AN INTERNATIONAL PERSPECTIVE ON DIGITAL LITERACY

Results from ICILS 2023

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Editor

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Researching education, improving learning

The International Association for the Evaluation of Educational Achievement (IEA) is an independent, international cooperative of national research institutions and governmental research agencies. It conducts large-scale comparative studies of educational achievement and other aspects of education, with the aim of gaining in-depth understanding of the effects of policies and practices within and across systems of education.

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Foreword

With today's rapid technological advancement, understanding how well students are prepared for study, work, and life in a digital world has become a question of utmost importance. The International Computer and Information Literacy Study (ICILS), now finalizing its third cycle, addresses this crucial inquiry by investigating students' computer and information literacy (CIL) and computational thinking (CT) skills. As we navigate the complexities of the 21st century, international large-scale assessments (ILSAs) provide imperative data that can help illuminate the ways in which students' learning develops and how it can be improved, and ICILS 2023's results contribute further to this database with its rich data from assessment items and context questionnaires.

Developing digital skills is a key for student success in many aspects of learning, as we also saw demonstrated during the COVID-19 crisis where digitalization helped education to continue in times of global disruptions of schooling and life. However, it should be noted that digital competencies are not replacing traditional learning areas, rather that they open a new field where students need to be competent in today's world.

The International Association for the Evaluation of Educational Achievement (IEA) has been at the forefront of educational research since the 1960s, consistently adding to our understanding of education systems worldwide. Our journey in investigating digital literacy began with the Computers in Education Study (COMPED) in 1987 and evolved into the Second Information Technology in Education Study (SITES) in the late 1990s and early 2000s. These pioneering efforts laid the groundwork for what would become ICILS, reflecting our commitment to adapting our research to the changing educational landscape.

The establishment of ICILS in 2013 marked a significant milestone in our mission to provide comprehensive insights into how students interact with technology and develop essential digital skills. The subsequent cycle in 2018 further expanded this understanding, paving the way for ICILS 2023 to build upon nearly a decade of trend data whilst also providing new, innovative measurements. This longitudinal approach allows us to not only capture the current state of digital literacy but also to track its evolution over time, providing invaluable insights for policymakers and educators alike.

ICILS 2023 builds upon this rich history, offering a unique perspective on the ever-changing landscape of technological innovation and its impact on education. This study encapsulates the broad use of computer technologies across various aspects of daily life—from schools and homes to communities and workplaces—and examines how students investigate, create, participate, and communicate in digital environments. By doing so, ICILS 2023 provides a holistic view of students' digital competencies, going beyond mere technical skills to encompass critical thinking, problem-solving, and effective communication in digital contexts.

The current cycle of ICILS further expands on the optional component of computational thinking, reflecting the growing recognition of these skills as vital for success in a digital world. This addition acknowledges the increasing importance of algorithmic thinking and problem-solving skills in various fields, from computer science to data analysis and beyond. Understanding how computers work helps both to interact with the information presented and to use them effectively. Additionally, this cycle emphasizes new areas of interest related to digital citizenship, acknowledging the increasing opportunities for young people to engage in online civic participation as well as insights into the developing use of AI in schools. This focus on responsible and comprehensive digital navigation is particularly timely, as we witness the growing influence of digital platforms on public discourse and civic engagement.

With 35 education systems participating from all around the world, ICILS 2023 underscores its global relevance and importance. The study aligns closely with UNESCO's Sustainable Development Goals,

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Chapter 1:

Introduction to the IEA International Computer and Information Literacy Study 2023

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1.1 Background

Between the first cycle of IEA's International Computational and Information Literacy Study (ICILS) in 2013 and the third cycle in 2023, the number of individuals using the internet worldwide has increased from an estimated 2.4 billion (35% of the world's population) to 5.4 billion (67% of the world's population) (International Telecommunication Union [ITU], 2024). Across the globe, the use of information communications technologies (ICT) is integrated in all aspects of our daily lives, including education, work, recreation, civil and civic engagement, and socializing. In addition to the ongoing increase in people's access to the internet and digital technologies, the evolution of digital tools serves to amplify the essential value of the development of digital literacy competencies (Council of the European Union, 2018; European Commission, 2021; Gómez, 2021; National Assessment Governing Board [NAGB], 2018). While some of these competencies relate to basic technical skills, they extend well beyond these to include essential skills associated with the critical evaluation of the relevance, accuracy, plausibility, and social consequences of digital information (Vuorikari et al., 2022). In ICILS, this is addressed from the perspective of individuals as consumers and producers of digital information. The recent emergence of generative AI tools and their integration into existing software environments, together with the ease with which individuals can create and publish digital information have served only to heighten the importance of these core skills assessed in ICILS (COMEST, UNESCO, 2019; Ng et al., 2022; Picton & Teravainen, 2017).

