IEA International Computer and Information Literacy Study

Progress report for IEA General Assembly 2016

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1 Study Overview

1.1 Introduction

The IEA International Computer and Information Literacy Study 2018 (ICILS 2018) will measure computer and information literacy (CIL) and computer use in Grade 8 (or its national equivalent) students across countries. It will also collect information about contexts (at the student, school and system level) in which CIL is developed. Computer and information literacy refers to an individual's ability to use computers to investigate, create, communicate and solve problems in order to participate effectively at home, at school, in the workplace and in the community.

ICILS 2018 is the second cycle of ICILS. As such, it provides the opportunity for countries that participated in ICILS 2013 to compare selected data with those collected in 2013.

As a result of interest expressed by ICILS countries and as a reflection of recent developments in CIL-related education, ICILS 2018 also includes an assessment of computational thinking (CT) as an international option.

The ICILS international consortium and ICILS National Research Coordinators have considered two approaches to accommodate the inclusion of the CT international option in the conceptual frame of the study that will ultimately be expressed in the ICILS 2018 assessment framework:

i. Maintaining the definition of CIL used in ICILS 2013 and including CT as a separate parallel entity to CIL; or

ii. Modifying the definition of CIL to account for the inclusion of CT as one of two achievement measurement dimensions (accepting that measurement and reporting of CT is an international option).

This issue was discussed in detail at the second and third meetings of ICILS National Research Coordinators (in February and September 2016, respectively). The recommendation from the September 2016 meeting was to adopt the second approach.

According to this approach the definition of CIL used in the ICILS 2013 assessment framework will be broadened to include *aspects of computational thinking,* and the measurement scale described as CIL in 2013 will be referred to as digital information literacy (DIL) in 2018. Computational thinking (CT) will be included as a second (international option) achievement construct.

1.2 ICILS international core research questions and instruments

1.2.1 Research questions

The ICILS international core study is framed by the following research questions.

RQ 1 *What variations exist across countries, and within countries, in student digital information literacy and what changes have occurred in student digital information literacy between 2013 and 2018?*

This research question concerns the distribution of digital information literacy outcomes across participating countries (at the country level) and within these countries. Analyses that address this question focus on the national means and national distributions of digital information literacy and comparisons of those statistics between countries. It is hypothesized that there will be differences within and among countries in digital information literacy. It is further hypothesized that student digital information literacy will have increased between 2013 and 2018.

RQ 2 *What aspects of schools and education systems are related to student achievement in digital information literacy?*

Data relevant to this question will be collected at the national level on curriculum and programs as well as at the school level through teacher, ICT-coordinator and principal questionnaires. Some of the aspects of schools and education systems hypothesized to be related to digital information literacy are:

a) General approaches, and priorities accorded, to digital information literacy education at system and school level.

This aspect of the research question refers to the context for digital information literacy-related learning at the system level as well as more detailed contexts in schools.

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

It is hypothesized that stronger coordination and higher levels of collaboration regarding ICT use will be related to the purposeful teaching about and with ICT, and this will be reflected in the extent to which students develop digital information literacy.

c) School and teaching practices regarding the use of technologies in digital information literacy.

It is hypothesized that greater emphasis on the development of digital information literacy when students are using ICT will be related to the extent to which students develop digital information literacy. It is also hypothesized that the use of some types of ICT application will support development of digital information literacy more than others.

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

It is hypothesized that digital information literacy will be greater in schools where teachers are more confident in using computer technology, have more positive dispositions towards the use of computer technologies in education, and have more extensive experience of pedagogical computer use.

e) ICT resources in schools.

It is hypothesized that digital information literacy will be greater in schools where students and teachers reported higher levels access to ICT resources in schools.

f) Teacher professional development.

It is hypothesized that digital information literacy will be greater in schools where there is greater access to, and participation in, professional learning opportunities in digital information literacy (including within-school opportunities).

RQ 3 *What characteristics of students' levels of access to, familiarity with, and self-reported proficiency in using computers are related to student achievement in digital information literacy?*

It is hypothesized that students who have higher levels of self-reported proficiency in the use of computer technology, are more frequent users of computer technologies and have longer experience of computer use will have higher levels of digital information literacy. It is also hypothesized that the strengths of the relations between these characteristics and measured digital information literacy will differ among countries.

