Q#20: 4 in SCH: 65

6016: (Q#23) Sum of ref.processors (0) not equal tot num of comp.: AQGNCOMT (15) in SCH: 543

6216: (Q#23) Sum of ref.processors equals zero, AQGTYPT is recoded to missing in SCH: 53

6017: (Q#23) Sum of OS (10) exceeds tot num of comp.: AQGNCOMT (5) in SCH: 10

6018: (Q#23) Sum of OS (0) is lower than tot num of comp.: AQGNCOMT (20) in SCH: 70

6019: Tot num of comp.in #15 and 18 lower than num of comp. not used: (35) #15 and 18 vs. #25 (41

6020: Tot num of comp. in #20 lower than num.of comp.fit for MM: 29 #20 vs. #26 54 in SCH: 13

6021: Tot num of comp. in #20 lower than num.of comp.access to mail: 29 #20 vs. #22 54 in SCH: 13

6022: Tot num of comp. in #20 lower than num.of comp.access to web: 19 #20 vs. #22 26 in SCH: 54

6108: Years as comp.coord. at this school (1) is larger than at any schools (0) in SCH: 163

6109: Years as comp.coord. at this school (1) is larger working as capacity (0) in SCH: 639

6124: Reasons for no-use recoded in AQGRUSE1 from (1) to NA because of filter AQGNUSE in SCH: 5

6126: More printers (Q#29) than computers (Q#20): Check manually in SCH: 152

6127: Computers available (Q#20) but no software (Q#30) in SCH: 175

6128: Computers available (Q#20) but no educational software (Q#31) in SCH: 157

ANNE

A lied Codes for issing Data

One of the most common problems in the SITES pilot was the usage of missing codes. Problems with handling these codes occurred very often, especially for split questions and filter-dependent questions. To give a clear guide about the coding of missing information from the questionnaire, two different missing codes were defined:

Missing codes (9, 99, 999, ...) and

Not Administered codes (8, 98, 998, ...)

issing

The 'Missing' code is the appropriate code if the puncher knows that the respondent has seen the question. In other words the question should have been answered but:

a) the answer was unreadable or given in an unclear way;

b) the whole question or single items were skipped; or

c) the respondent checked more options than requested.

The numeric codes for missing are 9, 99, 999, and so forth, depending on the defined length of the variables. If a variable was defined to contain numbers with decimal places only, the integer part of the figure would have been used to indicate the appropriate 'Missing' code. The definition of the 'Missing' code for each variable is given in the codebook.

Not Administered

'Not Administered' is the appropriate code if the respondent did not have the opportunity to answer the question. For example:

a) one question or a set of questions is misprinted; or

b) a question or a set of questions is logically not appropriate.

'Logically not appropriate' questions are those that, for example, should be skipped, depending on the answer of a former question (dependent questions are skipped after filter questions).

In addition, all variables of a questionnaire must be coded as 'Not Administered' if:

c) the respondent did not answer the whole questionnaire (or none of the questions) at all.

In this case the corresponding participating variables give the information needed for the data processing. If, for example, a principal refused to participate in SITES or the technical questionnaire were lost during shipping of the materials back to the NCC, all variables for the questionnaire would have been coded as 'Not Administered' as well.

The 'Not Administered' codes are 8, 98, 998, and so on, depending on the length of the variable. The 'Not Administered' codes are always defined as the 'Missing Code' minus 1. If a variable was defined to contain numbers with decimal places only, the integer part of the figure would have been used to indicate the appropriate 'Not Administered' code. The definition of the 'Not Administered' code for each variable is given in the codebook.

APPENDI

NATIONAL ICT POLICIES IN T E NET ERLANDS AND T E USA

T E NET ERLANDS

G Doorne am and Drent

Since 1982, the Dutch government has applied a series of stimulation policies to promote the use of new technologies in education. The stimulation has taken place via a number of promotion programs, which are briefly described below.

E PLORATION,

The first program was called the 100 Schools Project. This project was aimed at creating computer awareness and improving computer and information literacy. It included the provision of computer hardware, in-service training, and assistance with curriculum development to a small number of secondary schools.