The rapid and ongoing increase in the pervasiveness of computer technologies including ICT is a function of the value and efficiency of computers to contribute to solutions for myriad problems. This brings with it the need for innovation and skills that can be used to extend the range of computer-based solutions to problems (see, for example, Cedefop, 2018; Ciarli et al., 2021; OECD, 2022). In ICILS this is reflected in the optional assessment of computational thinking (CT) that was first made available to countries in ICILS 2018.

The importance placed on the need to monitor citizens' ICT-related competencies in an increasingly digital world is evident, for example, in the inclusion of measures of youth and adults' information and communications technologies (ICT) skills in Indicator 4.4.1 of the United Nations (UN) Sustainable Development Goals (UN, 2017). Digital competence is one of the eight key competencies for lifelong learning (European Commission and Directorate-General for Education, Youth, Sport and Culture, 2019). Reflected in the evolution since 2010 of the European Commission Digital Competence Framework for Citizens (DigComp) as the pre-eminent supranational digital skills framework across Europe (European Commission, n.d.). The value of ICILS in contributing to the monitoring of these competencies is manifest in the Resolution on a strategic framework for European cooperation in education and training towards the European Education Area and beyond (2021–2030) (European Commission, 2021), under which the digital skills of grade 8 students will be monitored, using data collected in ICILS.

IEA has been studying the relationship between ICT and educational processes, as well as factors related to the pedagogical use of ICT, since the late-1980s (Pelgrum & Plomp, 2011). IEA's ICILS emerged in response to the increasing value being placed on the use of ICT in modern society and the need for citizens to develop relevant capabilities to participate effectively in a digital world. ICILS also addresses proficiency by revising both the boundaries on the scale, and the descriptions of the levels within those boundaries. This process established the four-level ICILS CT described achievement scale that replaces the preliminary draft regions reported in ICILS 2018 (see Chapter 4 for more details). The percentages of students achieving each preliminary draft region in ICILS 2018 cannot be directly compared to the percentages of students achieving each level of the CT scale in 2023. However, the CT scale scores are directly comparable between ICILS 2018 and 2023 and with future cycles of ICILS. Direct comparison of the percentages of students achieving each CT level will be possible between ICILS 2023 and future ICILS cycles.

ICILS 2023 includes both the core assessment of CIL and the optional assessment of CT. ICILS 2023 provides, across relevant countries, the opportunity to report on trends in student CIL achievement across 10 years and across three assessment cycles since ICILS 2013. As part of ICILS 2023, a described CT achievement scale has been established (replacing the previously drafted preliminary described regions) with descriptions of CT proficiency across four levels (see Chapter 4 for further details). The updated scale description was planned and made possible by including a larger amount of CT test content in ICILS 2023 in comparison to 2018. Despite this change in scale description, student CT achievement in ICILS 2023 is reported on the CT reporting scale established in 2018 and, consequently for relevant countries, ICILS 2023 provides the opportunity to measure changes in student CT achievement scale scores between 2018 and 2023. The CT measurement scale established in 2018 and the four-level description of the scale established in 2023 will continue to be used in future cycles of ICILS.

This report presents research outcomes at the international level of analyses of data collected in the ICILS main survey in 2023. The focus of this report is on CIL and CT achievement of lower secondary school students, with reference to the contexts in which these competencies have been and are being developed. Thirty-four countries and one benchmarking participant took part in the core assessment of CIL in ICILS 2023, and twenty-four countries also took part in the optional assessment of CT (Table 1.1).

Table 1.1: ICILS 2023 participating countries

Austria (CIL&CT)	Germany (CIL&CT)	Oman (CIL)
Azerbaijan (CIL)	Greece (CIL)	Portugal (CIL&CT)
Belgium (Flemish) (CIL&CT)	Hungary (CIL)	Romania (CIL)
Bosnia and Herzegovina (CIL)	Italy (CIL&CT)	Serbia (CIL&CT)
Chile[1] (CIL)	Kazakhstan (CIL)	Slovak Republic (CIL&CT)
Chinese Taipei (CIL&CT)	Korea (Rep. of) (CIL&CT)	Slovenia (CIL&CT)
Croatia (CIL&CT)	Kosovo (CIL)	Spain (CIL)
Cyprus (CIL)	Latvia (CIL&CT)	Sweden (CIL&CT)
Czech Republic (CIL&CT)	Luxembourg (CIL&CT)	United States (CIL&CT)
Denmark (CIL&CT)	Malta (CIL&CT)	Uruguay (CIL&CT)
Finland (CIL&CT)	Netherlands[2] (CIL&CT)	
France (CIL&CT)	Norway (CIL&CT)	
Benchmarking participant		
North Rhine-Westphalia (Germany) (CIL &CT)		

1 Due to issues with the ICILS main survey data collection in 2023 in Chile, data from Chilean schools are not included in this report. An additional data collection exercise has subsequently been conducted to support the reporting of national data within Chile.

2 Due to issues with the ICILS main survey data collection in 2023 in the Netherlands, data collected from schools in the Netherlands are not included in this report. Selected data from the Netherlands are provided as an appendix.

