CHAPTER 2:

The contexts for education on computer and information literacy and computational thinking

Chapter highlights

Characteristics of the educational systems vary considerably across participating ICILS 2018 countries.

- In 11 of the 14 ICILS 2018 educational systems (the exceptions being Germany, the United States, and benchmarking entity, North Rhine-Westphalia, Germany), the national educational ministry leads the primary role of defining the goals and direction for the school education system. The characteristics of these systems in terms of years of schooling at each educational level and school financing type fluctuated across countries. (Table 2.1)
- In almost all countries, schools had at least some autonomy with most aspects of school policies, with private schools typically having a greater degree of autonomy. (Table 2.2)
- A wide range of differences across participating countries exist, both in relation to information and communication technology (ICT) infrastructure availability and economic characteristics. (Table 2.3)

Although the formulation of plans and policies supporting the use of ICT in education differed across countries, there was a high degree of similarity in the content related to improving student learning, ICT resources, methods to support student learning, and the priorities for the use of ICT.

- While many countries had explicit or implicit recognition of different computer and information literacy (CIL) aspects in their national curriculum,[4] aspects of computational thinking (CT) were less frequently included. (Table 2.4 and Table 2.5)
- CIL was offered to students at lower-secondary level in all 14 participating countries and benchmarking participants. In eight out of 14 this was a separate subject, although it was not always compulsory. (Table 2.6)
- Countries had very different approaches to the development of teachers' capacity to use ICT. In most countries it was either a mandatory component of pre-service education or part of some form of professional development for teachers. Rarely was it a requirement for registration as a teacher. (Table 2.7)
- In general, countries provided a large degree of support for teacher access to ICT-based professional development, mainly by funding teacher participation in programs and/or by providing resources for teachers to access. (Table 2.8)

4 There is no national curriculum for the United States. Data related to the curriculum reported in this chapter are based on selected state curricula.

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Reports from school principals and ICT coordinators provide a contrasting profile of differences across participating ICILS countries in terms of school resourcing, policies, and priorities.

- Most technology-related resources and software-related resources were reported as being available in schools. (Table 2.9 and Table 2.10)
- Considerable variation was evident across countries on whether ICT facilities were available for the teaching and learning of target grade students. (Table 2.11)
- Large differences were evident across countries in terms of the availability of ICT devices per student. The overall influence of school location on this ratio was minimal. (Table 2.12)
- School computers were typically available in computer laboratories. When students were able to bring portable computers to class, these were most commonly provided by the school for school use only. (Table 2.13)
- Schools across countries varied in their implementation of policies towards different aspects of ICT. (Table 2.14)
- School principals had different perspectives on the priority areas for facilitating the use of ICT for teaching and learning (both within and across countries). (Table 2.15)

Introduction

This chapter provides information about the national contexts in which computer and information literacy (CIL) and computational thinking (CT) are developed for grade 8 students. The chapter is intended to support interpretation of the International Computer and Information Literacy Study (ICILS) 2018 data gathered from students, teachers, and schools. The chapter begins with a discussion of the data sources used in this chapter, primarily the ICILS national contexts survey (NCS) and the information and communication technology (ICT) coordinator and school principal surveys. We then present a series of country profiles, provided by national research coordinators in each participating country. The profiles describe the overarching goals and direction for the educational system in participating countries as well as providing details about how the curriculum relating to the use of ICT in education is developed, implemented, and assessed. We then discuss the approaches to CIL and CT education in participating countries. The chapter concludes with the presentation of results related to schools' access to ICT resources and school policies and practices for using ICT.

The ICILS 2018 assessment framework stresses the importance of setting student outcomes in CIL and CT in the context of the factors influencing them (Fraillon et al. 2019). Consistent with ICILS 2013, the ICILS 2018 contextual framework identifies four levels that influence student outcomes in this area: *contexts of the wider community*, *contexts of school/classroom*, *contexts of the student*, and *contexts of the home environment*. The chapter examines data related to the first two of these four contexts to help address Research Question 2 for both CIL and CT: *What aspects of schools and countries are related to students' achievement in CIL and CT?*

Aspects of schools and education systems potentially related to students' CIL and CT are:

- General approaches and priorities to CIL and CT education at system and school level;
- School coordination and collaboration regarding the use of ICT in teaching;
- School and teaching practices regarding the use of technologies in students' CIL and CT;
- Teacher proficiency in, attitudes towards, and experience with using computers;
- ICT resources in schools; and
- Teacher professional development.

Collecting data on contexts for CIL/CT education

The results presented in this chapter are gathered from a variety of data sources: national research centers (primarily through responses to the ICILS 2018 NCS); the ICILS 2018 school questionnaires; and external databases including selected statistics from the International Telecommunications Union (ITU 2017) and a United Nations Human Development Programme (UNDP) report (UNDP 2016).

The 2018 version of the ICILS NCS is an extension of the instrument that was first developed for ICILS 2013. That survey in itself was influenced by two previous contextual data collections. The first major influence was the United States (US) Department of Education Technology study on international experiences with ICT in education (US Department of Education, Office of Educational Technology 2011). That particular study collected information from 21 different educational systems on aspects of ICT use for education including the provision of infrastructure, improving student learning through the use of ICT, building capacity through ICT, and using ICT to support school improvement. The report outlined an overview of practice and policy in the area in addition to providing a profile of each of the participating educational systems.

The second major influence on the ICILS 2013 NCS was the IEA Second Information Technology in Education Study (SITES; see IEA 2019). SITES involved 22 educational systems who were asked to provide detailed information on aspects of their national education system, as well as information on the use of ICT in education, in particular regarding teacher preparation, changes in the past five years, and system-wide policies and practice on the use of ICT (Anderson and Plomp 2008; Plomp et al. 2009).

The ICILS 2013 NCS incorporated content from both of these sources and consisted of 25 questions and 106 items. National research centers were asked to coordinate responses from experts on key antecedents and processes relevant to CIL education in their country. The questions were grouped into five sections:

(1) Education system;

(2) Plans and policies for using ICT in education;

(3) ICT and student learning at lower-secondary level;

(4) ICT and teacher development; and

(5) ICT-based learning and administrative management systems.

Data from that NCS were used extensively in the ICILS 2013 international report (Fraillon et al. 2014) to provide a context for CIL education in participating countries.

The NCS for ICILS 2018 incorporated many of the aspects included in the previous cycle of the study. We updated some content areas to reflect revised research questions. The response format of some questions was modified to reduce the reliance on subjective information and to capture information that was not clearly identified in the previous cycle. We included some new questions to capture changes to the structure of the countries' education systems or to the way in which countries have conceptualized and delivered CIL education in the years prior to the data collection. Several questions were expanded to include contextual information related specifically to CT in national plans and policies and how it was intended to be taught. The NCS for ICILS 2018 included 25 questions and 174 items allocated to the five sections that were identified in the 2013 version of the NCS.

The NCS was to be completed in 2018 (i.e., at a similar time to when other ICILS data were collected), and responses were intended to reflect policies and structures for that year. We acknowledge that policy regarding the use of technology in education is likely to evolve quite rapidly in future years, and responses to the NCS may not necessarily reflect policies at the time of the publication of this report. It is important to note that while efforts were made to make the questions as objective as possible, much of the content in the questionnaire relies on the subjective judgement of experts within each participating national research center who were encouraged to draw on their own expertise and reference information from their respective countries. Consequently, we advise readers to keep these matters at the forefront when interpreting data from this chapter.

The other main sources of data used in this chapter were the ICILS 2018 ICT coordinator and principal questionnaires. The target audiences for these questionnaires responded to a series of questions related to different types of ICT resourcing and school policies regarding the teaching and learning of ICT. These data provided a complementary perspective on the practice of ICT policies and resourcing at the school level to the information reported from policy documents at the educational system level.

In order to reduce the burden on respondents to the NCS, the chapter also reports on information from external sources including well-established databases. This includes information related to ICT infrastructure and economic characteristics of participating countries.

Education systems and national contexts

Country profiles of the responsibility for school education and the design, implementation, and assessment of ICT in education

The ICILS 2018 NCS included a question asking respondents to indicate who in their country had overall responsibility for establishing the overarching goals and direction for school education. Other questions covered issues related to how the curriculum for the use of ICT in education was developed and implemented for target grade students and how the use of ICT in education was assessed. Each national research center was asked to expand the details from these questions to provide a broad overview of the contexts for CIL (and CT) education in their country. The summary profiles authored by each national research center are presented in this section.[5] More specific details related to the use of ICT in education for each participating country and benchmarking participant are contained in the sections following this.

Chile

The Chilean educational system is governed by the National Educational Quality Assurance System. Four institutions make up this system: the Ministry of Education, the Superintendence of Education, the National Council of Education, and the National Agency for Educational Quality. The Ministry of Education is the central institution. It grants official recognition to schools, defines regulations, provides funding, offers support, defines standards of learning, and provides pedagogical training. It is also in charge of defining the national curriculum. Chile's educational system combines public, private, and private subsidized providers in all education levels. Public schools are managed by local governments (municipalities and local public education services) and receive public funding. Private schools have private administration and receive funds from families. Private subsidized schools have private administration and receive public funding.

The national curriculum determines the fundamental objectives and minimum mandatory contents for each grade and subject at a national level. Schools are free to decide how to implement it and may include additional educational objectives, content, and programs. The national curriculum includes digital literacy as an independent subject named Technology. Technology was implemented in 2012 for primary education and 2014 for secondary education. At the target grade, assessment is primarily school-based testing: it includes projects, written assignments and essays, group research, oral presentations, and classroom participation. The National Agency for Educational Quality implements the National System of Learning Assessment to measure student achievement. It is implemented annually in different subjects, although Technology was not evaluated at the time of this report (it was in 2011 and 2013).

Denmark

The Danish education system is governed by the Ministry of Education and the Ministry of Higher Education and Science. The 98 municipalities are the school owners. Education is compulsory for children from age six. For the target grade of ICILS 2018, 76 percent of the students attended public schools (*folkeskoler*) and the remaining 24 percent attended other schools (such as private schools or independent residential schools). The Ministry of Education develops national curriculum standards, exams, national tests, and sets regulations, but it is the responsibility of the schools and municipalities to determine how their schools are organized within the state regulations. There is no inspectorate, or similar, in Denmark.

The national curriculum contains no compulsory subjects relating to ICT. Instead, according to the standards, ICT should be integrated into all subjects. National exams, tests, and evaluations of students' learning outcomes only indirectly assess students' ICT competencies.

5 The profiles for each country were contributed by the national research coordinators of the participating countries; the authors of the report undertook only minor language editing.

Since at least the 1990s, the government and municipalities have continuously provided funding for integration of ICT in teaching and learning. Most recently, in the years 2011–2017, they provided one billion DKK (US$ 152 million) as, in part, financial support for digital learning materials. In line with the worldwide interest in CT, and in acknowledgement of students as producers and not only consumers of ICT, the Danish Ministry of Education initiated an experiment in 2018 by introducing Technological Literacy both as a subject and as material integrated in subjects. Forty-six schools are participating. The curriculum includes competencies within CT, digital design, and critical understanding of ICT. Target grade students of ICILS 2018 did not participate in this new curriculum.

Finland

The republic of Finland has organized the national education administration at two levels: state and local. At state level, the Ministry of Education and Culture is responsible for the education policy and the Finnish National Agency for Education for the implementation of the policy aims (e.g., creating the national core curriculum). At local level, municipalities are responsible for administration, such as allocation of funding and the effectiveness and quality of their education. Some decision-making power is also delegated to the schools (e.g., recruitment of personnel).

The education providers draw up their own curricula within the framework of the national core curriculum, which includes the objectives and core contents of different subjects and learning areas. Schools and teachers can decide how the use of ICT is implemented and assessed. ICT is not a separate subject: ICT competences are assessed as a part of subject based assessments (no separate grades or certificates). However, optional courses of ICT or programming are provided in grades 8 and 9.

The target grade students in ICILS 2018 followed the old core curriculum, in place from 2004. It included cross-curricular themes called “Media skills and communication” and “Technology and the individual.” These mainly covered CIL-related areas including, for example, the use of media and communication tools, information retrieval, and information security. In 2016, Finland started gradually integrating the new core curriculum, which has a strong focus on CIL, across all subjects. For example, the stated objectives of mathematics in grades 7 to 9 explicitly reference issues of CT including logical and algorithmic thinking, and learning good programming practices.

France

The Ministry of National Education and Youth is responsible for preparing the government’s national education policy and national educational curriculum. Implementation is the responsibility of the 30 educational districts (*académies*). The common base of competences (*Socle commun de connaissances, de compétences et de culture*) presents what every student must know and master at the end of compulsory schooling. In the digital domain, developing the necessary skills for ICT use is acquired in the context of activities in the various disciplinary fields. ICT is not a separate subject but instead is integrated within all other subjects. The latest curriculum implemented at the start of September 2016 includes learning computer code via algorithms and robotics in mathematics and technology.