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

It is hypothesized that students who have more advantaged social backgrounds will have higher levels of digital information literacy and that girls will have higher levels of digital information literacy than boys.

1.2.2 Core instruments

In total, ICILS comprises six international core instruments.

1 Student test of digital information literacy

Each student will complete two 30-minute test modules (randomly allocated from a larger pool of test modules). The modules include authentic computer-based information literacy, management and communication tasks in a controlled online environment.

In ICILS 2013 there were four assessment modules. One was released for use in the international report and other publicly available information about the project. The three remaining modules have been held secure for use in ICILS 2018 and will be used as the basis for comparing student CIL achievement in 2018 with results from 2013. For ICILS 2018 we are developing two new modules to assess the same aspects of CIL that were assessed in 2013. In addition to providing a replacement of the released test module, these new modules incorporate more recent developments in user contexts (such as social networking) into the ICILS assessment suite.

2 Student questionnaire

The student questionnaire will be computer-based and be incorporated as part of the assessment software so that students move seamlessly from the assessment to the questionnaire. It will comprise questions about aspects of students' background, their use of computer technology and attitudes towards the use of computer technology.

3 Teacher questionnaire

The online teacher questionnaire will ask about teacher use of computers at school and outside school and about self-reported competency in using computers.

4 & 5 School questionnaires

The online school questionnaires are to be completed by the school principal and the ICT-Coordinator at the school. These will ask about computing resources and policies and practices regarding the use of information technologies at the school, as well as school characteristics.

6 National contexts survey of DIL education

The on-line national context survey will collect information on participating education systems, including policies, initiatives, infrastructure resources and practices relating to DIL education in schools.

1.3 Computational thinking as an international option

Computational thinking is the style of thinking used when programming a computer or developing an application for another type of digital device. However, its usefulness extends beyond this. The reasoning strategies that underlie computational thinking can help make sense of complex ideas and solve problems.

Computational thinking, when directed at a problem, includes the activities of formulating, representing and analyzing, which contribute to solving a problem efficiently. In ICILS 2018 computational thinking comprises five aspects organized into two strands. These strands and their specific aspects are listed below.

Strand CT1: Conceptualizing problems

- Aspect CT1.1: Knowing about and understanding computer systems
- Aspect CT1.2: Formulating and analyzing problems
- Aspect CT1.3: Collecting and representing relevant data.

Strand CT2: Operationalizing solutions

- Planning and evaluating solutions
- Developing algorithms, programs and designs.

All countries participating in ICILS 2018 will have student achievement reported on the DIL achievement scale established in ICILS 2013[1]. For countries that participate in the computational thinking international option, we plan to report student achievement in computational thinking on a new and separate computational thinking achievement scale.

1.3.1 Research questions regarding the study of computational thinking

The computational thinking research questions are modelled on those used for digital information literacy with the addition of a fifth research question relating to the relationship between achievement in digital information literacy and computational thinking.

RQ CT1 *What variations exist across countries[2], and within countries, in students' achievement in computational thinking?*

This research question concerns the distribution of computational thinking outcomes across participating countries and within these countries. Analyses that address this question focus on the national means and national distributions of computational thinking and comparisons of those statistics between countries.

RQ CT2 *What aspects of schools and education systems are related to student achievement in computational thinking?*

This question focuses on the way in which computational thinking is implemented in the curriculum with and across[2] participating countries and how differences in implementation may be associated with differences in computational thinking outcomes. Data relevant to this question will be collected at the national level on curriculum and programs as well as at the school level through teacher, ICT-coordinator and principal questionnaires. A small number of questions relating specifically to the teaching of computational thinking have been added as an international option to the teacher questionnaire. It is hypothesized that specialized resourcing for and teaching of computational thinking will be positively associated with computational thinking achievement outcomes.

RQ CT3 *What characteristics of students' levels of access to, familiarity with, and self-reported proficiency in using computers are related to student achievement in computational thinking?*

It is hypothesized that students who have higher levels of self-reported proficiency in the use of computer technology, are more frequent users of computer technologies and have longer experience of computer use will have higher levels of computational thinking.

RQ CT4 *What aspects of students' personal and social backgrounds (such as gender and socioeconomic background) are related to computational thinking?*

It is hypothesized that students who have more advantaged social backgrounds will have higher levels of computational thinking and that boys will have higher levels of computational thinking than girls.