1.3 ICILS 2023 research questions

ICILS aims to investigate the extent of CIL and CT among grade 8 students and to examine how these learning outcomes are associated with students' backgrounds, developed attributes, experiences with using computer technologies, and learning about computer technologies.

The core student achievement measure of ICILS is CIL. Computational thinking is available as an optional additional measure. As a consequence, two sets of ICILS research questions (RQ) are presented relating to these two outcome measures, and the contexts in which CIL and CT are developed.

CIL

RQ CIL 1 What variations exist in students' CIL within and across countries?

RQ CIL 2 How is CIL education implemented across countries, and what aspects of schools and countries are related to students' CIL?

Following are some of the aspects of schools and education systems that could potentially be related to students' CIL:

(a) General approaches and priorities accorded to CIL education at system and school level

(b) School coordination and collaboration regarding the use of ICT in teaching

(c) School and teaching practices regarding the use of technologies in students' CIL

(d) Teacher proficiency in, attitudes towards, and experience with using computers

(e) ICT resources in schools

(f) Teacher professional development

(g) School leadership for technology

RQ CIL 3 How has CIL changed since ICILS 2013?

RQ CIL 4 What aspects of students' personal and social backgrounds (such as gender and socioeconomic background) are related to students' CIL?

RQ CIL 5 What are the relationships between students' levels of access to, familiarity with, and self-reported proficiency in using computers and their CIL?

CT

The proposed research questions relating to CT closely reflect those proposed for CIL. Analyses include data from those countries participating in the international option assessing students' CT.

RQ CT 1 What variations exist in students' CT within and across countries?

RQ CT 2 How is CT education implemented across countries, and what aspects of schools and countries are related to students' CT?

RQ CT 3 How has CT changed since ICILS 2018?

RQ CT 4 What aspects of students' personal and social backgrounds (such as gender and socioeconomic background) are related to students' CT?

RQ CT 5 What are the relationships between students' levels of access to, familiarity with, and self-reported proficiency in using computers and their CT?

RQ CT 6 What is the association between students' CIL and CT, and how has this changed since 2018?

1.4 The ICILS assessment framework

The contents and high-level operational procedures of ICILS 2023 are instantiated in the ICILS 2023 assessment framework (Fraillon & Rožman, 2024). The core of the assessment framework "outlines the design and content of the measurement instruments, sets down the rationale for those designs, and describes how measures generated by those instruments relate to the constructs" (Fraillon et al., 2024, p. 2).

The assessment framework includes the following sections that provide detailed information which may help understanding and interpretation of the findings presented in this report.

- Introduction: This includes details of the background and rationale for ICILS, an overview of policy developments and programs with respect to CIL and CT within selected ICILS countries, uses of ICILS data, and high-level information about the ICILS study design.
- The CIL framework defines and explains the structure and content of the CIL construct measured and addressed through the CIL test.
- The CT framework defines and explains the structure and content of the CT construct measured and addressed through the CT test.
- The contextual framework maps the context factors as they are anticipated to influence and explain variation in CIL and CT.
- The ICILS achievement and questionnaire instruments are described and explained with details of their structure, content, and the computer-based delivery environment.

Following are summary extracts of key aspects of the CIL framework, the CT framework and the contextual framework that were used as the basis for developing the ICILS assessments of CIL and CT and contextual questionnaires.

The CIL framework

The ICILS definition of CIL (see Figure 1.1) was established for use in ICILS 2013 and has been maintained for use in ICILS 2018 and 2023. The definition "relies on, and brings together, technical competence (computer literacy) and intellectual capacity (conventional literacies including information literacy) to achieve a highly context-dependent communicative purpose that presupposes and transcends its constituent elements" (Fraillon & Duckworth, 2024, p. 26).

The structure of the CIL construct comprises four strands that encompass the skills, knowledge, and understanding assessed by the CIL test instrument: *understanding computer use*, *gathering information*, *producing information*, and *digital communication* (Figure 1.1).

classified and mapped according to these classifications (see Table 1.2).