Within the ministry, the Directorate of Evaluation, Foresight and Performance assesses and measures performance in the areas of education and training. ICT skills are assessed at the end of primary school, at the end of lower-secondary schooling with the national certificate of ICT standards (*Brevet Informatique et Internet*), at the end of upper-secondary schooling, and again as pupils enter higher education.

Germany

Germany is a federal republic consisting of 16 federal states. Each federal state has supreme legislative and administrative power over all cultural policy issues including its education system. This includes regulation of school curricula and professional requirements, teacher recruitment, and quality development in schools. In lower-secondary schooling, which includes the target grade level of ICILS 2018 (grade 8), there are two to four paths of secondary education in the federal states which vary according to their respective school leaving certificates and qualifications.

Regarding ICT integration into schools, the federal regulations differ between the states. However, in recent years, the topic of digitalization in education has moved clearly into the spotlight of public interest in Germany. In this context, the Standing Conference of the Ministers of Education and Cultural Affairs (*Kultusminister Konferenz*) published a strategy "Education in the digital world" (*Bildung in der digitalen Welt*) in the year 2016. In this strategy, a competence model of ICT-related abilities for students in primary and secondary schools, including explicit reference to the model established with ICILS 2013, is presented. This cross-federal strategy will be carried out from the school year 2018/2019, after the ICILS 2018 data collection. The implementation of these recommendations on federal state level are still in progress in each of the federal states. Furthermore, in 2016 the Federal Ministry of Education and Research announced the provision of a five billion euro budget to equip schools with ICT as part of the *Digitalpakt Schule* project. For this initiative, the German constitution first needed to be changed, and financing schools with federal money started in 2019.

Italy

The Ministry of Education, University and Research issues the general guidelines and policies for the public educational system. The main document establishing the objectives of digital education is the National Plan for Digital Education (*Piano Nazionale Scuola Digitale*), organized into 35 broad actions covering all of the areas connected to the development of ICT in public education. The curriculum is derived from two documents which provide general directives: one relevant to nursery schools and the first cycle of public education (*Indicazioni nazionali per il curricolo della scuola dell'infanzia e del primo ciclo di istruzione*) and the other relevant to secondary and technical education (*Indicazioni nazionali per i licei e Linee guida per il biennio e il triennio*). The above mentioned documents contain specific reference to actions, tools, and strategies aimed at acquiring the necessary ICT competence to complete each cycle (e.g., primary, secondary). ICT and its use in education is viewed as a transversal objective, necessary to fulfil the requirements on each subject.

Every school has the autonomy to monitor and assess students' progress in ICT, each using different tools. The Ministry has issued models for certification of competences that each school can use according to their own needs. In those models there is a specific entry for digital competences. In the first cycle of education (primary), moreover, national tests are run digitally since 2018.

Kazakhstan

Kazakhstan is administratively divided into 14 regions (provinces) and three[6] cities of republican significance. Each region consists of several smaller districts. The Ministry of Education and Science is responsible for implementation of the unified education and training system with an involvement of regional and district education departments. Education curricula and assessment are standardized across the country and implemented in each region and district. Based on approved curricula, each school prepares its own working curriculum. The national school

6 On December 28, 2018, amendment to the Law of the Republic of Kazakhstan on the administrative and territorial structure took place to include the third city of republican significance. During the ICILS 2018 main survey, there were two cities (April–May 2018).

system includes primary, lower secondary, and general (upper) secondary education levels. All of these education levels are free and guaranteed for citizens by the Constitution of the Republic of Kazakhstan. Target grade students are enrolled in a lower-secondary education level, which includes grade 5 to grade 9.

ICT education policy started with the adoption of the State Program for the Informatization of the Secondary Education System for 1997–2002, followed by the State Program for Education Development 2011–2020 and 2016–2019. Thus, ICT is a part of the school curriculum and taught as a separate discipline. Schools administer students' general assessment against all disciplines, including ICT, every school term in accordance with the state compulsory standard. There are also state level external assessments that take place annually. In 2016, a gradual transition to an updated education program started, including the target grade levels of ICILS 2018, with emphasis on the development of students' ICT competencies and increasing teacher use of ICT.

Republic of Korea

The Korean Ministry of Education has primary responsibility for planning, operation, and management of the national curriculum for primary and secondary schools. The national curriculum standards serve as the basis for educational contents and textbook development. Korean schools follow the national curriculum framework developed by the Ministry of Education, but they can autonomously organize and operate some elective courses.

The Ministry of Education released the 2009 Revised National Curriculum to deal with Korea's continuously evolving national and social needs. Students in the target grade level of ICILS 2018 learned under the 2009 Revised National Curriculum. These students can learn CIL and CT as a separate subject, Informatics, in middle school. The Informatics curriculum focuses on understanding the basic concepts and principles of computer science and fostering the ability to solve various problems in real life with CT. However, because it is an optional subject, there are schools that teach Informatics and schools that do not. Currently, the 2015 Revised Curriculum is being introduced, and Informatics will be changed from an elective to a compulsory subject in middle school. At the target grade, student achievement levels are evaluated in most schools using various assessment tools and methods. Students are evaluated at the end of each semester by a teacher. The Korea Education and Research Information Service assessment of digital literacy monitors ICT literacy of Korean elementary and middle school students at the national level.

Luxembourg

The Ministry of Education, Children and Youth is responsible for the planning and management of school education, of structures for providing non-formal extracurricular education and care, and of a large part of the adult education provision and support schemes. Within this ministry, the Department of Coordination Service for Educational and Technological Research and Innovation offers support to all public schools in terms of pedagogical and technical innovation, coordination of school projects and initiatives, curriculum development, creation of learning resources, data analysis and evaluation of projects, and support for school development. It is the driving force behind the development of the national education system and is responsible for implementing the educational policies.

The development of ICT is included in the Luxembourg national curriculum from lower-secondary education onwards and as a separate subject for upper-secondary education. Secondary schools are strongly encouraged to use digital media for learning and tablets are used optionally by teachers in all subjects to enhance learning. For upper-secondary education, a new section specializing in ICT was introduced in 2017 addressed to students in grade 11. This initiative emerged in the context of a new label called "Future hub," which serves to highlight innovative high schools in ICT. Learning activities are project-based with a focus on learning autonomy. Emphasis is placed on the learning of sciences and ICT, creative thinking, and communication. Learning is placed within a chosen theme, which is cross-curricular. Examples include the construction of a robot, game programming, and the development of a website. The whole teaching and learning approach is based on collaboration between teachers and students; solutions are sought in different subjects as the project is implemented and completed. The use of ICT in education is not assessed in national assessments.

Portugal

The Portuguese Ministry of Education is responsible for establishing the overarching goals and direction for school education concerning curriculum, national assessment, funding, and schools' resources and organization. In 2017, the document "Student profile at the end of compulsory education," established the benchmark for all schools and curricula within the scope of compulsory education. This included ICT and the development of capacities associated with digital literacy. The ICT core curriculum competences are organized in four domains: digital citizenship; investigate and research; communicate and collaborate; and create and innovate. ICT is also a mandatory subject for students from grade 5 to grade 9.

The Ministry of Education also promotes and supports several school projects in the area of ICT. The initiative "Introduction to programming in the 1st cycle of basic education" addressed to students from grades 3 and 4, between 2015 and 2018, covered about half of the Portuguese school clusters. The National Network of Programming and Robotics Clubs, launched in 2014/2015, achieved significant coverage in Portuguese schools, with 269 clubs registered in 2018/2019. Assessment for ICILS 2018 target grade students is school-based and includes written assignments and reports, group research and investigation, oral presentations, tests, and classroom participation. There are no national exams in ICT.

United States

The United States (more fully, the United States of America) consists of 50 states and the District of Columbia. There are three levels of government: federal, state, and local. Education and training are primarily the responsibility of the state and local governments (including school districts), with some decision-making occurring at the school level. Plans and policies to support ICT exist at both the federal and state levels in the United States, with each state's Department of Education responsible for setting policies and standards to guide school instruction within that state. Districts may also set their own academic standards and suggest ICT curricula for schools, such as setting technology skill standards for various grade levels. In addition, principals and teachers usually have a high level of autonomy in curriculum delivery, including selecting instructional materials, teaching techniques, and evaluation methods. There are no required CIL or CT courses at the federal or state levels. Districts and schools have the authority to offer and require ICT courses, or to incorporate ICT into other subjects.

There is no federal requirement for assessing ICT or computing-related skills at the target grade, nor do most states have a compulsory assessment focused solely on ICT at the state level. At the federal level, a sample-based, non-compulsory assessment of technology and engineering literacy has been conducted as part of the National Assessment of Educational Progress. State assessments in other subjects (e.g., engineering and science) may reflect some CIL-related aspects. US districts and schools generally have a high level of autonomy in assessment of ICT skills.

Uruguay

Uruguay is a South American republic with a population of 3.5 million. There is a national education system. The National Administration of Public Education (ANEP), an autonomous entity, is the state agency responsible for the planning, management, and administration of the public education system (including preschool, primary, secondary, vocational, and teacher education). ANEP is in charge of the public education system and also controls the private system.

There are two government institutions that aim to ensure quality of education and access to equitable education opportunities. The first is the National Institute for Educational Evaluation, which is a fully autonomous public institution created by the General Law of Education in 2008 to evaluate the quality of national education. Every three years there is a national assessment (*Aristas*) of representative samples at the primary (primary grades 3 and 6) and secondary level (secondary or vocational schools at secondary grade 3). The assessments are focused on reading and mathematics, but also examine socioemotional abilities and school environment.

Plan Ceibal was created in 2007 to foster inclusion and equal opportunities in schooling and to support the implementation of Uruguayan educational policies related to technology. Since it was implemented, every child in the public education system has been given a computer or tablet device for personal use, with free internet access at school. Plan Ceibal provides programs, educational resources, and teacher training courses to support the use of ICT in teaching and learning. More recently, Plan Ceibal has become an agent for innovation in education. In this new role, it aims to promote new pedagogies for learning and competences for the twenty-first century.

Moscow (Russian Federation)

The Russian Ministry of Education (*Minprosveschenie*) is responsible for the development and implementation of educational policy. Regional executive authorities (including the Department of Education of Moscow) are responsible for regulating education within their jurisdiction and exercise state control over educational activities.

Target grade students of ICILS 2018 can be assessed in the subject Informatics, while ICT literacy is represented in the Russian curriculum as a general capability (a capability to be addressed through all the learning areas). The assessment of results in the Informatics subject and in ICT literacy across subjects is carried out at the school, regional, and national levels. School assessments are carried out by teachers and by the administration during the school internal monitoring. Regional assessments include subject-specific diagnostic tests on informatics and diagnostic assessment of general ICT literacy using computer-based testing. National assessments include national Informatics exams taken by students at the end of grade 9 and grade 11.

North Rhine-Westphalia (Germany)

North Rhine-Westphalia, with 18 million inhabitants, is the most populous of the 16 federal states in Germany. It has supreme legislative and administrative power over all cultural policy issues including its education system. This administrative power includes regulation of curricula and time schedules, professional requirements, teacher recruitment, and quality development in schools. Compulsory education begins at the age of six. In general, there are four paths of secondary education, which vary according to their respective school leaving certificates and qualifications. Compulsory schooling ends after completion of lower-secondary education.

North Rhine-Westphalia follows the cross-federal state strategy of the Standing Conference of the Ministers of Education and Cultural Affairs (*Kultusminister Konferenz*) developed in 2016, which outlined general ICT competencies. In 2017, North Rhine-Westphalia (NRW) developed the “Media Competence Framework NRW” (*Medienkompetenzrahmen NRW*) which targets grade 1 to grade 9/10. This was in place from June 2018 (immediately after data collection for ICILS 2018) and as such, the curricula of target grade students for ICILS 2018 did not explicitly cover ICT-related skills. In some schools and school tracks, ICT-related subjects are offered as elective subjects. Additionally, a number of schools have been developing profiles in teaching and learning with ICT in the scope of their pedagogical autonomy.

Characteristics of the education systems in participating ICILS countries

The characteristics of school education systems for those countries participating in ICILS 2018 (Table 2.1) show that the starting age of participating countries ranged from four years in Luxembourg and Uruguay, to seven years in Finland, Kazakhstan, and Moscow (Russian Federation). Half of the countries and benchmarking participants had a starting age of six years old. The number of years of compulsory schooling across countries ranged from nine years (in Finland, Germany, and Korea) to 13 years in Chile.

The structure of school-based education also varied considerably across countries (Table 2.1). The number of years typically spent at the three levels of school education provision were classified according to the International Standard Classification of Education (ISCED) (UNESCO Institute for Statistics 2011). The ISCED 1 level loosely corresponds to primary education, the ISCED 2 level to lower-secondary education (and includes the classification of the target grade in ICILS), and the ISCED 3 level to upper-secondary education.

