The IEA International Study of Computer and Information Literacy (ICILS)

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Introduction

Rationale

Recent decades have witnessed the development and pervasive implementation of computer and other information technologies throughout societies across the world. There is consensus that the exchange and transformation of knowledge through information technologies is a feature of modern societies. Information technologies provide the tools for the creation, collection, storage and use of knowledge as well for communication and collaboration (Kozma, 2003). The development of these technologies has changed the environment in which students develop skills for life, the basis of many occupations and the way a number of social transactions take place. Knowing about, understanding, and using, information technologies has become important for life in modern society and its assessment has become a component of monitoring student achievement in many educational systems. In this proposal this set of knowledge, understanding and skills is referred to as computer and information literacy.

Many countries that have recognised the importance of education and training in information and communications technologies (ICT), which subsumes computer technology, so that citizens can access information and participate in transactions through these technologies. In the United Kingdom, the Qualifications and Curriculum Authority asserts that ICT "is an essential skill for life and enables learners to participate in a rapidly changing world" (QCA 2007). In the United States, the National Literacy Act includes the ability to use computers in its definition of literacy and many states have programs to monitor student ICT literacy (Crawford & Toyama 2002). In Australia the national goals for schooling characterise successful learners as being "creative and productive users of new technologies, especially ICT" (MCEETYA 2008). It is interesting to note that, in an international context where the importance of ICT- related literacies is universally acknowledged and widely regarded to be increasing (Blurton 1999, Kozma 2003), there is large variation between (and even within) countries of explicit ICT curriculums, resources and teaching approaches (ETS 2002, Mullis et al. 2004, OECD 2005). Consistent with and parallel to this variety of approaches to ICT literacy education is the finding reported by Thompson and De Bortoli (2007) that in Australia (which is a country with high computer access and use in schools by international standards) only 24 percent of 15 year-old students report that they learn most about how to use computers *at school* (compared to from friends, family, themselves or other). One of the larger aims of this proposed study is to develop a uniform framework and empirically based set of outcome standards that could help to inform and guide policy and bring coherence to an area of learning that is of increasing international significance.

The place of computer and information literacy in relation to traditional disciplines

In some senses computer and information literacy is analogous to reading literacy in that it is both an end and a means in school education. At school young people learn to use ICT and they use ICT to learn. ICT is used as the basis for instructional delivery systems to increase skills and knowledge in other learning areas; as a tool for accessing resources, communicating, analysing or conducting simulations. However, education systems also intend that students can develop ICT skills and knowledge and understand the role of ICT in learning, work and society.

The use of ICT in schools for discipline-based instruction and to develop computer and information-based skills and understandings has led to two approaches to the measurement of computer-based achievement. One approach is to measure learning area-specific achievement of computer use, such as online reading or the use of ICT to solve mathematics or science-based problems. This approach typically presupposes that ICT achievement is inseparable from subject-based achievement. The second approach is to measure ICT achievement as a discrete learning area. This approach assumes that ICT achievement is transcends individual disciplines and comprises a set of knowledge skills and understandings that can readily be transferred and adapted to new contexts.

The proposed international computer and information literacy study (ICILS) adopts the second approach. The broad conceptual aim of the study is to examine the outcomes of student computer and information literacy (CIL) education across countries.

The two primary justifications for researching CIL as integrating and transcending individual learning areas are conceptual and practical. At a conceptual level CIL-related literacies increasingly are being regarded as a broad set of generalisable and transferable knowledge, skills and understandings that are used to manage and communicate the cross-disciplinary commodity that is *information*. The integration of information and process through CIL is seen to transcend the application of computer technologies within any single learning discipline (see for example Audunson, 2003, ETS, 2002, Markauskaite, 2007 and Amtmann & Poindexter, 2008). This can be compared to online assessments of discipline-specific learning areas, such as online reading, writing, mathematics or science.