Figure 1.3: Contexts for ICILS 2023 CIL/CT outcomes

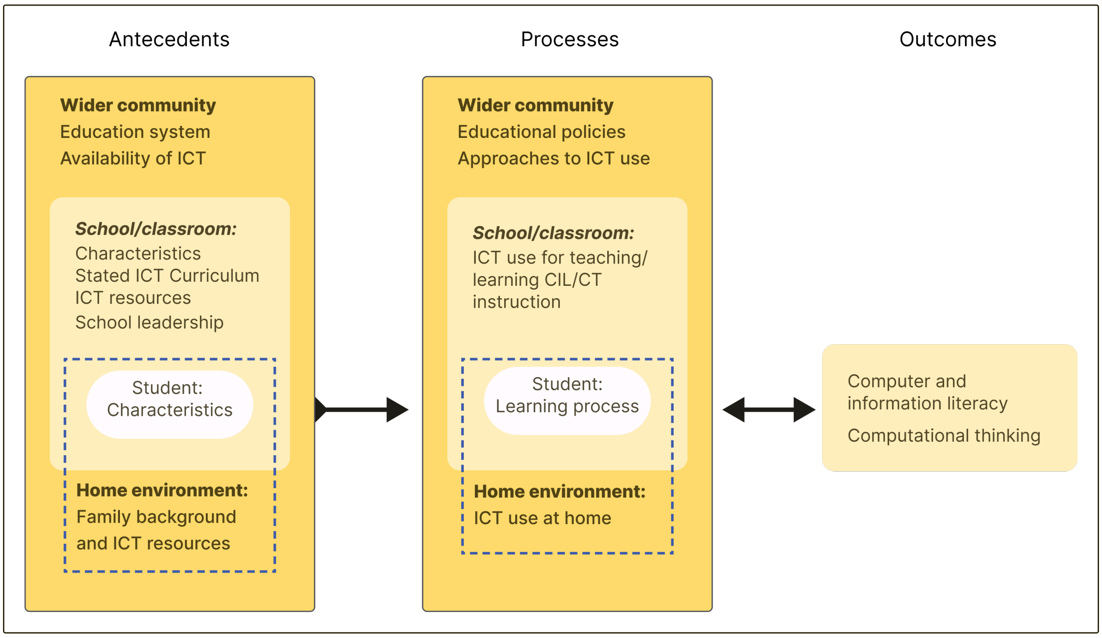

Table 1.2: Mapping of variables to contextual framework (examples)

Context level	Antecedents	Processes
Wider community	**Example antecedents** Structure of education Availability of ICT **Data sources** NCS, PQ, ICQ, and other sources	**Example processes** Role of ICT in curriculum Approaches to ICT use **Data sources** NCS, PQ, ICQ, and other sources
School/classroom	**Example antecedents** School characteristics ICT resources School leadership **Data sources** PQ, ICQ, and TQ	**Example processes** ICT use in teaching and learning CIL/CT instruction **Data sources** PQ, ICQ, TQ, and StQ
Student	**Example antecedents** Gender Age **Data source** StQ	**Example processes** ICT activities Use of ICT CIL/CT **Data source** StQ
Home environment	**Example antecedents** Parent socioeconomic status ICT resources **Data source** StQ	**Example processes** Learning about ICT at home **Data source** StQ

Data sources: NCS = national contexts survey; PQ = principal questionnaire; ICQ = ICT coordinator questionnaire; TQ = teacher questionnaire; StQ = student questionnaire.

achievement (and in the associations between CIL and CT) between ICILS 2018 and 2023. The chapter includes comparisons within and across countries of CIL and CT scale scores, and of the distributions of student achievement across the levels of the CIL and CT scales. Comparisons are made between CIL and CT achievement in ICILS 2023 and in previous cycles of ICILS.

Chapter 6 addresses CIL and CT Research Questions 4 and 5 with respect to variations in CIL and CT achievement that are associated with students' personal and social backgrounds, including their access to ICT resources. The chapter documents the achievement gaps associated with these key student background characteristics. Additionally, the chapter highlights that the size of performance gaps vary across countries, suggesting statistically significant disparities in the relationship between educational outcomes and social factors.

Chapter 7 addresses CIL and CT Research Question 5 with respect to students' engagement with ICT and associated variations in students' CIL and CT achievement. The chapter investigates and reports on students' use of digital devices, their perceptions about the use of computing technologies, and the circumstances of their learning about ICT. These contribute to an understanding of the broader context in which students develop CIL and CT. In addition, the chapter reports on the associations between these aspects of student engagement with ICT, and achievement in each of CIL and CT.

Chapter 8 discusses the themes emerging from the results of ICILS 2023. We reflect on the key findings relating to student achievement in CIL and CT, and with respect to student characteristics and engagement with ICT. The chapter includes reflections on the implications for policy and practice and suggests some future directions for research on CIL and CT education.

References

Cedefop. (2018). *Insights into skill shortages and skill mismatch: Learning from Cedefop's European skills and jobs survey*. Publications Office. http://data.europa.eu/doi/10.2801/645011

Ciarli, T., Kenney, M., Massini, S., & Piscitello, L. (2021). Digital technologies, innovation, and skills: Emerging trajectories and challenges. *Research Policy*, *50*(7), 104289. https://doi.org/10.1016/j.respol.2021.104289

COMEST, UNESCO. (2019). Preliminary study on the ethics of artificial intelligence. https://unesdoc.unesco.org/ark:/48223/pf0000367823.locale=en

Council of the European Union. (2018). Council recommendation on key competences for lifelong learning. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018H0604(01)

Duckworth, D., & Fraillon, J. (2024a). Computational thinking framework. In J. Fraillon & M. Rožman (Eds.), *IEA International Computer and Information Literacy Study 2023 assessment framework* (pp. 35–43). Springer. https://doi.org/10.1007/978-3-031-61194-0_3