The way in which the first two ISCED levels were implemented varies considerably across the participating countries. Although the number of years these two levels typically apply ranges from eight to 10 years, the proportion at ISCED level 1 varies across countries. For instance, in Germany (including North Rhine-Westphalia), Kazakhstan, and Moscow (Russian Federation) the ISCED 1 programs are of shorter duration (four years) than in other participating countries, but conversely their ISCED 2 programs are longer than in most other countries (being six years for Germany, and five years in Kazakhstan and the Russian Federation). Some countries have longer ISCED 1 programs, and shorter ISCED 2 programs. In Chile, ISCED 2 programs (lower secondary) form the second stage of basic education programs. It is important to note that there is some variation in the number of compulsory years of education at different levels within countries, both across states and provinces, and potentially across educational tracks (e.g., academic or vocational).

The proportion of students who attended the ISCED 2 level (lower secondary) by school type reveals that in 12 of the 13 countries with data available, at least three out of every four students attended a public or government school (instead of a private or other non-government school). The exception is in Chile where less than half (41%) of students at this level attended public or government schools.

Level of school autonomy for aspects of school policy

In the NCS, each country respondent was asked to indicate the degree to which schools have autonomy regarding the following aspects of school policy:

- School governance (e.g., whole financial management, setting strategic goals, implementation of the curriculum);
- Selection and purchase of ICT equipment;
- Selection and purchase of software;
- Staff participation in professional learning in the use of ICT;
- ICT curriculum delivery;
- Selection and appointment of teachers;
- Assessment of student achievement in CIL (or its equivalent); and
- Technical support for ICT.

Countries were asked to indicate the level of autonomy for each school type (public/government and private/non-government) (Table 2.2). For each of the eight aspects, respondents could choose between three descriptions that indicated whether schools had full or almost full autonomy, had some autonomy while educational authorities mandated some aspects, or little or no autonomy with education authorities mandated most aspects.

Table 2.1: Characteristics of education systems participating in ICILS 2018: compulsory schooling, years of education by levels, and percentage of lower-secondary students in private/public schools

Country	School age		Typical number of years of education at each education level			Percentage of lower-secondary students	
	Starting age	Number of years of compulsory schooling	ISCED level 1 (primary)	ISCED level 2 (lower secondary)	ISCED level 3 (upper secondary)	Public or government schools	Private or other nongovernment schools
Chile	5	13	6	2*	4	41	59
Denmark	6	10	7	2	3	76	24
Finland	7	9	6	3	3	96	4
France	6	10	5	4	3	78	22
Germany	6	9–10	4	6	3	89	11
Italy	6	10	5	3	5	96	4
Kazakhstan	7	11	4	5	2	97	3
Korea, Republic of	6	9	6	3	3	83	17
Luxembourg	4	12	6	3	3–5	N/A	N/A
Portugal	6	12	6	3	3	85	15
United States	6	11	6	3	3	91	9
Uruguay	4	12	6	3	3	87	13
Benchmarking participants							
Moscow (Russian Federation)	7	11	4	5	2	98	2
North Rhine-Westphalia (Germany)	6	10	4	6	3	89	11

Notes: N/A = not available. The ICILS 2018 national contexts survey provided data on school start age, number of years of compulsory schooling, and percentage of students attending public or private schools. Eurydice network data (Eurydice 2019) and data from the UNESCO Institute for Statistics (UNESCO Institute of Statistics 2019) were used to establish the typical number of years of education at each education level.

*ISCED level 2 offered as second stage of combined International Standard Classification of Education (ISCED) 1+2 program.

Table 2.2: Degree of school autonomy regarding different aspects of school policies by school type

Country	School governance (e.g., whole financial management, setting strategic goals, implementation of curriculum)		Selection and purchase of ICT equipment		Selection and purchase of software		Staff participation in professional learning in the use of ICT		ICT curriculum delivery		Selection and appointment of teachers		Assessment of student achievement in CIL (or its equivalent)		Technical support for ICT	
	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private
Chile	◑	●	◑	●	◑	●	●	●	●	●	◑	●	●	●	◑	●
Denmark	◑	●	◑	●	◑	●	◑	●	◑	●	●	●	●	●	◑	●
Finland	◑	◑	◑	●	◑	●	●	●	●	●	●	●	●	●	◑	●
France	◑	◑	◑	●	◑	●	◑	◑	○	○	○	●	○	○	◑	●
Germany	◑	●	◑	●	◑	●	●	●	◑	●	◑	●	◑	●	◑	●
Italy	◑	◑	●	N/A	●	N/A	◑	N/A	◑	◑	○	●	●	N/A	●	N/A
Kazakhstan	○	●	◑	●	◑	●	◑	●	◑	●	●	●	●	●	◑	●
Korea, Republic of	◑	◑	●	●	●	●	●	●	◑	◑	○	●	●	●	●	●
Luxembourg	◑	●	○	◑	○	●	●	●	●	●	○	●	●	●	○	●
Portugal	◑	●	◑	●	◑	●	●	●	◑	●	○	●	●	●	◑	●
United States	◑	●	◑	●	◑	●	●	●	●	●	●	●	●	●	◑	●
Uruguay	◑	◑	○	●	○	●	◑	●	◑	◑	○	●	●	●	○	●
Benchmarking participants																
Moscow (Russian Federation)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
North Rhine-Westphalia (Germany)	◑	●	◑	●	◑	●	●	●	◑	●	◑	●	◑	●	◑	●

Notes: N/A = not available. Data collected from ICILS 2018 national contexts survey.
● Schools have full or almost full autonomy.
◑ Schools have some autonomy and education authorities mandate others.
○ Schools have little or no autonomy and education authorities have the mandate.

In almost all participating educational systems at the time of the NCS data collection, schools reportedly had at least some autonomy for the eight different aspects. For example, for matters that relate to school governance (including financial management, setting strategic goals, and implementation of the curriculum), public schools in 12 out of 14 educational systems were reported to have some autonomy, whereas these schools in Moscow (Russian Federation) had full autonomy. Only in Kazakhstan were schools reported to have no autonomy for these aspects of governance. As a general pattern, the level of autonomy that public and private schools were reported to have over school policies were not the same, with private schools having a greater degree of autonomy. Schools in Moscow (Russian Federation) reportedly have the greatest degree of autonomy out of all countries. Both public and private schools were reported as having full autonomy for all eight aspects.

An aspect in which schools had a greater degree of autonomy was the assessment of student achievement in CIL (11 countries reported public schools have full autonomy for this aspect). Six out of the 14 countries or benchmarking participants reported that their public schools had no autonomy over the selection and appointment of teachers, whereas all countries reported that private schools had full autonomy for this particular aspect. Similarly, public schools were reported to have no autonomy, or only some autonomy, for technical support for ICT and the selection and purchase of ICT and software in 10 of the countries or benchmarking participants, whereas all countries with data available reported that private schools had full autonomy in these aspects (the exception was Luxembourg where private schools were reported as having only some autonomy for the purchase of ICT equipment). There were relatively higher reported levels of autonomy for staff participation in professional learning in the use of ICT (in all countries the level of autonomy was rated between some and full autonomy for both public and private schools). The level of autonomy for the assessment of student achievement in CIL (or its equivalent) was similarly high, with the exception of France, where it was reported that there was no autonomy in either public or private schools for assessment. The delivery of ICT curriculum had relatively lower levels of reported autonomy in comparison to other aspects of school policies. In France, no autonomy was given to either public or private schools for this aspect.

ICT infrastructure and economic characteristics of countries

In order to provide information on antecedent aspects of national contexts for the implementation of ICT in education, we collected data relating to ICT infrastructure and economic characteristics in participating countries (Table 2.3). The ICT infrastructure data include the proportion of the population using the internet aged 16-74 in the last three months, and the ICT development index (IDI) score[7] and country ranking; economic development data include the gross domestic product (GDP), income Gini coefficient,[8] and the percentage of public expenditure apportioned to education (Table 2.3).

An examination of the information about infrastructure reveals diverse country profiles. The percentage of individuals using the internet provides an indicator of how widespread the ICT infrastructure is in a country. Denmark and Luxembourg had very high levels of access (more than 97% of people aged 16-74 accessed the internet within three months). The lowest recorded level of access was in Italy (61%). Denmark, Finland, France, Germany, Korea, Luxembourg, and the

7 The IDI is a composite index that incorporates 11 different indicators relating to ICT readiness (infrastructure, access), ICT usage (individuals using the internet), and proxy indicators of ICT skills (adult literacy, secondary and tertiary enrollment). Each country is given a score out of 10 that can be used to provide a benchmarking measure to compare ICT development levels with other countries and within countries over time. Countries are ranked according to their IDI score.

8 The Gini income coefficient is a measure of the deviation of the distribution of income (or consumption) among individuals or households within a country from a perfectly equal distribution. A value of 0 represents absolute equality. A value of 100 represents absolute inequality (see UNDP 2016).

Table 2.3: ICT infrastructure and economic characteristics of the ICILS countries

Country	Percentage of individuals aged 16–74 using the internet in the past three months	ICT development index (IDI) score (and country rank)	GDP per person (2011 PPP US$)	Income Gini coefficient	Public expenditure on education as a percentage of GDP
Chile	82.3	6.57 (56)	22,767	47.7	4.9
Denmark	97.1	8.71 (4)	46,683	28.2	7.6
Finland	87.5	7.88 (22)	40,586	27.1	5.3 [4]
France	80.5	8.24 (15)	38,606	32.7 [3]	5.5
Germany	84.4	8.39 (12)	45,229	31.7	4.9
Italy	61.3	7.04 (47)	35,220	34.7	4.1
Kazakhstan	76.4	6.79 (52)	24,056	26.9	3.0
Korea, Republic of	95.1	8.85 (2)	35,938	31.6	5.1
Luxembourg	97.8	8.47 (9)	94,278	31.2 [3]	4.0
Portugal	73.8	7.13 (44)	27,937	35.5	5.1
United States	75.2	8.18 (16)	54,225	41.5	5.0
Uruguay	68.3	7.16 (42)	20,551	39.7	4.4 [5]
Benchmarking participants					
Moscow (Russian Federation)	83.1 *	7.07 (45) [1]	24,766 [1]	37.7 [1]	3.8 [1]
North Rhine-Westphalia (Germany)	84.4 [2]	8.39 (12) [2]	45,229 [2]	31.7 [2]	4.9 [2]

Notes: The percentage of individuals using the internet, ICT development index (IDI) score, and country rank data were from 2017, and were collected by the International Telecommunications Union (ITU 2019). Data for gross domestic product (GDP) per person, income Gini coefficient, and public expenditure on education were sourced from the United Nations Development Programme (UNDP) (UNDP 2016, 2018) unless otherwise stated. Data on GDP per person relate to 2017, data for income Gini coefficients relate to the years 2010–2017, and data for public expenditure on education relate to the years 2012–2017. PPP = purchasing power parity.

*Data for Moscow were sourced from Rosstat (2019). [1] Data relate to Russian Federation. [2] Data relate to Germany. [3] Data refer to a year earlier than 2010. [4] Data are from 2017 (source: Statistics Finland 2019). [5] Data are for the years 2010–2014 (source: UNDP 2016).

United States were all ranked in the top 22 countries on the IDI. The IDI scores for the remaining countries all ranked lower (country rankings ranged between 42 and 56). Country diversity is also evident when examining the economic characteristics of the participating countries. GDP (expressed in 2011 international dollars using purchasing power parity rates and divided by the total population during the same period) was particularly high for Luxembourg, and relatively high for Denmark, Finland, Germany (including North Rhine-Westphalia), and the United States. GDP was lower for Chile, Kazakhstan, Portugal, Uruguay, and the Russian Federation. The data on the Gini income coefficient (a measure of the variation in income across households within countries) again reinforce the different economic profiles of participating countries. Higher coefficients (representing greater levels of inequality) were found for Chile, the United States, Uruguay, and the Russian Federation. Lower coefficients (representing lower levels of inequality) can be seen in Denmark, Finland, Germany (including North Rhine-Westphalia), Kazakhstan, Korea, and Luxembourg. The level of expenditure on education (relative to the GDP) was found to be higher in Denmark (almost 8%), and lowest in Kazakhstan (3%), the Russian Federation (4%), and Luxembourg (4%).

Approaches to CIL/CT education in ICILS countries

Details of plans and policies for the use of ICT in education

In the NCS, each country was asked a series of questions related to plans or policies that support the use of ICT in education. In general there was little variation across participating countries in their descriptions of their plans and policies.

Support was found for all participating countries either by authorities at the local /district/ municipal level, at the state/provincial level, at the national level, or some combination of the three levels. Countries were asked to indicate whether the plans or policies explicitly or implicitly: *emphasize different aspects improving student learning*, *emphasize the need for different ICT resources*, *emphasize different methods of supporting student learning*, and *include different aspects as priorities*.