PRO ISION AND INTRODUCTION,

The Information Technology Stimulation Plan (INSP) program had two primary objectives: (i) to promote information and computer literacy as an essential skill for life in society; and (ii) to improve the quality of vocational education ('human capital') by preparing skilled workers. The use of IT to enhance the learning process itself was mentioned only as a secondary possibility, although a significant proportion of the development activities focused on this aspect.

The INSP program led to a number of parallel projects (for example, the so-called NIVO and POCO projects), which were aimed at training teachers in vocational and general secondary schools, providing hardware, and developing software.

I PLE ENTATION,

The OPSTAP period began when the government decided to provide a further boost for IT in education. The Dutch word *opstap* means 'going away' or 'moving on'. The government used the word to express its intention that, after an additional period of support, schools in principle should be able to implement and independently maintain the use of IT in their education practices. The program broke with the procedures of the INSP by ending the integrated approach. Thenceforth, hardware acquisition and infrastructure measures were brought under the control of the Ministry of Education, while courseware development, in-service training, and the support of schools became the responsibility of the educational support organizations.

The Project Implementation New Technology (PRINT) program evolved from the OPSTAP idea that a single development project should promote and implement the use of IT in the schools. PRINT offered assistance by organizing professional development activities and fulfilling a general 'help' function (providing advice and information about the use of IT and IT-related products). In the sector of general secondary education, PRINT continued along the lines set out for the INSP and NIVO projects.

In order to intensively stimulate IT in primary schools, the government started the PRINT-Comenius project. Every primary school received a MS-DOS AT computer (one computer for every 60 students). A computer coordinator was trained in advance, and hardware was supplied to the schools while the in-service training of teachers was still in progress.

Another program, Enter: The Future, began in 1992. It was underpinned by the following principles:

1. Any further implementation of IT in education would take place under the authority and responsibility of the schools.
2. Schools would have the ability to direct the integration of IT into their educational practices.
3. IT in education no longer needed to be a policy theme in itself.
4. The government would take a more selective role regarding IT in education.

PRESENT POLICIES AND INTENTION,

In 1997 the government published the action plan, *Investing in Staying Ahead.* This plan was thought necessary because the described past investment and development programs had not led to the real integration of ICT into Dutch education. Moreover, the development of the Information Society and the increasing importance of ICT demanded that schools familiarize children with ICT at an early age to prevent a division between those who are and those who are not familiar with these technologies. Another important aim of *Investing in Staying Ahead* was to use ICT as an engine for important educational innovations and higher standards in education. Here, ICT is seen as a tool that can facilitate individualized learning, independent learning, and learning at one's own pace. Investing in Staying Ahead applies to primary education, secondary education, vocational and adult education, and teacher education.

The government has enlarged its role in creating the right conditions for schools to integrate ICT in their education, because educational institutions do not seem able to implement ICT successfully themselves. To this end, the government set up an organization, the ICT in Education Process Management Agency (PM-ICT), to manage all aspects of this process. The agency will direct and support the processes of change throughout the term of the program until the year 2002. However, the responsibility for the effective implementation of ICT will stay with the schools themselves.

Essentially, there are four areas for which the government lays down guidelines and provides financial resources:

- the arrangement of further training;
- the promotion of availability of educational software;
- connection to 'Kennisnet', a national Intranet for education;
- technical facilities (one computer for every 10 students in primary, secondary, and vocational and adult education, and one computer for every three students in teacher education).

Not all schools will start at the same time with the implementation of ICT. Several hundred schools within primary, secondary, and vocational and adult education have been designated as 'vanguard' schools. These schools, which were already ahead of other schools in applying ICT in education, are taking the lead in systematically applying ICT to improve educational practice. The vanguard schools are the first in getting support for the above-mentioned resources. Another initiative has seen all schools for primary education receiving, in the first year of *Investing in Staying Ahead*, a minimum foundation of modern equipment (multimedia computers) and further training.