Duckworth, D., & Fraillon, J. (2024b). ICILS instruments. In J. Fraillon & M. Rožman (Eds.), *IEA International Computer and Information Literacy Study 2023 assessment framework* (pp. 57–81). Springer. https://doi.org/10.1007/978-3-031-61194-0_5

European Commission. (n.d.). *EU science hub | DigComp*. https://joint-research-centre.ec.europa.eu/digcomp_en

European Commission. (2021). *Council resolution on a strategic framework for European cooperation in education and training towards the European Education Area and beyond (2021–2030)*. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021G0226(01)

European Commission and Directorate-General for Education, Youth, Sport and Culture. (2019). *Key competences for lifelong learning*. Publications Office. https://doi.org/10.2766/569540

Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Duckworth, D. (2020). *Preparing for life in a digital world: IEA International Computer and Information Literacy Study 2018 international report*. Springer. https://doi.org/10.1007/978-3-030-38781-5

Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Gebhardt, E. (2014). *Preparing for life in a digital age: The IEA International Computer and Information Literacy Study international report*. Springer. https://doi.org/10.1007/978-3-319-14222-7

Table 2.1: ICT infrastructure and selected economic characteristics of the ICILS countries

Country	Percentage of individuals using the internet in the past three months (2021)	ICT Development index score (and country rank) (2023)	Gross Domestic Product (GDP) per capita ($) (2023)	Income Gini coefficient (2022)	Public expenditure on education (% of GDP) (2022)
Austria	93	93 (23)	56,506	[A]0.31	4.8
Azerbaijan	86	79 (84)	7,155	[F]0.27	2.9
[1] Belgium (Flemish)	93	88 (42)	53,475	[A]0.27	[A]6.2
Bosnia and Herzegovina	76	77 (94)	8,426	[E]0.33	
Chile	89	91 (32)	17,093	0.43	[A]4.0
Chinese Taipei	86	[3]95	[4]32,444	[5]0.34	[6]4.9
Croatia	81	87 (47)	21,460	[A]0.29	[A]5.2
Cyprus	91	87 (43)	34,701	[A]0.31	[A]5.5
Czech Republic	83	86 (55)	30,427	[A]0.26	[A]5.1
Denmark	99	97 (4)	67,967	[A]0.28	[A]5.9
Finland	93	97 (6)	53,756	[A]0.28	[A]5.7
France	86	89 (35)	44,461	[A]0.32	[A]5.2
Germany	91	87 (44)	52,746	[B]0.32	4.5
Greece	79	84 (68)	22,990	[A]0.33	[A]4.1
Hungary	89	87 (53)	22,147	[A]0.29	[A]5.0
Italy	82	86 (54)	38,373	[A]0.35	[A]4.0
Kazakhstan	91	89 (37)	13,137	[A]0.29	4.2
Korea, Republic of	98	94 (18)	33,121	[A]0.33	[A]5.4
Kosovo	89		5,943	[D]0.29	
Latvia	91	94 (19)	23,184	[A]0.34	[A]5.6
Luxembourg	99	92 (25)	128,259	[A]0.33	4.7
Malta	88	87 (50)	37,882	[B]0.31	[A]5.4
Netherlands	92	94 (20)	62,537	[A]0.26	[A]5.1
Norway	99	91 (31)	87,962	[C]0.28	4.0
Oman	[B]95	91 (33)	23,295		4.2
Portugal	82	86 (59)	27,275	[A]0.35	[A]4.6
Romania	84	87 (51)	18,419	[A]0.34	[A]3.3
Serbia	81	85 (63)	11,361	[A]0.33	[A]3.3
Slovak Republic	89	87 (48)	24,470	[A]0.24	[A]4.3
Slovenia	89	88 (41)	32,164	[A]0.24	[A]5.7
Spain	94	91 (29)	32,677	[A]0.34	[A]4.6
Sweden	95	94 (17)	56,305	[A]0.30	[A]6.7
United States	97	97 (7)	81,695	0.41	5.4
Uruguay	88	87 (49)	22,565	0.41	4.4
Benchmarking participant					
[2] North Rhine-W. (Germany)	91	87 (44)	52,746	[B]0.32	4.5

Notes: Percentage of individuals using the internet, ICT Development index score, and country rank data were collected from the International Telecommunications Union. Source: http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx [07/03/2024]. Data on GDP per capita, Gini coefficient, and public expenditure on education were collected from the World Bank database (Indicators NY.GDP.PCAP.CD, SI.POV.GINI, SE.XPD.TOTL.GD.ZS, respectively). Source: https://data.worldbank.org/ [26/09/2024].