Most of the following seven aspects of ICT in education were largely recognized (either explicitly or implicitly) across the 14 participating countries and benchmarking participants:

- Learning of subject matter content (art, language, mathematics, science, etc.) (except in Kazakhstan and the United States);
- Preparing students for using ICT in their future work;
- Developing information literacy;
- ICT-based skills in critical thinking, collaboration, and communication;
- Increasing access to online courses of study (e.g., for rural students) (except in Denmark and Germany, including North Rhine-Westphalia);
- Computer programming or developing applications for digital devices[9, 10]; and
- Responsible and ethical use of digital devices including cyber-safety.

The importance of all seven of the following ICT resources were recognized (explicitly or implicitly) in plans and policies of most participating countries and benchmarking participants:

- Provision of computer equipment and other ICT resources;
- Maintenance of computer equipment and other ICT resources (except in Chile and Portugal);
- Renewal, updating, and replacement of computer equipment and other ICT resources (except in Chile);
- Support for teachers for using computer equipment and other ICT resources in their work;

9 This aspect applies to a large number of German federal states.

10 The Finnish curriculum at the time of the study did not emphasize this, but this has since been updated to have an emphasis on programming.

- Access to digital educational resources;
- Internet connectivity; and
- Home access to school-based digital education resources such as through school-hosted online portals (except in Chile, Kazakhstan, and Korea).

The plans and policies of most countries and benchmarking participants emphasized the following methods of supporting student learning (implicitly or explicitly):

- Pre-service teacher education in the use of ICT (except in Portugal);
- In-service teacher education in the use of ICT;
- The use of learning management systems (except in Finland and Germany, including North Rhine-Westphalia);
- Reporting to parents (except in Finland and Germany, including North Rhine-Westphalia); and
- Providing feedback to students (except in Finland, Germany, including North Rhine-Westphalia, and Korea).

When asked about the extent that the plans and policies emphasize priorities for the use of ICT, again there was near full agreement across participating countries that the following were explicitly or implicitly mentioned:

- Professional development for teachers' pedagogical use of ICT;
- Sufficient ICT infrastructure and resources in schools;
- Development of ICT-related competencies in students;
- Development and provision of digital learning materials;
- Reduction of the digital divide between groups of students (except in Finland and Portugal);
- Improvement of administrative and management systems in schools (except in Finland and France); and
- Use of ICT to improve communication with parents (except in Finland and the United States).

A reference to providing one-to-one computing in schools was noted in the plans and policies for Chile, Germany, Luxembourg, and Uruguay. All countries, with the exception of Kazakhstan and Portugal, had coverage of formal support for the development of digital resources in their plans and policies.

Emphasis on aspects of CIL in plans and policies

All countries were asked to complete a question on the extent to which their plans and policies for the 2018 year emphasized the following aspects of CIL in their national curricula or selected curricula (Table 2.4):

- Searching for information using ICT;
- Evaluating the reliability of information sources accessed using the internet;
- Presenting information for a given audience or purpose using ICT;
- Organizing information obtained from internet sources;
- Issues relating to intellectual property (such as copyright and attribution sources);
- Responsible and respectful publication of information;
- Use of productivity tools (such as word processing, spreadsheet, and presentation software);
- IT security issues (e.g., passwords, malware, phishing); and
- Data security (such as the collection of internet use data by search engines and social media sites).

Table 2.4: Emphases in national curricula of teaching aspects related to CIL

Country	Extent that plans and policies emphasize aspects of CIL in national curriculum								
	Searching for information using ICT	Evaluating the reliability of information sources accessed using the internet	Presenting information for a given audience or purpose using ICT	Organizing information obtained from internet sources	Issues relating to intellectual property such as copyright and attribution sources	Responsible and respectful publication of information	Use of productivity tools (e.g., word processing, spreadsheet, and presentation software)	IT security issues (e.g., passwords, malware, phishing)	Data security (e.g., collection of internet use data by search engines and social media sites)
Chile	●	●	●	◐	●	●	●	●	●
Denmark	●	●	●	●	●	●	●	●	●
Finland	●	◐	●	◐	◐	●	◐	●	●
France	●	●	●	●	◐	●	●	◐	◐
Germany	● [1]	●	●	●	●	●	●	●	●
Italy	●	●	●	●	○	○	●	○	○
Kazakhstan	●	◐	◐	◐	◐	◐	●	◐	◐
Korea, Republic of	●	◐	○	◐	●	●	◐	●	◐
Luxembourg	◐	◐	◐	◐	◐	◐	◐	◐	◐
Portugal	●	●	◐	●	●	◐	●	●	●
United States	●	●	●	◐	●	●	●	●	●
Uruguay	●	◐	◐	○	○	○	●	○	○
Benchmarking participants									
Moscow (Russian Federation)	●	●	●	●	●	●	●	●	●
North Rhine-Westphalia (Germany)	◐	◐	◐	◐	◐	◐	◐	◐	◐

Notes: Data from the ICILS 2018 national contexts survey.
● Explicitly stated in the curriculum.
◐ Implicitly stated in the curriculum.
○ No emphasis on this aspect in the curriculum.
[1] The ICILS 2018 age cohort were the last to follow the curriculum; this has been replaced with stronger emphasis on aspects of ICT including CT.

In general, each of these aspects was included in national curriculum documents, either explicitly or implicitly in 12 to 14 of the participating countries and benchmarking participants. In three entities, Denmark, Germany, and Moscow (Russian Federation), all aspects were mentioned explicitly. The aspects that were most often explicitly noted in plans and policies were the use of productivity tools (such as word processing, spreadsheet, and presentation software) (10 countries or benchmarking participants) and searching for information using ICT (12 countries or benchmarking participants). The remaining five aspects were typically included in plans or policies, but often were indicated as being implicitly stated in the curriculum.

Emphasis on aspects of CT in plans and policies

A feature of ICILS 2018 was the international option for a student test of CT. A new question for the ICILS 2018 NCS was included to assess whether national curriculum emphasized aspects of CT. All ICILS 2018 countries were asked to indicate whether their curriculum documents contained each of the following aspects:

- Planning technology-based products or solutions;
- Developing technology-based products or solutions to meet user requirements;
- Evaluating and refining technology-based products or solutions;
- Creating visual representations (e.g., flow charts and decision trees) of processes;
- Creating visual representations (e.g., flow charts and decision trees) of information/data;
- Designing user interfaces for technology-based products or solutions;
- Revising technology-based products or solutions on the basis of user feedback or other data;
- Creating algorithms;
- Writing code, programs, or macros;
- Evaluating code, programs, or macros;
- Developing digital applications (e.g., programs/apps); and
- Identifying and describing the properties of digital systems.

The extent to which CT aspects were present in curriculum documents varied across the ICILS 2018 countries (Table 2.5). Luxembourg and Uruguay did not contain any details (explicitly or implicitly) of these concepts in their curriculum documents, whereas all were contained in documents for Denmark, Korea, the United States, and Moscow (Russian Federation). The creation of visual representations (e.g., tables, graphs, or charts) of information/data and the creation of algorithms were the only aspects to be explicitly stated by the majority of ICILS 2018 participants (eight countries or benchmarking participants). Amongst the other aspects most likely indicated as being explicit parts of the curriculum were: writing code, programs, or macros (seven countries or benchmarking participants); planning technology-based products or solutions and the creation of visual representations (e.g., flow charts and decision trees) of processes (six countries or benchmarking participants). Revising technology-based products or solutions on the basis of user feedback or other data, identifying and describing the properties of digital systems, and designing user interfaces for technology-based products or solutions were the aspects that were least frequently suggested as being explicitly part of the curriculum.

Table 2.5: Emphases in national curricula of teaching aspects related to CT

Country	Extent that plans and policies emphasize aspects of CT in the national curriculum											
	Planning technology-based products or solutions	Developing technology-based products or solutions to meet user requirements	Evaluating and refining technology-based products or solutions	Creating visual representations (e.g., flow charts and decision trees) of processes	Creating visual representations (e.g., tables, graphs, or charts) of information/data	Designing user interfaces for technology-based products or solutions	Revising technology-based products or solutions on the basis of user feedback or other data	Creating algorithms	Writing code, programs, or macros	Evaluating code, programs, or macros	Developing digital applications (e.g., programs/apps)	Identifying and describing the properties of digital systems
Chile	●	●	●	◑	◑	●	●	○	○	○	○	○
Denmark	●	●	●	◑	◑	◑	◑	●	●	●	●	◑
Finland [1]	○	○	●	●	●	○	○	◑	○	○	○	◑
France	●	●	◑	●	●	○	○	●	●	●	●	●
Germany	○	○	○	◑	○	○	○	●	○	○	○	○
Italy	◑	◑	◑	●	●	◑	○	◑	◑	◑	◑	○
Kazakhstan	◑	◑	◑	●	●	○	○	●	●	◑	●	◑
Korea, Republic of	●	●	●	●	●	◑	◑	●	●	●	●	●
Luxembourg	○	○	○	○	○	○	○	○	○	○	○	○
Portugal	●	◑	○	◑	●	●	◑	◑	●	◑	●	◑
United States	●	●	◑	●	●	◑	◑	●	●	◑	◑	◑
Uruguay	○	○	○	○	○	○	○	○	○	○	○	○
Benchmarking participants												
Moscow (Russian Federation)	◑	◑	◑	◑	●	◑	◑	●	●	●	◑	●
North Rhine-Westphalia (Germany)	○	○	○	◑	○	○	○	●	○	○	○	○

Notes: Data from the ICILS 2018 national contexts survey.
● Explicitly stated in the curriculum.
◑ Implicitly stated in the curriculum.
○ No emphasis on this aspect in the curriculum.
[1] The ICILS 2018 age cohort were the last to follow the curriculum; this has been replaced with stronger emphasis on aspects of ICT including CT.

School delivery and assessment of CIL-related skills

Data from ICILS 2013 show contrasting ways in which CIL was delivered to students across countries (Fraillon et al. 2014). In ICILS 2018, each country was asked a series of questions on how CIL was delivered and assessed in their countries for the year of the data collection (Table 2.6). Firstly, respondents were asked whether CIL was included at each level as either a separate subject, whether it was integrated into science and technology studies, and/or whether it was integrated into other subjects. For each of these options they were asked to indicate whether the subject was compulsory or non-compulsory. At the primary level, it was rare for countries to have a separate subject: in Chile there was a compulsory subject, in Finland schools can choose themselves if they have short compulsory or non-compulsory courses for ICT, whereas the United States had a non-compulsory subject at this level. The remaining educational systems (with the exception of Kazakhstan and North Rhine-Westphalia, Germany), had CIL skills integrated into science and technology studies or integrated into other subjects (noting that in many countries this was a non-compulsory study). In eight countries or benchmarking participants, at the primary level CIL was delivered in two or three different ways (either as a separate subject or as part of another subject).

CIL was delivered as part of a compulsory separate subject in five different countries or benchmarking participants at the ISCED 1 level, and in six at the ISCED 2 level. All countries had some sort of CIL offered at the lower- and upper-secondary levels, via a separate subject or integrated into other studies. The exceptions to this were in North Rhine-Westphalia (Germany) and Uruguay (both at the upper-secondary level). When CIL was integrated into other subjects (e.g., science and technology studies), the subjects tended to be non-compulsory. In nine of the ICILS 2018 countries or benchmarking participants, a separate subject of CIL also included coding and applications data, although this was sometimes defined at the school, district, or state level. In Uruguay the inclusion of coding and applications data is at the discretion of the teachers.

All country respondents were also asked questions about their policies regarding the assessment of ICT. Each country had to indicate whether there was a requirement at school level regarding mandated assessment of ICT and computing skills of target grade students. Only France, Italy, Kazakhstan, Korea, Portugal, and Moscow (Russian Federation) had such policies. Respondents were also asked whether there were different types of ICT student assessments used or supported by ministries or departments of education, including diagnostic assessments, formative assessments, summative assessments, and national or state/provincial monitoring programs. Representatives from Denmark, Finland, the United States, Uruguay, and Moscow (Russian Federation) reported that all four types of assessment/monitoring were implemented in their countries. France, Italy, Kazakhstan, Korea, and Luxembourg all used between one and three of these types of assessments in their countries.

Teacher support and requirements for using ICT

Using previous research as a guide, the ICILS 2018 assessment framework highlights the importance of collecting process-related information at the system level for the development of teacher expertise in ICT-related teaching and learning (Fraillon et al. 2019; Charalambos and Glass 2007; Law et al. 2008; Scherer and Siddiq 2015). Data from ICILS 2013 confirm that teachers were using ICT extensively for teaching and learning (Fraillon et al. 2014). In the NCS, all participating countries were asked about the support and requirements for developing teachers' capacity in the following aspects of ICT for the year of the data collection (Table 2.7):

- Technical capacity in using ICT;
- Using ICT in pedagogy;
- Collaboration and communication in using ICT; and
- Using ICT for student assessment.