The critical conceptual difference between online assessments of discipline-specific learning areas and a CIL assessment is that the latter measures students' ability to use computers to manage and communicate information whereas in discipline based assessments the computer is used as a vehicle for students to express their discipline-specific knowledge, understanding and skills. For example, assessments of online reading focus on students' capacity to make sense of text by locating and interpreting information within the electronic text. Items may focus on specific details, themes, main ideas, nuance and authorial purpose and techniques evident in the text. The text is the primary information source and is understood to be deliberately crafted in order to communicate ideas. In CIL a written text must of course be read in order for students to be able to make sense of it however, texts will typically be one of many information sources that students need to consider with a larger purpose in mind. At a practical level a written text in a CIL assessment is likely to have been "located" (searched for and/or identified) by the student as one of many possible information sources relating to a larger research question or proposition. Receptive items relating to students' "reading" of a text in CIL focus on the likely trustworthiness and accuracy of the information and by necessity requires students to be aware of the role of the text as a vehicle to promote an author's potential agenda. CIL items do not focus on the detailed reading of the text in the same way that electronic reading items do. Students' capacity to "read" texts in CIL is evident only in the way in which students use information in the texts for a communicative purpose. Criteria relating to information use (that by inference relate to students' capacity to have made sense of electronic texts) focus on the ways in which students have selected and made use of (synthesised) the key ideas and information in the source texts. It is at the point where the reading of electronic texts combines with the necessity to synthesise and communicate information within a computer-based (hardware, software) context for a particular audience and purpose that CIL *transcends* the conventional literacies and computer literacy that underpin it.

The difference between CIL and electronic reading is equally relevant to the learning areas of mathematics and science. In mathematics for example, computer technologies are frequently used to draw graphs of data or functions or to rotate shapes in 3-dimensional space. Items relating to computer related mathematical literacy may for example require students to plot multiple functions for the purpose of determining the points at which the graphs of the functions intersect (are "equal") or to rotate a shape in space to determine how it appears from different perspectives. In these cases the computer technology is used as a tool for students to demonstrate their understanding of underlying mathematical concepts. In CIL students may be presented with a table of data and asked to draw a chart for the purpose of including the data in a report. At a basic level the student may be assessed on their capacity to apply the necessary software commands. The student is likely also to be required to make use of the data as part of an information product. In CIL the student's use of the data may be assessed in terms of how it is presented in the information product, whether it is presented with appropriate labelling conventions, whether there is sufficient text to explain the place and role of the data in the information product. In CIL the data or chart are information commodities that need to be used for a purpose rather than tools for the expression of understanding of mathematical concepts.

Computer technologies provide two immediate opportunities for computer-based science assessment: one is to use multimedia technology to demonstrate the physical manifestations of a scientific concept (such as colour change or precipitation as evidence of a chemical reaction); the second is to provide software that students can use to help conduct investigations or generate data. The first opportunity provides the advantage of demonstrating complex change without the need for text to describe the change. This can reduce the reading load of science stimuli. The second opportunity provides a potentially efficient and safe way for students to complete scientific observations from which they may draw conclusions. In a computer-based science assessment students may be asked, for example, to use simulation software to manipulate independent variables such as sunlight and water and monitor their influence on the growth of plants. In such a science assessment the students would be assessed on their capacity to determine a systematic way in which to manipulate the variables so that meaningful conclusions can be made about the influence of water and light on plant growth. In a CIL assessment students would not be expected to express understanding of scientific reasoning through the manipulation of variables. Were students required to use the simulation software they would be required to follow instructions about what to change (rather than deciding what to change) and may be assessed on their capacity to use the software accurately. Students may also be provided with unambiguous experimental data and required to make use of it as part of an integrated information product. In a CIL assessment the students would be assessed on their capacity to select the relevant aspects of the information, and to incorporate them in a larger information product. As for the examples of reading and mathematics, in CIL the focus on any science-related information is on the students' capacity to use the scientific information as a commodity rather than as an expression of their understanding of specific science-related concepts.