[1] Data relates to Belgium.
[2] Data relates to Germany.
[3] IDI estimate provided by the National Research Center in Chinese Taipei. Estimate based on data provided by the government of Chinese Taipei for the IDI indicators.
[4] GDP per capita was collected from International Monetary Fund database. Source: https://www.imf.org/external/datamapper/NGDPDPC@WEO/TWN [07/10/2024]
[5] Gini was collected from Statista database. Source: https://www.statista.com/statistics/922574/taiwan-gini-index/ [06/09/2024]
[6] Public expenditure on education provided by Department of Statistics of Ministry of Education in Chinese Taipei.
[ABCDEF] Data relates to the following years: (A) = 2021; (B) = 2020; (C) = 2019; (D) = 2017; (E) = 2011, (F) = 2005

Chapter 7:

Students' engagement with information and communications technologies

Mojca Rožman, Marlen Holtmann, and Sabine Meinck

Chapter Highlights

Behavioral engagement: Students' use of information and communication technology (ICT).

- Half of the students across countries had been using digital devices for at least 5 years. In most countries, the average computer and information literacy (CIL) and computational thinking (CT) scale scores of students using digital devices at least 5 years were significantly higher than of those with less experience (Table 7.1 and Table 7.2).
- ICT use is prevalent among students. Three out of four students across countries reported daily ICT use outside school for other (i.e., non school-related) purposes on school days and on non-school days (Table 7.3).
- On average across participating countries administering this question, more than half of the students reported having no screen time limit set by their parents on school days, and three-quarters reported this on non-school days (Table 7.4).
- Very frequent engagement in academic-media multitasking, a concept referring to the simultaneous digital engagement in academic tasks and media-related activities, was reported by more than two-thirds of the students on average across countries (Table D.1).
- General software applications (such as word processing software) are used more often in lessons than specialist classroom applications (such as simulation, or concept mapping software). There is considerable variation among countries in students' reported frequency of use of software applications in lessons (Table 7.7 and Table 7.8).

Cognitive engagement: Students' learning how to use ICT in and outside of school.

- More than half of students across countries reported having learned about ICT (such as organizing files, editing documents or presentations) and CT tasks (such as making diagrams that explain concepts, detect patterns in data) at school, with the exception of programming which was reportedly learned at school less than general ICT and CT activities (Table 7.10 and Table 7.11).
- Students reported having more opportunities to learn about internet related tasks, specifically about safe and responsible use, outside of school than at school (Appendix D, Table D.7 and Table D.9). There is substantial variation across and within countries regarding both these learning opportunities at and outside schools.
- At least two-thirds of the students reported they have learned about different issues regarding ICT use and health at school, on average across countries (Appendix D, Table D.11).

Emotional engagement: Students' perceptions of ICT.

- In all countries, there was a weak statistically significant correlation between students' ICT self-efficacy in using general applications and their performance in CIL and CT achievement, reaffirming the findings from earlier ICILS cycles (Table 7.15).

- Across all countries, over 80 percent of students tended to agree or strongly agree with statements highlighting the positive societal value of ICT. Yet, there was also a high level of agreement with statements reflecting potentially negative perceptions of ICT (Appendix D, Table D.19 and Table D.21).

7.1 Introduction

This chapter focuses on a subset of contextual information collected from grade 8 students during the International Computer and Information Literacy Study (ICILS) 2023, namely information on various types of student engagement with information and communication technology (ICT). We report on young people's experience with digital devices, their perceptions about the use of computing technologies, and the circumstances of their learning about ICT, at school, and outside school. We examine students' access to, familiarity with, and self-reported proficiency in using computers. For these topics, the current cycle of ICILS builds on the findings of the previous two cycles by maintaining the relevant measures of students' current use of ICT. However, ICILS 2023 has expanded on some topics that are also growing in importance. Specifically, we present measures related to digital citizenship (including cybersecurity, privacy, and online safety), digital footprint, and cyberbullying. We also shed light on the importance of understanding copyright and fair use, developing skills for critically evaluating online information, and maintaining mental and physical well-being in the context of ICT use. Through this analysis, we seek to provide an understanding of the factors that shape students' digital literacy and their ability to navigate the digital world responsibly and effectively.

In the ICILS 2023 assessment framework (Fraillon & Rožman, 2024), we distinguish between four contexts relevant for student learning: wider community, schools and classrooms, home environment, and the individual level. Further, the status of contextual factors within the learning process is important as well. Factors can be classified either as antecedents or processes.

Antecedents are contextual factors that are not directly influenced by learning process variables or outcomes. At the individual level these are, for example, learner characteristics (such as socioeconomic status). These have already been described and presented in detail in Chapter 6. Processes are those factors that directly influence computer and information literacy (CIL) and computational thinking (CT) learning and may be constrained by antecedents and factors at higher levels. In ICILS 2023, processes included variables such as students' reported activities in class associated with CIL/CT learning in the classroom, and students' use of computers at home. In this chapter, we focus on student-level and school/classroom level processes represented by students' engagement with ICT.