Table 2.6: CIL-related subjects at different levels of schooling and ICT assessment policies

Country	CIL-related subjects											Requirement at school level regarding mandated assessment of ICT and computing skills of target grade students	ICT student assessments used by educational authorities (national, state/provincial, or local/municipal) within the last seven years			
	ISCED level 1 (primary)			ISCED level 2 (lower secondary)			ISCED level 3 (upper secondary)			Name of separate subject at lower-secondary level	Separate subject includes coding or applications		Diagnostic assessments	Formative assessments	Summative assessments	National or state/provincial monitoring programs
	Separate subject	Integrated into science and technology studies	Integrated into other subjects	Separate subject	Integrated into science and technology studies	Integrated into other subjects	Separate subject	Integrated into science and technology studies	Integrated into other subjects							
Chile	◆	◇	◇	◆	◇	◇	◆	◇	◇	Technology	■	○	○	○	○	○
Denmark	–	◆	◆	–	◆	◆	◆	◆	◆			○	●	●	●	●
Finland	◇[1]	◇	◇	◇	◇	◇	◇	◇	◇	Information technology or Programming (most common)	■[3]	○	●	●	●	●
France	–	◆	◆	–	◆	◆	◆	◆	◆			●	●	○	○	○
Germany	–	◇	◆	–	◆	◆	◇[2]	◇[2]	◇[2]	Defined at state level	■[3]	○	○	○	○	○
Italy	–	◆	◇	–	◇	◇	◆	◇	◇			●	●	○	○	●
Kazakhstan	–	–	–	◆	–	–	◆	–	–	Computer science	■	●	●	●	●	○
Korea, Republic of	–	◆	–	◇	–	–	◇	–	–	Informatics	■	●	○	○	○	●
Luxembourg	–	–	◇	–	–	◇	◇	◇	◇			○	○	○	○	●
Portugal	–	◇	–	◆	◇	–	◇	◇	–	Information and communication technologies	■	●	○	○	○	○
United States	◇	◇	◇	◇	◇	◇	◇	◇	◇	Defined at district/school level	■[3]	○	●	●	●	●
Uruguay	–	–	◇	◆	◇	◇	–	–	–	Informatics	■[4]	○	●	●	●	●
Benchmarking participants																
Moscow (Russian Federation)	–	–	◆	◆	–	–	◆	–	–	Informatics	■	●	●	●	●	●
North Rhine-Westphalia (Germany)	–	◇	◆	–	◆	◆	–	–	–			○	○	○	○	○

Notes: ◆ Compulsory subject. ◇ Non-compulsory subject. ● Referenced in plans or policies for using ICT in education. ○ No reference in plans or policies for using ICT in education.
■ Subject includes coding or applications.
[1] Schools can choose themselves if they have short compulsory or non-compulsory courses for ICT. [2] Variation across states to whether subject is separate or compulsory/non-compulsory.
[3] Defined at the state, district, or school level. [4] Not mandatory, defined by teachers.

For each aspect, respondents were asked to indicate whether learning is a mandatory component of pre-service education, whether it was a requirement for being a teacher, and also whether participation in some form of professional learning program was required for teachers. The responses present a different profile across participating countries and benchmarking participants in the way in which teachers' capacity to use ICT is mandated. In Finland, Germany (including North Rhine-Westphalia), Kazakhstan, Korea, and Portugal, there are no requirements for any of these aspects to be learned by teachers. In Denmark, France, and Moscow (Russian Federation), those aspects that are required, are a mandatory component of pre-service education. In Chile, Luxembourg, the United States, and Uruguay, there were requirements for participation in some form of professional learning program. Only in Italy and the United States were teachers' capacities in any of these areas a registration requirement. In both the United States and Moscow (Russian Federation), these aspects were all both a mandatory part of pre-service education and teachers were required to obtain some form of professional learning in this area.

Support for ICT-based professional development

The NCS also asked about the level of support and teacher access to participation in ICT-based professional development. Respondents were asked to judge whether any of the following aspects were supported by funding teacher participation in programs, by providing resources for teachers to access, or by providing relieving teachers to allow regular teachers to attend programs (Table 2.8):

- To improve ICT/technical skills;
- To improve content knowledge with respect to CIL;
- To improve teaching skills with respect to CIL-related content;
- To develop digital teaching and learning resources;
- To integrate ICT in teaching and learning activities; and
- To improve skills in computer programming or developing applications for digital devices.

All aspects were supported in various ways across all countries (the exception is improving skills in computer programming or developing applications for digital devices in Kazakhstan and Portugal). Support was more likely to be provided by funding teacher participation in programs and by providing resources for teachers to access, in comparison to providing relieving teachers to allow regular teachers to attend programs, which occurred less frequently across countries. There was little variation within countries over the types of supports provided across the different aspects. Most countries used a combination of support for each aspect. In Denmark, Finland, Korea, and Luxembourg, all three types of support were provided for each of the six aspects. In Germany, support was offered by providing resources for each of the aspects for teachers to access (support in North Rhine-Westphalia was provided for all except to improve ICT/technical skills), whereas in Kazakhstan this was most likely in the form of funding teacher participation in programs.

Schools' access to ICT resources

Previous findings from cross-national surveys, including ICILS 2013, show differences in the provision of ICT resources in schools across countries (Anderson and Ainley 2010; Fraillon et al. 2014; Pelgrum and Doornekamp 2009). School ICT coordinators were asked to identify whether a range of specified technology and software resources are available in their school, and whether these were available to only students, only teachers, or both students and teachers.

Table 2.7: Requirements for developing teachers' capacity to use ICT

Country	Technical capacity in using ICT	Using ICT in pedagogy	Collaboration and communication in using ICT	Using ICT for student assessment
Chile	◇	● ◇	◇	◇
Denmark	●	●	●	–
Finland	–	–	–	–
France	●	●	●	●
Germany	–	–	–	–
Italy	▲	◇	◇	–
Kazakhstan	–	–	–	–
Korea, Republic of	–	–	–	–
Luxembourg	◇	◇	◇	◇
Portugal	–	–	–	–
United States	● ▲ ◇	● ▲ ◇	● ◇	● ◇
Uruguay	–	◇	◇	◇
Benchmarking participants				
Moscow (Russian Federation)	● ◇	● ◇	● ◇	● ◇
North Rhine–Westphalia (Germany)	–	–	–	–

Note: Data from the ICILS 2018 national contexts survey.
● Mandatory component of pre-service teacher education.
▲ Requirement for registration as a teacher.
◇ Participation in some form of professional learning program in this area required for teachers.

Access to technology-based resources

ICT coordinator responses on whether different technology resources were available in schools for both teachers and students were recorded (Table 2.9). Access to the internet through the school network was largely available to both groups in all participating countries, on average almost 90 percent across countries (relatively low availability of 66% was reported for Italy). Digital learning resources that can only be used online were also commonly available to both teachers and students, on average 86 percent of students attended schools with this resource available. On average, approximately two thirds of students across countries attended schools where digital learning resources could be accessed offline and an educational site or network maintained by education authorities was available to both teachers and students. Some country variation was evident for both types of resources, particularly for the latter with a low of 29 percent of students from Italy attending schools with these resources available, compared with a high of 94 percent of students from Moscow (Russian Federation). Email accounts for school-related use was the least common technology resource available for both students and teachers across countries (on average 55%), although it appears that these are relatively commonplace in some countries (more than 90% availability in Denmark, Finland, and Luxembourg), but relatively scarce in others (21% availability in North Rhine-Westphalia, Germany). It is worth noting that in a large proportion of schools cross-nationally, email was made available only for teachers.

Table 2.8: Level of support for teacher access to and participation in ICT-based professional development

Country	To improve ICT/ technical skills	To improve content knowledge with respect to CIL	To improve teaching skills with respect to CIL-related content	To develop digital teaching and learning resources	To integrate ICT in teaching and learning activities	To improve skills in computer programming or developing applications for digital devices
Chile	● ▲	● ▲	● ▲	● ▲	● ▲	● ▲
Denmark	● ▲ ◇	● ▲ ◇	● ▲ ◇	● ▲ ◇	● ▲ ◇	● ▲ ◇
Finland	● ▲ ◇	● ▲ ◇	● ▲ ◇	● ▲ ◇	● ▲ ◇	● ▲ ◇
France	▲ ◇	▲ ◇	▲ ◇	▲ ◇	▲ ◇	▲ ◇
Germany	▲	▲	▲	▲	▲	▲
Italy	▲	◇	●	●	◇	●
Kazakhstan	●	●	●	●	●	–
Korea, Republic of	● ▲ ◇	● ▲ ◇	● ▲ ◇	● ▲ ◇	● ▲ ◇	● ▲ ◇
Luxembourg	● ▲ ◇	● ▲ ◇	● ▲ ◇	● ▲ ◇	● ▲ ◇	● ▲ ◇
Portugal	◇	◇	▲	▲	▲	–
United States	● ▲ ◇	● ▲ ◇	● ▲ ◇	▲	● ▲	● ▲
Uruguay	● ▲	●	● ▲	● ▲	●	● ▲
Benchmarking participants						
Moscow (Russian Federation)	● ▲	● ▲	● ▲	● ▲	● ▲	● ▲
North Rhine–Westphalia (Germany)	–	▲	▲	▲	▲	▲

Note: Data from the ICILS 2018 national contexts survey.
● By funding teacher participation in programs.
▲ By providing resources for teachers to access.
◇ By providing relief teachers to allow regular teachers to attend programs.

Table 2.9: School reports on technology-related resources for both teaching and learning

Country	Percentages of students at schools where technology-related resources are available for both teaching and learning				
	Digital learning resources that can be accessed offline	Digital learning resources that can only be used online	Access to the internet through the school network	Access to an education site or network maintained by education authorities	Email accounts for school-related use
Chile	75 (3.7) △	87 (3.0)	85 (3.9)	60 (3.2) ▽	32 (6.2) ▼
Denmark† 1	68 (4.6)	99 (0.6) ▲	100 (0.0) ▲	87 (3.3) ▲	91 (2.8) ▲
Finland	46 (4.9) ▼	94 (2.3) △	99 (1.3) △	66 (4.5)	93 (2.2) ▲
France	78 (4.1) △	85 (3.3)	100 (0.0) ▲	79 (3.5) ▲	73 (4.2) ▲
Germany	64 (3.9)	73 (4.3) ▼	91 (2.6)	50 (4.1) ▼	30 (4.2) ▼
Italy2	72 (3.7)	75 (4.0) ▼	66 (4.5) ▼	29 (3.8) ▼	38 (4.2) ▼
Kazakhstan1	65 (3.8)	77 (3.8) ▽	80 (3.5) ▽	63 (4.1)	42 (4.6) ▼
Korea, Republic of	78 (3.4) △	87 (3.2)	82 (3.8) ▽	77 (4.0) △	33 (4.1) ▼
Luxembourg	61 (0.0) ▽	100 (0.0) ▲	100 (0.0) ▲	87 (0.0) ▲	99 (0.0) ▲
Portugal†† 1	69 (3.4)	83 (2.7)	93 (2.0)	67 (3.4)	35 (3.4) ▼
Uruguay	74 (4.1)	86 (3.6)	86 (3.9)	87 (3.3) ▲	40 (5.4) ▼
ICILS 2018 average	68 (1.1)	86 (0.9)	89 (0.9)	68 (1.1)	55 (1.2)
Not meeting sample participation requirements					
United States	74 (3.3)	95 (1.9)	99 (0.5)	93 (1.6)	84 (2.7)
Benchmarking participants meeting sample participation requirements					
Moscow (Russian Federation)	83 (3.1) ▲	98 (0.9) ▲	92 (2.6)	94 (2.0) ▲	53 (4.7)
North Rhine-Westphalia (Germany)	60 (4.5)	69 (4.4) ▼	86 (3.7)	40 (4.4) ▼	21 (4.5) ▼

Notes: Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent. Comparisons with ICILS 2018 only reported for countries or benchmarking participants meeting sample participation requirements.

† Met guidelines for sampling participation rates only after replacement schools were included.

†† Nearly met guidelines for sampling participation rates after replacement schools were included.