Extra attention is being given to teacher education because these institutions are seen as an important means of stimulating innovation in all educational sectors. Within teacher education the following actions have been established to stimulate the implementation of ICT. Two institutes for teacher education have been designated as experimental institutions. Their role is to utilize ICT in innovative ways. Institutes for teacher education can also apply for funds to develop regional centers for learning technology. Institutes for teacher education can further apply for funds to execute ICT projects relating to emergent practices (examples of arrangements for education in the future) or for bringing multimedia into the curriculum (development of multimedia programs).

UNITED STATES OF A ERICA

R E Anderson and S Dexter

The educational system in the United States has traditionally operated on the basis of decentralized decision-making processes and diverse philosophies and practices. For the most part, the K12 schools in the United States run under the control of a local board of education that sets policy and is the authority for a district (or diocese) of schools. Within each district, the degree of autonomy allowed for individual schools and for teachers varies. However, a district of schools usually shares the same curriculum, schedules, and access to resources. Also, each state does influence what happens in its public schools, through policies and practices such as funding patterns, legislation, teacher licensing requirements, and graduation standards or requirements.

The federal government traditionally has had very little direct control or influence on the nation's schools, which receive only a small percentage of their funding from the national government, and there are no national policies for education. Instead, the United States

Department of Education exerts influence through making extra funding available for congressional or presidential initiatives, and through crafting and disseminating national reports and recommendations.

ICT policies and practices for K12 education at the state and federal levels follow the pattern of local control influenced by state and federal funding opportunities and policy recommendations. In 1996 this included the President's Educational Technology Initiative, a four-point plan which stated that:

- modern computers should be available to every student;
- classrooms should be connected to one another and to the outside world;
- educational technology should become an integral part of the curriculum;
- teachers should be ready to use and teach with technology.

That same year, in an effort to facilitate state-based research and development directed toward these goals, USD2B were allocated to the Technology Learning Challenge grants, an initiative that matches funds through competitive grants for school, business, and higher education collaboratives. Also in 1996 the United States Congress passed the Telecommunications Act. This led to the 'e-rate', a source of funding to assist K12 schools gain access to telecommunications services. Another component of this act established 'regional technology consortia programs' throughout the country to provide ICT-related professional development, technical assistance, and information dissemination. Existing federally funded programs were also encouraged to include technology efforts in their work and to coordinate these efforts with those of other programs.

In addition, volunteer or private sector-based initiatives have been promoted, such as annual NetDays that coordinate volunteers to wire schools for telecommunications. In 1999, a funding initiative specifically targeted USD75M in matching funds through competitive grants for institutes of higher education to better prepare pre-service teachers to use technology.

While each state has individually developed policies and practices to meet these or other self-determined goals to support ICT in K12 education, there are some common patterns among the states. Nearly all have regularly updated technology plans. This situation is, in part, the result of the federal mandate requiring states to submit a technology plan addressing the points of the President's Educational Technology Initiative, in order to apply for the federal e-rate subsidy or any Technology Learning Challenge grant monies. Within the last few years, all but a few of the states have begun to dedicate their own legislative funds for the purchase of technology for schools. In addition, 42 states have established technology standards or requirements for students. Furthermore, 46 of the 50 states report that 14 or more hours of technology training are offered to teachers each year.

Within each school district, the funding and infrastructure policies and practices for ICT reflect the traditional emphasis on local control and decision-making, but state and federal influences are also evident. For example, about two-thirds of the funds for software purchases come from the school districts, and the source of the remainder is split between allotments from federal government programs and other resources that include private donations and special fundraising.[1]

Because of local district control and varying degrees of school and teacher autonomy within districts, use of ICT in classrooms varies widely from school to school and within subject areas. No national curriculum currently exists for any subject, let alone the relatively newborn subject of computer education and the practices associated with ICT. Nevertheless, national movements do emerge out of wide and long-standing concerns over improving educational outcomes for all United States students and out of the research and debates that accompany this goal. Today, 'technology integration' is the ascending curricular model for computer education. In this model, teachers of several non-computer subjects together share the responsibility for teaching basic computing skills to students, thereby allowing students to use these skills as they learn subject matter.