[1] Referred to as the CIL achievement scale in ICILS 2013

[2] The viability of the investigation related to this research question will depend on the number and profile of countries participating in the CT option in ICILS 2018.

RQ CT5 *What relationship exists within students between digital information literacy and computational thinking?*

This research question focuses on the relationship, in those countries completing the computational thinking option, between student achievement in computational thinking and digital information literacy. It is hypothesized that there will be a high positive association in student achievement between the two constructs. Although the two constructs are different, they share a core of being computer-based and most likely both are positively associated with general academic achievement.

1.3.2 Computational thinking instruments and assessment design

Each student will complete two 30-minute computational thinking test modules *after* they have completed the ICILS core test and questionnaire. The modules are delivered using the same system used for the core test and questionnaire. The computational thinking modules require students to complete a set of tasks based on real-world scenarios in which a computer system automates or controls a sequence of processes. The tasks assess the computational thinking content listed in the previous section. In broad terms, students complete tasks requiring them to recognize the potential for computer applications to help real-world problems, plan solutions to problems, and implement solutions both as broad algorithms (as expressions of logical sequencing of ideas and actions) and through the use of a visual code system that allows for commands to be executed in specified sequences. ICILS does not presuppose that students are familiar with the syntax and features of any particular coding language, and it also avoids dependence on any given language by focusing on the logical reasoning that underpins the development of algorithms and code to solve problems.

The student questionnaire contains three questions as international options (comprising roughly 25 items in total) relating to students' experiences of learning aspects of computational thinking at school and students' self-efficacy relating to tasks associated with computational thinking. These questions are completed by students at the end of the student questionnaire (i.e. before they complete the test of computational thinking).

The ICILS international core teacher and school questionnaires have some items associated with teaching practices and resources associated with computational thinking that may be used both to help develop a profile of computational thinking-related education across all ICILS countries but also as potential school-level predictors of computational thinking achievement in countries that complete the international option.

2 Progress report

2.1 Country participation

At the time of writing, the following fourteen educational systems have confirmed participation in ICILS 2018: Alberta (Province of Canada), Chile, Denmark, Finland, France, Germany, Italy, Kazakhstan, Korea, Luxembourg, Moscow (region of the Russian Federation), Portugal, Uruguay and the United States of America. Participation in the computational thinking international option has thus far been confirmed by Germany, Luxembourg and the United States of America.

2.2 ICILS 2018 second meeting of National Research Coordinators

The second meeting of ICILS 2018 National Research Coordinators was held in Amsterdam, the Netherlands, from 15 to 18 February 2016. At this meeting National Research Coordinators provided feedback on proposals for development of the ICILS assessment framework and on the contents of all instruments proposed for use in ICILS 2018. National Research Coordinators were also introduced to the assessment software system being developed for ICILS 2018, received information (in broad terms) about the key instrument preparation and operations procedures for the field trial, and had the opportunity to participate in interviews with the IEA DPC to discuss sampling and field operations.

At the time of this meeting, the IEA had not yet confirmed whether the computational thinking international option would proceed. However, in order to ensure that the development of the computational thinking international option was still viable once confirmed, the assessment framework discussion paper included proposals for how the framework could be structured to include computational thinking and three draft computational thinking assessment modules were presented for discussion.

2.3 Instrument development and assessment framework refinement

An intensive period of instrument development and assessment framework refinement began immediately after the second meeting of National Research Coordinators.

Following the meeting, the IEA confirmed that the computational thinking international option would proceed, and consequently development proceeded on two assessment modules and questionnaire content related to computational thinking.

Each of the questionnaire instruments was revised on the basis of feedback from the meeting and the proposed test module contexts were altered with consequent changes to the module contents.

In March–April 2016 the revised test instruments (including computational thinking) were made available to National Research Coordinators for another round of feedback. The instruments were further revised on the basis of this feedback, although these revisions were not as extensive as those following the February meeting. In June/July 2016 the revised questionnaires were made available to National Research Coordinators for review. Based on their feedback, numerous changes were made to the field trial draft questionnaires.

In May 2016, small-scale pilots of selected student test modules and the student questionnaire were conducted in Australia and the USA. In September 2016 similar pilots were conducted in Germany (using German-language translations of the source instruments). In these pilots, students completed two digital information literacy (international core) test modules and the questionnaire in a 'think aloud' format where students were encouraged to raise any issues they had as they worked through the contents. Students provided feedback on both the technical functioning of the assessment delivery system and on the contents of the test modules and questionnaire. This information was used to further refine the content and functionality of the instruments.