1 National defined population covers 90% to 95% of the national target population.

2 Country surveyed target grade in the first half of the school year.

National ICILS 2018 results are:

▲ More than 10 percentage points above average

△ Significantly above average

▽ Significantly below average

▼ More than 10 percentage points below average

Access to software resources

ICT coordinators were also asked about the availability of software resources for both students and teachers (Table 2.10). Word and presentation software were almost universally available to both groups (98% on average across countries for both types of software). High levels of availability (in terms of students attending schools with resources available to both students and teachers) were also found for:

- Video and photo software for capturing and editing (85% on average, with national percentages ranging from 66% in Italy to 96% in Finland);
- Graphic or drawing software (76% on average, with national percentages ranging from 48% in Italy to 97% in Finland);
- Digital contents linked with textbooks (70% on average, with national percentages ranging from 37% in North Rhine-Westphalia, Germany, to 90% in Italy and Moscow, Russian Federation);
- A learning management system (66% on average, with national percentages ranging from 25% in Chile to 97% in Finland and 90% in Uruguay);
- Practice programs or apps where teachers decide which questions are asked of students (60% on average, with national percentages ranging from 23% in Chile to 98% in Denmark);

- Social media (59% on average, with national percentages ranging from 22% in France to 84% in Denmark); and
- Single user digital learning games (54% on average, with national percentages ranging from 27% in North Rhine-Westphalia, Germany, to 80% in Finland).

The following software resources were available to an average of half of ICILS 2018 students or less (in terms of school availability for both teachers and students):

- Concept-mapping software (50% on average, with national percentages ranging from 25% in Portugal to 76% in Denmark);
- Simulations and modeling software (42% on average, with national percentages ranging from 8% in Italy to 91% in Finland and North Rhine-Westphalia, Germany);
- E-portfolios (39% on average, with national percentages ranging from 3% in Germany to 85% in Uruguay);
- Multi-user digital learning games with graphics and enquiry tasks (29% on average, with national percentages ranging from 4% in North Rhine-Westphalia, Germany, to 51% in Finland); and
- Data logging and monitoring tools (22% on average, with national percentages ranging from 3% in Italy to 46% in Denmark).

Access to technology facilities

ICT coordinators were further asked about technology facilities available in their school for the teaching and learning of the target grade students. Again, they were asked to indicate whether each facility was available either only for students or only for teachers, or for both groups. Summary percentages of the proportion of respondents who indicated that both students and teachers had access to the facilities (Table 2.11) suggest that access to a wireless local area network (LAN or wifi) and the use of a learning management system were relatively common (an average of 65% of students attended schools where these technologies were reported as being available to both students and teachers). As with the software resources, there was considerable variability: access to wifi was reported as being nearly universally available in Denmark, whereas less than one fifth of students attended schools in North Rhine-Westphalia (Germany) where this was available for both students and teachers. Internet-based applications for collaborative work and space on a school network to store files were also more commonly reported (63% and 58% on average respectively across countries). Both resources also had considerably high discrepancies: availability of the former ranged from 97 percent in Finland and Denmark to 13 percent in North Rhine-Westphalia (Germany), while availability of the latter ranged from 97 percent in Luxembourg to 19 percent in Korea. Robots or robotic devices (average 46%), a school intranet with applications and workplaces (average 46%), remote access to a school network (39%), and a 3D printer (27%), were available to both target grade students and teachers less than half the time.

Table 2.10: School reports on software-related resources for both teaching and learning

Country	Percentages of students at schools where ICT coordinators indicate that the following software-related resources are available for both teaching and learning:													
	Practice programs or [apps] where teachers decide which questions are asked of students (e.g., [Quizlet, Kahoot], [mathfessor])	Single user digital learning games (e.g., [languages online])	Multi-user digital learning games with graphics and inquiry tasks (e.g., [Quest Atlantis])	Word processor software (e.g., [Microsoft Word ®])	Presentation software (e.g., [Microsoft PowerPoint ®])	Video and photo software for capture and editing (e.g., [Windows Movie Maker, iMovie, Adobe Photoshop])	Concept mapping software (e.g., [Inspiration ®], [Webspiration ®])	Data logging and monitoring tools (e.g., [Logger Pro]) that capture real-world data digitally for analysis (e.g., speed, temperature)	Simulations and modeling software (e.g., [NetLogo])	A learning management system (e.g., [Edmodo], [Blackboard])	Graphing or drawing software	e-portfolios (e.g., [VoiceThread])	Digital contents linked with textbooks	Social media (e.g., [Facebook, Twitter])
Chile	23 (5.2) ▼	40 (6.9) ▼	29 (5.2)	97 (1.5)	99 (0.4)	73 (4.5) ▼	26 (4.4) ▼	8 (3.0) ▼	10 (3.3) ▼	25 (4.2) ▼	49 (5.5) ▼	52 (4.2) ▼	55 (5.4) ▼	49 (4.8) ▼
Denmark† 1	98 (1.4) ▲	72 (4.0) ▲	30 (4.5)	98 (1.2)	98 (1.2)	88 (2.8)	76 (3.5) ▲	46 (4.3) ▲	34 (4.2)	84 (3.4) ▲	74 (3.7)	38 (4.2) ▲	83 (3.7) ▲	84 (3.2) ▲
Finland	95 (1.9) ▲	80 (3.8) ▲	51 (4.7) ▲	100 (0.4) △	100 (0.4) △	96 (1.9) ▲	75 (4.5) ▲	23 (4.3)	91 (2.3) ▲	97 (1.7) ▲	97 (1.5) ▲	82 (3.5) ▲	89 (2.9) ▲	78 (3.8) ▲
France	52 (5.1)	46 (4.8)	26 (4.6)	99 (0.9)	99 (0.9)	87 (3.5)	75 (4.3) ▲	17 (4.0)	68 (4.5) ▲	29 (4.4) ▼	84 (3.8) △	36 (4.3)	58 (4.8) ▼	22 (3.9) ▼
Germany	49 (4.3) ▼	35 (4.2) ▼	9 (2.6) ▼	100 (0.2) △	100 (0.2) △	79 (3.8)	45 (3.9)	19 (3.4)	81 (3.2) ▲	49 (4.0) ▼	95 (2.0) ▲	3 (1.3) ▼	38 (4.8) ▼	23 (3.9) ▼
Italy²	55 (4.5)	45 (4.6) ▽	20 (3.8) ▽	96 (1.6)	96 (1.6)	66 (4.2) ▼	51 (4.6)	3 (1.4) ▼	8 (2.4) ▼	62 (4.4)	48 (4.2) ▼	4 (1.7) ▼	90 (2.6) ▲	24 (3.6) ▼
Kazakhstan¹	52 (4.1) ▽	59 (4.1)	32 (3.5)	99 (0.9)	98 (1.2)	89 (2.9)	31 (4.0) ▼	27 (3.2)	44 (4.0)	85 (3.2) ▲	81 (3.6)	37 (4.8)	64 (3.8)	73 (3.9) ▲
Korea, Republic of	58 (4.8)	69 (4.1) ▲	45 (5.1) ▲	97 (1.5)	95 (1.9)	78 (3.9)	49 (4.3)	23 (3.9)	40 (4.9)	57 (4.7) ▽	61 (4.5) ▼	53 (4.6) ▲	74 (4.3)	73 (4.0) ▲
Luxembourg	51 (0.0) ▽	33 (0.0) ▼	15 (0.0) ▼	100 (0.0) △	100 (0.0) △	95 (0.0) △	26 (0.0) ▼	32 (0.0) △	34 (0.0) ▽	59 (0.0) ▽	94 (0.0) ▲	19 (0.0) ▼	62 (0.0) ▽	69 (0.0) ▲
Portugal†† 1	47 (4.0) ▼	59 (4.0)	37 (3.9) △	99 (0.6)	99 (0.6)	92 (2.0) △	25 (4.1) ▼	16 (3.3) ▽	20 (3.5) ▼	84 (2.9) ▲	65 (3.7) ▼	25 (3.7) ▼	73 (3.5)	74 (3.3) ▲
Uruguay	83 (4.2) ▲	60 (5.1)	26 (4.7)	96 (2.3)	95 (2.4)	92 (2.9) △	67 (4.5) ▲	28 (4.4)	30 (4.7) ▼	90 (3.4) ▲	85 (2.9) △	85 (3.7) ▲	85 (3.6) ▲	78 (4.3) ▲
ICILS 2018 average	60 (1.2)	54 (1.3)	29 (1.2)	98 (0.4)	98 (0.4)	85 (1.0)	50 (1.2)	22 (1.0)	42 (1.1)	66 (1.1)	76 (1.1)	39 (1.1)	70 (1.2)	59 (1.1)
Not meeting sample participation requirements														
United States	90 (2.2)	82 (2.9)	66 (3.6)	99 (0.6)	98 (1.1)	85 (2.6)	56 (3.7)	33 (3.2)	41 (3.3)	73 (2.8)	73 (2.7)	46 (3.6)	90 (2.1)	34 (3.2)
Benchmarking participants meeting sample participation requirements														
Moscow (Russian Federation)	60 (4.1)	47 (4.1)	45 (4.6) ▲	100 (0.0) △	100 (0.0) △	91 (2.8) △	30 (3.6) ▼	37 (4.1) ▲	83 (4.1) ▲	46 (3.8) ▼	88 (2.9) ▲	46 (4.6)	90 (2.7) ▲	80 (3.8) ▲
North Rhine-Westphalia (Germany)	35 (5.0) ▼	27 (4.1) ▼	4 (2.0) ▼	99 (0.9)	99 (0.9)	75 (4.5) ▽	39 (4.7) ▼	21 (4.1)	91 (2.0) ▲	37 (3.9) ▼	95 (2.1) ▲	7 (2.6) ▼	37 (4.4) ▼	24 (4.8) ▼

Notes: Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent. Comparisons with ICILS 2018 only reported for countries or benchmarking participants meeting sample participation requirements.

† Met guidelines for sampling participation rates only after replacement schools were included.

†† Nearly met guidelines for sampling participation rates after replacement schools were included.

¹ National defined population covers 90% to 95% of the national target population.

² Country surveyed target grade in the first half of the school year.

National ICILS 2018 results are:

▲ More than 10 percentage points above average

△ Significantly above average

▽ Significantly below average

▼ More than 10 percentage points below average

Table 2.11: Schools' reports on available technology facilities for teaching and learning of target grade students

Country	Percentages of students at schools where ICT coordinators indicate that the following technology facilities are available for target grade students for teaching and learning:							
	Remote access to a school network	Space on a school network to store files	A school intranet with applications and workspaces	Internet-based applications for collaborative work (e.g., [Google Docs ®])	A 3D printer	Robots or robotic devices	Access to a wireless LAN (wifi)	A learning management system (e.g., [WebCT ®], [Moodle])
Chile	40 (5.8)	24 (3.9) ▼	25 (5.5) ▼	42 (4.9) ▼	5 (2.5) ▼	17 (3.7) ▼	53 (4.9) ▼	17 (4.6) ▼
Denmark† 1	46 (4.7)	75 (4.0) ▲	84 (3.5) ▲	97 (1.6) ▲	46 (4.7) ▲	60 (4.1) ▲	100 (0.0) ▲	83 (3.4) ▲
Finland	19 (3.0) ▼	81 (3.0) ▲	40 (4.5)	97 (1.5) ▲	39 (4.4) ▲	64 (4.8) ▲	91 (2.9) ▲	97 (1.9) ▲
France	36 (4.2)	91 (2.6) ▲	81 (3.5) ▲	54 (5.8)	46 (5.3) ▲	65 (4.3) ▲	37 (5.2) ▼	28 (4.5) ▼
Germany	20 (2.8) ▼	92 (2.2) ▲	73 (4.1) ▲	16 (3.3) ▼	12 (3.0) ▼	47 (4.7)	26 (4.1) ▼	45 (4.1) ▼
Italy2	59 (4.6) ▲	26 (3.5) ▼	13 (2.9) ▼	39 (4.0) ▼	20 (3.4) ▽	28 (3.6) ▼	47 (4.4) ▼	59 (4.0)
Kazakhstan1	47 (4.2) △	48 (3.8) ▼	48 (4.0)	56 (4.1)	15 (2.9) ▼	35 (4.0) ▼	59 (4.1)	86 (2.7) ▲
Korea, Republic of	25 (4.4) ▼	19 (3.6) ▼	28 (4.2) ▼	60 (4.5)	35 (4.7)	26 (3.8) ▼	49 (4.6) ▼	60 (4.7)
Luxembourg	16 (0.0) ▼	97 (0.0) ▲	60 (0.0) ▲	81 (0.0) ▲	48 (0.0) ▲	54 (0.1) △	87 (0.0) ▲	65 (0.0)
Portugal†† 1	35 (4.4)	46 (4.0) ▼	29 (3.6) ▼	70 (2.9) △	7 (1.8) ▼	33 (3.9) ▼	85 (2.7) ▲	84 (3.1) ▲
Uruguay	83 (3.2) ▲	41 (5.5) ▼	26 (4.3) ▼	82 (3.5) ▲	25 (4.8)	82 (3.1) ▲	77 (5.1) ▲	90 (3.4) ▲
ICILS 2018 average	39 (1.2)	58 (1.1)	46 (1.2)	63 (1.1)	27 (1.1)	46 (1.2)	65 (1.2)	65 (1.1)
Not meeting sample participation requirements								
United States	43 (2.8)	76 (3.1)	59 (3.3)	93 (1.8)	49 (3.5)	58 (3.0)	91 (2.0)	73 (2.4)
Benchmarking participants meeting sample participation requirements								
Moscow (Russian Federation)	14 (4.8) ▼	42 (5.0) ▼	43 (5.4)	69 (3.5)	58 (4.2) ▲	83 (3.0) ▲	83 (3.4) ▲	43 (4.5) ▼
North Rhine-Westphalia (Germany)	25 (4.3) ▼	91 (2.8) ▲	67 (4.3) ▲	13 (3.0) ▼	11 (3.2) ▼	56 (4.7) △	19 (4.1) ▼	34 (3.7) ▼

Notes: Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Comparisons with ICILS 2018 only reported for countries or benchmarking participants meeting sample participation requirements.