At a practical level, ICILS offers the unique opportunity for countries to capture information on the outcomes of CIL education without the restriction of CIL to the context of a single learning area. The integration of contexts within CIL provides both efficiency (by collecting data through a single study rather than multiple studies) and removes the effect of variations across studies (such as through population selections, timing of data collection and variations across the role of CIL within learning areas) that may invalidate any attempts to compare CIL learning outcomes across learning areas. In addition ICILS will provide information about variations in student access to ICT in learning between, and within, countries as well as the relation between access and the outcomes of CIL education.

Research Questions

1) What variations exist between countries, and within countries, in student computer and information literacy?

2) What aspects of schools and education systems are related to student achievement in computer and information literacy:

   a) general approach to computer and information literacy education;

   b) school and teaching practices regarding the use of technologies in computer and information literacy;

   c) teacher attitudes to, and proficiency in, using computers;

   d) access to ICT in schools; and

   e) teacher professional development and within school delivery of computer and information literacy programs?

3) What characteristics of students' backgrounds, levels of access to, familiarity with and self-reported proficiency in using computers are related to student achievement in computer and information literacy and:

   a) how do these characteristics differ among and within countries;

   b) to what extent does measured computer and information literacy correlate with self reported proficiency in ICT; and

   c) does the strength of this correlation differ among countries and groups of students?

4) What aspects of student personal and social background (such as gender, socio-economic background, and language background) and familiarity with computers are related to computer and information literacy?

Computer and Information Literacy

Terminology

There is an extensive body of literature regarding the development and use of terms relating to computer and information literacy to describe a range of real-world proficiencies. The development of context-specific constructs relating to computer and information literacy has led to a proliferation of frequently overlapping and confusing definitions (Bawden 2001)[1]. Paralleling the proliferation of terms and

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1 For example, Virkus (2003) lists some of the terms used synonymously with information literacy as: 'infoliteracy, informacy, information empowerment information competence, information competency, information competencies, information literacy skills, information literacy and skills, skills of information literacy, information literacy competence, information literacy competencies,

definitions relating to information literacy has been the range of terms and definitions relating to *media* and *critical* literacies (Livingstone, Van Couvering et al. 2008) and similarly, definitions of computer literacy and digital literacy are extensively and increasingly proliferate and overlapping (Tyner 1998).

Livingstone et al. (2008) make the distinction between scholarly preferences to ‘introduce new terms to characterise these supposedly new skills (e.g. *digital literacy, cyber literacy, Internet literacy and network literacy)’* compared to those who choose to ‘emphasise the continuities between old and new media and information and communication technologies by extending the term *media literacy* or literacy in general to encompass a converged concept of media and information literacies’ (Livingstone, Van Couvering et al. 2008). They argue that the technological advances leading to the increasing range of media contents available on computers (through the use of video and audio streaming and pod-casts for example) support the recognition and assimilation of information and communications technology literacy-related constructs rather than the creation of new terms and constructs that purportedly access a “new” set of technical and cognitive competencies.

Part of the planning for this proposed International Computer and Information Literacy Study (ICILS) is to decide whether the definition and research construct of Computer and Information Literacy (CIL) will purport to address a new set of competencies or emphasise its connection to existing ones. The proposed CIL definition and draft construct supports the second approach. It has been derived from the existing literature regarding computer- and information- related literacies but has been developed with consideration of two fundamental parameters of the study:

1. The proposed ICILS study targets *school-aged* children (in their eighth year of school with a possible optional second sample of children in their fourth year of school)

2. The assessment will be completed using computers and will focus on computer use.

With these parameters in mind, the ICILS construct explicitly refers to *computer* literacy, rather than the broader contexts implicit (although not always measured in practice) in constructs relating to *digital* literacy or *information and communications technology* literacy (Educational Testing Service 2002; MCEETYA 2008).