We address Research Question 5 for CIL and CT: *What are the relationships between students' levels of access to, familiarity with, and self-reported proficiency in using computers and their CIL/CT?*

The chapter begins with a brief description of forms of engagement with ICT and how engagement was measured in ICILS. This is followed by the presentation of findings on the following aspects of student engagement and partly also their relationship with achievement:

- Behavioral engagement: Students' use of ICT
- Cognitive engagement: Students' learning how to use ICT in and outside of school
- Emotional engagement: Students' perceptions of ICT

The ICILS 2023 data reported in this chapter include 32 countries and one benchmarking participant, North Rhine-Westphalia (Germany). Twenty-two of these countries and the benchmarking participant conducted the CT assessment. The averages reported in this chapter are calculated based on the countries that met sampling participation requirements, excluding Romania because of late testing. When statements are made describing the data in this chapter, the term "countries" refers to the countries and benchmarking participant that met the ICILS sampling requirements. See Chapter 1 for further details.

Addendum Ad:

Principals' reports on the use of generative AI tools in schools: ICILS 2023 international option

Julian Fraillon

Ad.1 Introduction

Artificial intelligence (AI) began as a field of study in 1956 (Anyoha, 2017; Wadsworth et al., 2024). While chatbots have existed in various forms since the second half of last century, 2 months after the launch of ChatGPT on 30 November 2022, the generative AI tool had 100 million users (Sabzalieva & Valentini, 2023). The associated rapid development of widespread recognition of, interest in, and use of generative AI around this time resulted in us deciding to include, as an option for countries, a set of questions to collect information about school principals' responses to the introduction of generative AI tools (such as ChatGPT), and principals' beliefs about the potential impact of the use of generative AI tools on the work of teachers and students. The decision to include content at such a late stage of the study, and outside the conventional development practices of the study, was seen as an appropriate and nimble response to the very sudden and dramatic rise to prominence of generative AI tools. We felt that it would be remiss of ICILS 2023 not to offer countries the opportunity to collect such data at the beginning of this potentially significant period of development in the use of generative AI technology in schools, although we also were aware that data collection would not be feasible in all countries.[35]

The ICILS student, teacher, ICT coordinator and principal questionnaires were finalized and made available for translation to ICILS countries in late 2022 around the same time as ChatGPT was launched. The optional questionnaire content was made available to countries in mid-2023, after the main ICILS data collection had been completed in Northern Hemisphere countries and before it had begun in Southern Hemisphere countries. The decision to limit data collection to school principals was primarily made to minimize the operational burden on countries. Principals across 12 ICILS countries completed the optional questions.

In the Northern Hemisphere countries that were able to participate (Chinese Taipei, Cyprus, Denmark, Greece, Norway, Romania, the Slovak Republic, Slovenia, and Sweden), the additional questionnaire data were collected from principals of the sampled schools using an additional questionnaire in the second half of 2023, following the summer vacation period. In all countries except Romania,[36] this corresponded to the beginning of the school year following the school year in which the ICILS data main survey data were collected. In the countries using the Southern Hemisphere school calendar (Korea (Rep. of), Uruguay, and Chile[37]), the additional questions relating to the use of generative AI in schools were administered as part of the principal questionnaire.

Please note, as in Chapter 2, we report the principals' response data as estimates of the national percentages of students derived from the schools where the principals have responded. For the Northern

35 Factors such as staffing and financial resources, contractual agreements and obligations, approval processes, operational procedures, and predetermined timelines, affected the feasibility of the additional data collection across ICILS countries.

36 ICILS main survey data were collected in Romania in the first half of the 2023/24 school year.

37 Due to issues with the ICILS main survey data collection in 2023 in Chile, data from Chilean schools are not included in this report. An additional data collection exercise has subsequently been conducted to contribute the reporting of national data within Chile.

Hemisphere countries (except Romania), the estimated percentages of the number of students in the schools were calculated using the school sample data from the school year before the principals provided their responses. This information should be taken into account when interpreting the results presented in this addendum.

Ad.2 Principals' reports about the use of generative AI tools in schools

Principals responded to a series of questions addressing their experience with and use of generative AI tools, the existence of policies and plans for the use of generative AI in their schools, and their beliefs about the impact of the use of generative AI tools on students and teachers. Given that, at the time of administration, generative AI tools were potentially relatively new to many school principals, we included support information to define generative AI tools for principals. In the questionnaire we referred to the use of "ChatGPT or similar tools" because, at the time of administration, ChatGPT was the most widely known and recognized generative AI tool.

In the introduction to the questions, principals were provided the following information to help them to consider their responses:

In the past year, artificial intelligence tools that analyze and generate text have become readily accessible for use on the internet. At present, the best-known example of these tools is ChatGPT. This set of questions relate to the knowledge of, and approach to managing and using such tools in your school. The phrase 'ChatGPT or similar tools' is used throughout the questions to refer to artificial intelligence tools that analyze and generate text.