2.4 ICILS 2018 third meeting of National Research Coordinators

The third meeting of ICILS 2018 National Research Coordinators was held in Oporto, Portugal, from 5 to 9 September 2016. This was the final meeting of National Research Coordinators prior to the ICILS field trial. The main purpose of the meeting was to give National Research Coordinators the opportunity to provide final feedback on the draft instruments prior to the field trial. National Research Coordinators were presented with a preliminary draft version of the ICILS assessment framework (including integration of computational thinking) and final draft versions of all ICILS instruments for discussion.

Feedback from the meeting has informed the final revision of the field trial instruments. These are scheduled for release to countries on 1 November 2016.

National Research Coordinators were also provided details of planned field operations procedures for the field trial for consideration and comment. This included details of the software systems being developed by the IEA Data Processing and Research Center for ICILS.

2.5 Software development

Development of the computer-based assessment software, the IEA eAssessment System, has progressed throughout 2016. The system will be used for the student test delivery and also for the administration of contextual questionnaires. A variation of this system was already used successfully for ePIRLS and will also be applied in the context of eTIMSS 2019 and OECD TALIS 2018.

It consists of an item/question building and assembly module, a translation and adaptation module with full preview options, a delivery module (online for contextual questionnaires, Windows-based for student materials in the so called “ICILS Player”), a data viewer module (“Monitor”) to keep track of the administration progress, and finally a scoring and coding module. This system is currently being revised to incorporate additional features to allow for the administration of the ICILS instruments.

A total of seven test modules (three trend DIL modules, two new DIL modules and two computational thinking modules) have been created for delivery in the eAssessment System during 2016; two modules had been developed earlier so that they could be used in the pilot testing (described earlier). All questionnaire materials have also been prepared for delivery in the eAssessment system.

2.6 Next steps

The ICILS field trial instruments will be released to countries on 1 November 2016 for adaptation, translation and verification. The focus of the final months of 2016 and beginning months of 2017 will be on the preparation of instruments and field operations for the ICILS field trial. The field trial is scheduled to take place in countries between March and May 2017.

Critical to a successful implementation of the field trial is the Field Operations and Scorer Training meeting. At this meeting participants will be trained in all aspects of field operations for the field trial. This meeting is hosted by the IEA DPC and will take place from 7 to 11 November 2016 in Hamburg, Germany.

Attachment 1: Summary Timeline for ICILS 2018

Following is a timeline of the major milestones in ICILS 2018.

Milestone	Proposed Period or Date
Recruit countries and preliminary work	January 2015 to November 2017
NRC Meeting 1 (initial discussion)	*March 2015*
Initial framework refinement	March 2015 to November 2015
Initial instrument development	August 2015 to February 2016
NRC Meeting 2 (framework and draft instrument review)	15 to 19 February 2016, Amsterdam, the Netherlands
Field trial instrument development	March to October 2016
NRC review of draft instruments	March to May 2016
Piloting in selected countries	May, September 2016
NRC Meeting 3 (review of FT material)	*5 to 9 September, 2016 Oporto, Portugal*
Field trial instrument release	November 2016
Field trial training seminar	7 to 11 November 2016, Hamburg, Germany
Field trial preparations	November 2016 to February 2017
Field trial implementation	March to May 2017
Field trial analysis	June to Aug 2017
NRC Meeting 4 (main survey item selection)	*11 to 15 September 2017, Berlin, Germany*
Finalization of main survey instruments	September to November 2017
Main survey training seminar	*November 2017*
Main survey instruments release	November 2017
Main survey preparations	November 2017 to March 2018
Main survey implementation (northern hemisphere)	February to April 2018
National contexts survey (northern hemisphere)	July to October 2018
National contexts survey (southern hemisphere)	September to November 2018
Main survey implementation (southern hemisphere)	September to November 2018
Data compilation and analysis	June 2018 to March 2019
Report development and database preparation	December 2018 to October 2019

Milestone	Proposed Period or Date
NRC Meeting 5 (review of reports)	*June 2019*
International Report release	November 2019
Technical Report release	March 2020
International Database training	*March 2020*