† Met guidelines for sampling participation rates only after replacement schools were included.

†† Nearly met guidelines for sampling participation rates after replacement schools were included.

1 National defined population covers 90% to 95% of the national target population.

2 Country surveyed target grade in the first half of the school year.

National ICILS 2018 results are:

▲ More than 10 percentage points above average

△ Significantly above average

▽ Significantly below average

▼ More than 10 percentage points below average

Availability of ICT devices for students

ICT coordinators at the participating schools were asked to provide information about the number of ICT devices that were available to students, while school principals reported the number of students enrolled at their school. We used these data to compute ratios of the number of students per device (Table 2.12). Lower ratios indicate a better-resourced school whereas higher ratios indicate a school with less access to digital technologies.

Denmark, Finland, France, and Luxembourg were better resourced countries in terms of the ratio of digital devices per student, these countries all had seven students per device or fewer. The remaining countries had ratios ranging between 10 and 22 students per device. In most countries there was a higher ratio in urban areas in comparison to rural areas, although this difference was only significant at the country level for Korea and Luxembourg.

Table 2.12: National ratios for number of students to number of ICT devices in school by school location

Country	All students		By school location				Difference (urban – rural)	
			Urban		Rural			
Chile	18	(2.6)	20	(3.3)	14	(2.4)	6	(3.7)
Denmark[†1]	5	(1.2)	7	(2.7)	3	(0.7)	4	(2.8)
Finland	3	(0.3)	3	(0.3)	4	(1.5)	−1	(1.5)
France	7	(0.9)	8	(1.9)	6	(0.8)	2	(2.0)
Germany	10	(0.6)	10	(0.7)	8	(0.9)	2	(1.2)
Italy[2]	14	(1.7)	14	(2.2)	14	(2.5)	0	(3.3)
Kazakhstan[1]	22	(1.2)	24	(1.9)	20	(2.0)	4	(3.2)
Korea, Republic of	14	(0.8)	14	(0.8)	7	(0.9)	**7**	(1.2)
Luxembourg	5	(0.0)	6	(0.0)	3	(0.0)	**3**	(0.0)
Portugal[††1]	17	(1.7)	19	(3.1)	15	(1.5)	4	(3.4)
ICILS 2018 average	11	(0.4)	13	(0.6)	9	(0.5)	**3**	(0.8)
Not meeting sample participation requirements								
United States	2	(0.1)	2	(0.1)	1	(0.1)	**1**	(0.1)
Benchmarking participants meeting sample participation requirements								
Moscow (Russian Federation)	13	(0.7)	13	(0.7)				
North Rhine-Westphalia (Germany)	13	(1.0)	13	(1.1)	10	(1.9)	3	(2.2)

Notes: Data were not available for Uruguay. Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent. Statistically significant ($p < 0.05$) differences are shown in **bold**.
† Met guidelines for sampling participation rates only after replacement schools were included.
†† Nearly met guidelines for sampling participation rates after replacement schools were included.
1 National defined population covers 90% to 95% of the national target population.
2 Country surveyed target grade in the first half of the school year.

School location of ICT devices and student access to portable devices

The ICT coordinator questionnaire included questions on where school ICT devices were located at schools for the teaching and learning of target grade students, and on the proportion of students who have portable computers under different policies (Table 2.13). In all countries (except Denmark), the most common location of ICT devices for students of this grade was in computer laboratories (only a quarter of Danish students attended schools where computers were available in such a location). The school library was the only other location that had devices available for more than half of students (on average across countries), although this was much more common in some countries (France, Luxembourg, and Portugal in particular). In Finland (83%), Luxembourg (65%),

Table 2.13: School reports of school ICT devices at different locations and student access to portable devices at school

Country	Percentages of students at schools where ICT coordinators indicate that computers are available for the target grade students in the following locations:						Percentages of students where ICT coordinators indicate that 51% or more of the target grade students have portable computers under the following policy:		
	In most (80% or more) classrooms	In computer laboratories	As class sets of computers that can be moved between classrooms	In the library	In other places accessible to students (e.g., cafeteria, auditorium, study area)	Brought by students to class	Students provided with portable computers by their [school] for use at school only	Students provided with portable computers by their [school] for use at home and at school	Students bring portable computers which they own to use at school
Chile	22 (4.3) ▼	94 (2.6) △	52 (5.0)	66 (4.4) △	16 (3.9)	36 (4.8)	36 (4.8)	12 (3.7)	23 (4.6) ▲
Denmark† 1	52 (4.2) △	25 (4.2) ▼	40 (4.6)	31 (3.6) ▼	23 (4.0)	91 (2.5) ▲	31 (3.8)	39 (4.5) ▲	53 (4.3) ▲
Finland	34 (4.6) ▽	76 (4.0) ▼	83 (3.3) ▲	22 (4.6) ▼	12 (3.1) ▽	31 (5.0)	43 (4.7) ▲	12 (3.3)	7 (2.6) ▽
France	48 (5.3)	97 (1.5) △	44 (4.6)	98 (1.7) ▲	21 (4.1)	7 (1.8) ▼	19 (3.2) ▼	4 (1.5) ▽	0 (0.0) ▼
Germany	39 (4.4)	98 (1.1) ▲	49 (4.4)	42 (3.7) ▼	24 (2.8)	15 (3.4) ▼	20 (3.4) ▼	0 (0.5) ▼	4 (1.9) ▽
Italy2	56 (4.1) ▲	96 (1.7) △	46 (4.5)	17 (3.4) ▼	8 (2.1) ▼	21 (3.5) ▼	32 (3.7)	1 (0.8) ▼	8 (2.5)
Kazakhstan1	54 (4.2) ▲	99 (0.6) ▲	40 (4.2)	56 (3.4)	15 (3.2) ▽	11 (2.5) ▼	58 (3.5) ▲	3 (1.3) ▽	7 (2.1) ▽
Korea, Republic of	51 (4.3) △	94 (2.2) △	47 (4.8)	71 (4.1) ▲	22 (3.2)	16 (3.2) ▼	16 (3.3) ▼	1 (0.8) ▼	5 (2.0) ▽
Luxembourg	50 (0.1) △	95 (0.1) △	65 (0.0) ▲	94 (0.0) ▲	41 (0.0) ▲	52 (0.1) ▲	36 (0.1) △	4 (0.0) ▽	7 (0.0) ▽
Portugal†† 1	51 (4.5)	92 (1.7) △	18 (3.4) ▼	89 (2.7) ▲	35 (4.0) ▲	21 (3.3) ▼	31 (4.0)	3 (0.5) ▽	9 (2.4)
Uruguay	16 (3.4) ▼	95 (2.0) △	38 (5.0)	43 (5.1) ▼	11 (3.4) ▽	57 (4.5) ▲	37 (4.6)	52 (4.7) ▲	7 (2.6)
ICILS 2018 average	43 (1.3)	87 (0.7)	47 (1.3)	57 (1.1)	21 (1.0)	33 (1.0)	33 (1.1)	12 (0.8)	12 (0.8)
Not meeting sample participation requirements									
United States	72 (2.9)	82 (2.7)	75 (3.0)	84 (2.7)	24 (3.3)	46 (3.3)	70 (2.9)	25 (3.0)	8 (1.6)
Benchmarking participants meeting sample participation requirements									
Moscow (Russian Federation)	61 (5.0) ▲	99 (0.7) ▲	59 (5.3) ▲	67 (4.0) △	22 (4.0)	43 (5.1)	63 (5.2) ▲	0 (0.4) ▼	9 (3.1)
North Rhine-Westphalia (Germany)	26 (4.0) ▼	96 (2.1) △	44 (5.2)	47 (4.7) ▼	23 (4.0)	17 (4.0) ▼	17 (4.0) ▼	2 (1.8) ▼	1 (0.7) ▼

Notes: Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent. Comparisons with ICILS 2018 only reported for countries or benchmarking participants meeting sample participation requirements.

† Met guidelines for sampling participation rates only after replacement schools were included.

†† Nearly met guidelines for sampling participation rates after replacement schools were included.

1 National defined population covers 90% to 95% of the national target population.

2 Country surveyed target grade in the first half of the school year.

National ICILS 2018 results are:

▲ More than 10 percentage points above average

△ Significantly above average

▽ Significantly below average

▼ More than 10 percentage points below average

Moscow (Russian Federation) (59%), and Chile (52%), class sets of computers that can be moved between classrooms were available to the majority of students. In Denmark, Italy, Kazakhstan, Korea, Luxembourg, Portugal, and Moscow (Russian Federation), just over half of students had access to these in most classrooms (most defined as 80% or more). In Denmark (91%) and to a lesser extent in Luxembourg (52%) and Uruguay (57%), it is commonplace for target grade students to bring devices to class, but this was less common in other countries and benchmarking participants. In most countries and benchmarking participants there were relatively few devices located in other places accessible to students (e.g., in cafeterias, auditoriums, study areas), although slightly higher percentages were reported for Luxembourg (41%) and Portugal (35%).

ICT coordinators indicated the approximate proportion of students who had access to a portable device at school under three policy conditions. The most common of the three conditions was that students were provided with portable computers by their school for use at school only. For approximately one third of students in the study, the majority in their grade brought devices under this condition. This was more common in Moscow (Russian Federation) (63%) and Kazakhstan (58%). Students being provided with portable computers by their school for use at home and at school, and students bringing their own portable computers to use at school were much less frequent for the majority of target grade students. Notable exceptions for the former are evident in Uruguay (52% of students) and for the latter in Denmark (53% of students).

School policies and practices for using ICT

Procedures regarding different aspects of ICT

NCS data provided evidence of how national and state/provincial plans and policies intend to deliver the teaching and learning of ICT in education. In order to help capture information on the implementation of policies at the school level, principals were asked (yes or no) whether their school or school system had policies regarding different aspects of ICT use (Table 2.14). Aspects that were more commonly identified across countries (in terms of the percentages of students attending schools with these policies) included:

- Prohibitions of access to inappropriate material (e.g., pornography, violence) (92% on average, with national percentages ranging from 55% in Denmark to all or nearly all in Germany, including North Rhine-Westphalia, and Moscow, Russian Federation);
- The provision of security measures to prevent unauthorized system access or entry (91% on average, national percentages ranging from 76% in Uruguay to 99% in Portugal and Moscow, Russian Federation);
- Unacceptable behaviors towards other students (e.g., cyberbullying) (87% on average, national percentages ranging from 41% in Kazakhstan to 97% in Finland);
- Support for students with special needs or specific learning difficulties (82% on average, national percentages ranging from 45% in Chile to 98% in Denmark);
- The fulfilment of intellectual property rights (e.g., software copyrights) (80% on average, national percentages ranging from 66% in Chile to 98% in Moscow, Russian Federation);
- Student use of their own ICT at school (70% on average, national percentages ranging from 35% in France to 94% in Moscow, Russian Federation);
- Student access to school computers outside class hours (but during school hours) (70% on average, national percentages ranging from 37% in Italy to 92% in Moscow, Russian Federation);
- Student use of non-school related games on school computers (69% on average, national percentages ranging from 48% in Moscow, Russian Federation, to 82% in Portugal);

Table 2.14: School reports of procedures regarding different aspects of ICT use at school