Principals' use of generative AI

In order to determine the degree to which generative AI was in the consciousness of principals, they were first asked to indicate how often they used ChatGPT or similar tools for work-related and for non-work related purposes. Principals could select from a set of six frequencies ranging from never to more than once a day. On inspection of the data, we chose to report three categories of frequency: never, less than weekly, and weekly. This already suggests that we found that relatively few principals were reporting very frequent use of generative AI tools.

On average, across all countries, principals in schools accounting for 50 percent of students reported that they never use ChatGPT or similar tools for work-related purposes, and principals in schools accounting for 41 percent of students reported that they use these tools less than weekly (Appendix I, Table I.1). The corresponding percentages with respect to the use of ChatGPT or similar tools for non-work-related purposes were 49 percent (never) and 42 percent (less than weekly). While there was some variation in the reported frequencies of use across countries, overall, it can be observed that the use of generative AI was reported to be somewhat infrequent by principals. The highest reported frequency by principals of weekly use for work-related purposes was in schools accounting for 17 percent of students in each of Cyprus and Romania. Chinese Taipei (16%), Korea (Rep. of) (16%), and Uruguay (15%) are the only three other countries in which this was reported by principals in schools accounting for more than 10 percent of students.

Generative AI in school policies and curriculum

Principals responded to a series of questions examining the degree to which generative AI was being included or referenced in policies (or policy planning) and curriculum in their schools. Given the recency with which generative AI tools had become so broadly accessible to schools at the time of data collection, we assumed that across many schools there would not yet have been time for generative AI to have been included in policies and curriculum. These data were collected, in part, with a view to being baseline measures that can be compared to data collected in the future as the use of generative AI in schools develops and matures.

Below is a summary of the topics covered in the questions asked of principals with respect to the inclusion of generative AI in the policies and curriculum in their schools.

Appendix A:

Sampling information and participation rates

Table A.1: Coverage of ICILS 2023 target population

Country	International target population coverage (%)	Exclusions from target population (%)			
			Within sample		
		At school level	All reasons	Estimated due to language issues*	Overall
Austria	100	2.1	5.4	2.8	7.6
Azerbaijan	100	1.9	0.3	0.0	2.2
Belgium (Flemish)	100	1.4	1.3	1.0	2.7
Bosnia and Herzegovina	61	3.9	1.2	0.0	5.2
Chinese Taipei	100	0.3	1.8	0.1	2.1
Croatia	100	0.6	5.2	0.9	5.8
Cyprus	100	0.9	2.0	0.9	2.9
Czech Republic	100	3.0	3.1	2.7	6.2
Denmark	100	3.7	3.2	0.1	6.8
Finland	100	1.3	2.8	1.3	4.2
France	100	3.0	1.8	0.7	4.8
Germany	100	1.6	2.3	1.8	3.9
Greece	100	0.7	2.3	1.2	3.0
Hungary	100	2.4	2.1	0.6	4.5
Italy	100	0.8	3.8	0.0	4.7
Kazakhstan	100	2.2	4.0	3.2	6.1
Korea, Republic of	100	1.7	1.5	0.4	3.2
Kosovo	100	4.9	1.6	1.0	6.5
Latvia	100	5.7	4.0	2.3	9.7
Luxembourg	100	3.6	1.4	0.8	5.0
Malta	100	1.4	2.8	0.1	4.2
Netherlands	100	4.5	0.9	0.1	5.4
Norway (Grade 9)	100	1.9	4.4	0.0	6.3
Oman	100	1.1	0.8	0.1	1.9
Portugal	100	6.2	2.1	1.0	8.2
Romania	100	3.8	3.4	1.2	7.2
Serbia	100	3.8	2.8	2.4	6.6
Slovak Republic	100	0.6	2.8	1.4	3.3
Slovenia	100	2.8	3.5	1.2	6.3
Spain	100	1.3	4.5	1.9	5.8
Sweden	100	1.6	7.1	2.3	8.7
United States	100	0.0	3.5	1.0	3.5
Uruguay	100	0.9	1.2	0.0	2.2
Benchmarking participant					
North Rhine-W., Germany	100	1.7	2.0	1.6	3.7

Notes: Results are rounded to one decimal place.
* Exclusion due to language issues could be due to immigrants, refugees, or minority languages. The 0.0 means that no (or only very few) students were listed as excluded for language issues or that the country did not use this exclusion category and students with language issues could have been reported in other exclusion categories.

Appendix K:

Organizations and individuals involved in ICILS 2023

International study center

The international study center is located at the International Association for the Evaluation of Educational Achievement (IEA). Center staff at IEA are responsible for designing and implementing the study in close cooperation with the National Research Coordinators (NRCs) in ICILS 2023 participating countries.

IEA is also responsible for coordinating and implementing ICILS. IEA Amsterdam, the Netherlands, is responsible for membership, translation verification, quality control monitoring, and publication. IEA Hamburg, Germany is mainly responsible for field operations, sampling procedures, and data-processing, scaling, analysis, and reporting.

Staff at IEA Amsterdam

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