While curricula are determined at the district level, and integration patterns at the school or classroom levels, there are nonetheless traditions and patterns of instruction within subject areas that help to account for the different patterns of ICT use between elementary and secondary school teachers, and among subject areas at the secondary level. For example, a long history of National Science Foundation-sponsored technology projects and hardware and software development has increased the number and type of ICT choices available to integrate into the science classroom. It has also provided teachers with professional development opportunities to learn how to use ICT.

This sort of voluntary participation in formal learning opportunities about how best to support instruction with technology, along with optional classes offered by the districts themselves or regional service centers, are the main ways in which practicing in-service teachers update their knowledge on teaching with ICT. In response to the research and literature on teachers' professional development, these course providers increasingly emphasize the opportunity for teachers to consider the implications for instruction suggested by new software, and to share ideas with one another and construct professional knowledge.

A parallel emphasis regarding teachers' professional knowledge about supporting instruction with technology is under way in the United States' colleges of education. In 1995, only 19 states required computer training for teacher certification. As of 1999, 38 of the 50 states had this requirement.[2] Whether required or optional, colleges of education traditionally offered one skill-focused course on ICT in their teacher preparation programs. It is now recommended that they integrate a focus on supporting instruction with technology throughout the program of preparation, especially targeting the 'student teaching' or practicum experience.[3] The emphasis is increasingly on helping new teachers to construct

1 United States Congress, OTA (1988) *Power On! new tools for teaching and learning* (Office of Technology Assessment; OTA-SET-379), Washington, D.C.: US Government Printing Office; and United States Congress, OTA (1995) *Teachers and Technology: making the connection* (Office of Technology Assessment; OTA-EHR-616), Washington, D.C.: US Government Printing Office.

2 OTA (1995), ibid.

3 Moursund, D. and Bielefeldt, T. (1999) *Will New Teachers Be Prepared to Teach in a Digital Age? a national survey on information technology in teacher education*. Santa Monica, CA: Milken Exchange on Education Technology. [Available online at http://www.milkenexchange.org/research/iste_results.html]

their own understanding of how to teach with—not just operate—ICT. (An example of how the federal government encourages such initiatives is that of Congress legislating monies for a 1999–2001 competitive grants process to match the funds of colleges of education that propose exemplary methods of implementing ICT programs.)

All school systems have personnel who can provide teachers with ICT-related technical support. In some cases, these people have an instructional role as well. The wide variation in the background that these personnel bring to these positions—ranging from administrative through technical, media, or instructional—and the manner in which the positions are constructed and paid for reflect how each school district determines its own response to the need for ICT support. About 12,000 districts (more than three-quarters of the total number) have a district-level person designated as the 'computer supervisor'.[4] Only about half of these people are also considered as 'curriculum supervisors' for computer education, but an additional 4,000 are considered to be 'curriculum/instruction supervisors' at the school level. Most schools have a 'computer coordinator' to oversee or help manage the computer equipment, if not the instruction. This person may be in charge of the computer curriculum, teach a computer class, or provide technical or instructional support to teachers.

4 Quality Education Data (1994) *Technology in Public Schools 1993–94*. Denver, CO: Author.

The IEA Second Information Technology in Education Study (SITES) is an international comparative research project. It is intended to provide policy-makers and educational practitioners with information about ICT infusion in their educational systems and about the extent to which ICT contributes to bringing about reforms in the educational systems that satisfy the needs of the Information Society.

The SITES project consists of three modules:

1. Module-1: a survey in 26 countries in national samples of at least 200 computer-using schools from one or more of the following educational levels: primary, lower secondary, and upper secondary.
2. Module-2: case studies of schools that have implemented innovations as a result of ICT.
3. Module-3: a statistical survey of schools, teachers, and students.

The basic goal of SITES Module-1 was to describe the status of ICT in schools. Data therefore were collected at school level (late 1998) with regard to curriculum, ICT infrastructure, staff development, and management/organization.

This book contains comparative quantitative information from SITES Module-1 about the current state of ICT implementation in schools around the world.