Country	Percentages of students at schools where school principals indicated the following policies regarding how different aspects of ICT were implemented:										
	The provision of security measures to prevent unauthorized system access or entry	Restrictions on the number of hours students are allowed to sit at a computer	Student access to school computers outside class hours (but during school hours)	Student access to school computers outside school hours	The fulfilment of intellectual property rights (e.g., software copyrights)	Prohibitions of access to inappropriate material (e.g., pornography, violence)	Student use of non-school related games on school computers	The provision of access to school computers and/or the internet for the local community (parents and/ or others)	Support for [students with special needs or specific learning difficulties]	Unacceptable behaviors towards other students (e.g., [cyberbullying])	The provision of laptop computers and/or other mobile learning devices for student use at school and at home	Student use of their own ICT at school
Chile	89 (3.1)	59 (6.1) ▲	82 (4.4) ▲	64 (5.6) ▲	66 (4.8) ▼	95 (0.8) △	81 (4.8) ▲	60 (5.3) ▲	45 (6.3) ▼	93 (1.5) △	51 (5.1) ▽	69 (3.9)
Denmark† 1	85 (3.5)	7 (2.3) ▼	61 (4.2) ▽	57 (4.7)	80 (3.6)	55 (4.8) ▼	55 (4.6) ▼	44 (4.4)	98 (1.3) ▲	93 (2.2) △	89 (2.7) ▲	87 (2.9) ▲
Finland	90 (2.8)	1 (0.6) ▼	65 (5.1)	51 (4.5)	79 (4.1)	83 (3.5) ▽	69 (5.2)	35 (4.6)	89 (3.2) △	97 (2.1) △	89 (2.8) ▲	88 (3.5) ▲
France	92 (2.6)	13 (2.5) ▼	81 (3.5) ▲	21 (3.3) ▼	91 (2.5) ▲	97 (2.2) △	56 (3.8) ▼	35 (4.2)	87 (2.9) △	86 (2.8)	36 (3.6) ▼	35 (4.5) ▼
Germany	95 (2.0) △	30 (4.3)	60 (4.7) ▼	36 (4.1) ▼	95 (1.8) ▲	100 (0.0) △	71 (4.3)	46 (4.1)	54 (4.7) ▼	91 (2.3)	39 (4.3) ▼	69 (4.1)
Italy[2]	87 (2.7)	19 (3.5) ▼	37 (5.0) ▼	23 (4.0) ▼	67 (4.0) ▼	94 (2.1)	80 (3.8) ▲	40 (4.7)	92 (2.7) ▲	94 (2.0) △	49 (4.5) ▼	64 (4.5)
Kazakhstan[1]	93 (2.3)	85 (3.0) ▲	82 (3.4) ▲	69 (4.1) ▲	77 (3.3)	98 (0.7) △	49 (3.6) ▼	44 (4.3)	90 (2.5) △	41 (3.9) ▼	55 (4.1)	72 (4.0)
Korea, Republic of	96 (2.1) △	61 (4.3) ▲	68 (4.5)	55 (4.9)	95 (2.0) ▲	96 (2.3)	69 (4.4)	22 (3.6) ▼	69 (3.9) ▼	88 (3.0)	45 (4.3) ▼	50 (4.4) ▼
Luxembourg	95 (0.0) △	5 (0.0) ▼	79 (0.0) △	74 (0.0) ▲	73 (0.1) ▽	98 (0.0) △	69 (0.0)	33 (0.0) ▽	88 (0.0) △	92 (0.0) △	72 (0.1) ▲	71 (0.1)
Portugal†† 1	99 (0.7) △	26 (3.4)	80 (3.4) ▲	64 (4.3) ▲	90 (2.4) △	99 (0.5) △	82 (2.9) ▲	46 (4.5)	94 (2.1) ▲	88 (2.3)	59 (4.2)	77 (3.8)
Uruguay	76 (4.0) ▼	36 (5.3)	72 (4.3)	69 (4.8) ▲	72 (4.3) ▽	95 (2.2)	74 (3.9)	47 (5.1)	91 (2.7) △	91 (2.9)	86 (2.6) ▲	93 (2.4) ▲
ICILS 2018 average	91 (0.8)	31 (1.1)	70 (1.2)	53 (1.3)	80 (1.0)	92 (0.7)	69 (1.2)	41 (1.3)	82 (1.0)	87 (0.7)	61 (1.1)	70 (1.1)
Not meeting sample participation requirements												
United States	99 (0.5)	17 (2.3)	69 (3.1)	54 (3.6)	90 (2.1)	99 (0.5)	90 (2.0)	68 (3.1)	96 (1.4)	98 (0.8)	76 (3.1)	78 (2.9)
Benchmarking participants meeting sample participation requirements												
Moscow (Russian Federation)	99 (0.7) △	82 (4.8) ▲	92 (2.0) ▲	87 (2.8) ▲	98 (1.1) ▲	100 (0.0) △	48 (5.4) ▼	67 (4.6) ▲	97 (1.3) ▲	58 (4.6) ▼	45 (5.0) ▼	94 (2.0) ▲
North Rhine-Westphalia (Germany)	93 (1.6)	20 (3.9) ▼	64 (4.6)	23 (4.0) ▼	92 (2.8) ▲	100 (0.0) △	66 (4.5)	38 (5.1)	56 (3.5) ▼	92 (2.7) △	30 (4.9) ▼	67 (5.0)

Notes: Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Comparisons with ICILS 2018 only reported for countries or benchmarking participants meeting sample participation requirements.
† Met guidelines for sampling participation rates only after replacement schools were included.
†† Nearly met guidelines for sampling participation rates after replacement schools were included.
1 National defined population covers 90% to 95% of the national target population.
2 Country surveyed target grade in the first half of the school year.

National ICILS 2018 results are:
▲ More than 10 percentage points above average
△ Significantly above average
▽ Significantly below average
▼ More than 10 percentage points below average

- The provision of laptop computers and/or other mobile learning devices for student use at school and at home (61% on average, national percentages ranging from 30% in North Rhine-Westphalia, Germany, to 89% in Denmark and Finland); and
- Student access to school computers outside school hours (53% on average, national percentages ranging from 21% in France to 87% in Moscow, Russian Federation).

Aspects that were less commonly identified across countries (less than half of students attended schools with these policies) include:

- The provision of access to school computers and/or the internet for the local community (parents and/or others) (41% on average, national percentages ranging from 22% in Korea to 67% in Moscow, Russian Federation); and
- Restrictions on the number of hours students are allowed to sit at a computer (31% on average, national percentages ranging from 1% in Finland to 85% in Kazakhstan).

Priorities for facilitating ICT in teaching and learning

Principals were also asked to rate the priority ("high priority," "medium priority," "low priority," "not a priority") in their school for methods of facilitating ICT use in teaching and learning. Methods given a high priority (Table 2.15) by countries included:

- Increasing the bandwidth of internet access for the computers connected to the internet (59% on average, this typically ranged between 60% and 78%, with considerably lower proportions for Luxembourg, Korea, and Denmark);
- Increasing the range of digital learning resources available for teaching and learning (55% on average, all countries ranged between 40% in Denmark to a high of 78% in Moscow, Russian Federation); and
- Increasing the number of computers connected to the internet (53% on average, ranging from a low of 23% in Luxembourg to a high of 72% in Moscow, Russian Federation).

Other methods of ICT use that were reported as being a medium or high priority in the schools for less than half of students (on average across countries) included:

- Supporting participation in professional development on pedagogical use of ICT (48% on average, ranging from a low of 29% in Denmark to a high of 87% in Moscow, Russian Federation);
- Increasing the numbers of computers per student in the school (46% on average, ranging from a low of 24% in Luxembourg to a high of 69% in Kazakhstan);
- Increasing the availability of qualified technical personnel to support the use of ICT (45% on average, ranging from a low of 25% in Korea to a high of 69% in Moscow, Russian Federation);
- Providing teachers with incentives to integrate ICT use in their teaching (41% on average, ranging from a low of 24% in Finland to a high of 92% in Moscow, Russian Federation);
- Increasing the professional learning resources for teachers in the use of ICT (40% on average, ranging from a low of 20% in Luxembourg to a high of 69% in Kazakhstan);
- Establishing or enhancing an online learning support platform (37% on average, ranging from a low of 21% in France, Germany, and Luxembourg to a high of 64% in Moscow, Russian Federation); and
- Providing more time for teachers to prepare lessons in which ICT is used (24% on average, ranging from a low of 6% in Denmark to a high of 59% in Kazakhstan).

Table 2.15: School reports of priority given to different ways of facilitating ICT use in teaching and learning

Country	Percentages of students at schools where school principals indicated high priority to the following ways of facilitating ICT use in teaching and learning:									
	Increasing the numbers of computers per student in the school	Increasing the number of computers connected to the internet	Increasing the bandwidth of of internet access for the computers connected to the internet	Increasing the the range of digital learning resource available for teaching and learning	Establishing or enhancing an online learning support platform	Supporting participation in professional development on pedagogical use of ICT	Increasing the availability of qualified technical personnel to support the use of ICT	Providing teachers with incentives to integrate ICT use in their teaching	Providing more time for teachers to prepare lessons in which ICT is used	Increasing the professional learning resources for teachers in the use of ICT
Chile	52 (5.9)	63 (5.8) ▲	75 (5.5) ▲	65 (5.7) ▲	58 (5.9) ▲	48 (5.1)	39 (5.0)	25 (4.6) ▼	36 (6.3) ▲	46 (5.3)
Denmark† 1	50 (4.6)	49 (4.3)	48 (4.6) ▼	40 (4.0) ▼	45 (4.2) △	29 (4.3) ▼	27 (3.9) ▼	49 (4.7)	6 (2.4) ▼	26 (4.3) ▼
Finland	66 (4.8) ▲	70 (4.3) ▲	63 (4.6)	62 (4.0)	36 (4.4)	63 (5.0) ▲	47 (5.1)	24 (4.2) ▼	20 (3.9)	42 (4.8)
France	46 (4.4)	54 (4.5)	63 (4.4)	42 (4.6) ▼	21 (3.3) ▼	38 (4.6) ▽	45 (4.8)	54 (4.0) ▲	12 (2.9) ▼	33 (4.2)
Germany	42 (4.3)	52 (4.2)	76 (3.3) ▲	43 (4.7) ▼	21 (3.5) ▼	34 (4.4) ▼	42 (4.4)	28 (4.3) ▼	19 (3.8)	33 (4.5)
Italy²	41 (4.8)	56 (5.0)	72 (4.3) ▲	56 (4.7)	28 (4.2) ▽	50 (4.9)	60 (4.5) ▲	30 (4.4) ▼	18 (3.7)	41 (4.6)
Kazakhstan¹	69 (4.3) ▲	71 (4.2) ▲	67 (4.2)	62 (4.6)	45 (4.3) △	75 (4.2) ▲	62 (4.6) ▲	79 (3.9) ▲	59 (4.5) ▲	69 (4.0) ▲
Korea, Republic of	20 (3.2) ▼	29 (3.3) ▼	28 (3.9) ▼	49 (4.2)	46 (4.0) △	35 (4.2) ▼	25 (3.6) ▼	28 (3.7) ▼	26 (3.5)	37 (4.2)
Luxembourg	24 (0.0) ▼	23 (0.0) ▼	25 (0.0) ▼	52 (0.0) ▽	21 (0.0) ▼	52 (0.0) △	45 (0.0)	48 (0.0) △	10 (0.0) ▼	20 (0.0) ▼
Portugal†† 1	43 (4.0)	52 (4.7)	60 (4.5)	62 (4.1)	28 (3.3) ▽	39 (3.4) ▽	46 (4.5)	41 (3.9)	18 (3.4)	38 (4.1)
Uruguay	49 (4.7)	66 (4.4) ▲	72 (4.3) ▲	73 (4.7) ▲	57 (5.3) ▲	62 (5.2) ▲	54 (5.6)	51 (5.2) △	42 (5.6) ▲	57 (5.3) ▲
ICILS 2018 average	46 (1.3)	53 (1.3)	59 (1.3)	55 (1.3)	37 (1.2)	48 (1.3)	45 (1.3)	41 (1.2)	24 (1.2)	40 (1.3)
Not meeting sample participation requirements										
United States	68 (3.3)	68 (3.4)	66 (2.8)	62 (3.3)	49 (3.4)	51 (3.0)	41 (3.3)	27 (2.8)	32 (3.3)	49 (3.5)
Benchmarking participants meeting sample participation requirements										
Moscow (Russian Federation)	65 (4.8) ▲	72 (4.6) ▲	73 (4.0) ▲	78 (3.7) ▲	64 (5.1) ▲	87 (3.0) ▲	69 (3.9) ▲	92 (2.2) ▲	49 (4.6) ▲	64 (4.6) ▲
North Rhine-Westphalia (Germany)	44 (4.6)	52 (4.8)	78 (4.0) ▲	48 (5.0)	30 (4.4)	35 (4.7) ▼	37 (4.8)	31 (4.6) ▼	17 (3.1) ▽	41 (4.5)

Notes: Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
Comparisons with ICILS 2018 only reported for countries or benchmarking participants meeting sample participation requirements.

† Met guidelines for sampling participation rates only after replacement schools were included.

†† Nearly met guidelines for sampling participation rates after replacement schools were included.

1 National defined population covers 90% to 95% of the national target population.

2 Country surveyed target grade in the first half of the school year.

National ICILS 2018 results are:

▲ More than 10 percentage points above average

△ Significantly above average

▽ Significantly below average

▼ More than 10 percentage points below average

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