In contrast to this primarily practical consideration, the choice of *information* rather than *media* literacy has been made more on the basis of a key difference that still exists between the two constructs. Both media and information literacy typically refer to the capacity to access, analyse, evaluate and communicate information. What distinguishes the two is that media literacy has a stronger emphasis on explicitly measuring “understanding” of the information as an outcome, whereas information literacy has a stronger emphasis on the processes of information management (Christ and Potter 1998; Peters 2004; Ofcom 2006; Catts and Lau 2008; Livingstone, Van Couvering et al. 2008). Of course students must understand the information they are

information competence skills, information handling skills, information problem solving information fluency, information mediacy and even information mastery''.

dealing with in order to evaluate and use it effectively however, explicit measurement of students' actual understanding of material is not typically an explicit focus of information literacy. A second area of difference between media and information literacy is their approach to the concept of *information*. Traditionally media literacy has emphasised the *range* of information forms and information literacy has focussed on static texts (electronic or print). As indicated previously, advances in technology are increasingly blurring this distinction and may well render this difference redundant in the future.

In summary, the focus of ICILS is on students' use of computers as information tools rather than on students' capacity to understand information presented from a range of sources. Although the type of information processing associated with conventional literacies (including media literacy) is acknowledged to influence students' capacity work with information, they are not the focus of the proposed ICILS study.

Defining Computer and Information Literacy

Information literacy constructs developed first through the fields of librarianship and psychology (Church 1999; Bawden 2001; Marcum 2002; Homann 2003). Common to information literacy constructs are the processes of: identifying information needs; searching for and locating information; and evaluating the quality of information (UNESCO 2003; Catts and Lau 2008; Livingstone, Van Couvering et al. 2008). Most information literacy constructs (and particularly those developed in the past 10 years) extend these processes to include ways in which the collected information can be transformed and used to communicate ideas (Peters 2004; Catts and Lau 2008).

Computer literacy constructs in education typically have not focused on the logical reasoning of programming (nor the syntax of programming languages) but rather declarative and procedural knowledge about computer use, familiarity with computers (including their uses) and, in some cases, attitudes towards computers (Richter, Naumann et al. 2001; Wilkinson 2006). More recent information literacy constructs have adopted and largely subsumed computer literacy constructs now that digital technologies have developed as the world's primary information management resources. Global concepts of the *knowledge economy* and *information society* are regarded as essential drivers for the ongoing integration of information and computer literacy. According to Catts and Lau (2008):

> *People can be information literate in the absence of ICT, but the volume and variable quality of digital information, and its role in knowledge societies, has highlighted the need for all people to achieve IL skills. For people to use IL within a knowledge society, both access to information and the capacity to use ICT are prerequisites. IL is however, a distinct capacity and an integral aspect of adult competencies.*
>
> (Catts and Lau 2008)

Both information and computer literacy constructs assume that information is received, processed and transmitted. The key difference between explicit information literacy constructs (that still rely on and assume some computer proficiency) and computer literacy constructs appears to be that computer literacy constructs allocate less importance to the nature and constituent parts of the information processing that happens between reception and transmission. Computer literacy focuses on a more direct path between reception and transmission than information literacy which emphasises the processing *steps* as information is evaluated and transformed along the way (Boekhorst 2003; Catts and Lau 2008).

Computer and information literacy constructs have converged in the form of Information and Communications Technology (ICT) literacies (ETS 2002; MCEETYA 2005) and Digital Literacy (Lemke 2003). The proposed ICILS construct of computer and information literacy is strongly related to both ICT and Digital Literacy constructs. Following are two definitions of ICT literacy and one of Digital Literacy.

1. *ICT literacy is using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society.*
   (ETS 2002)
2. *ICT literacy is the ability of individuals to use ICT appropriately to access, manage and evaluate information, develop new understandings, and communicate with others in order to participate effectively in society.*
   (MCEETYA 2005)
3. *Digital literacy can be defined as "…the ability to use digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society"*
   (Lemke 2003).

Common to the definitions are the assumed necessary technical skills of using technologies and very similar sets of information literacy and communication processes. In each case, the definitions are primarily a list of the information literacy processes involved each suggests that the overarching purpose of literacy is participation and functioning in society.

With reference to both the parameters of the proposed International Computer and Information Literacy Study and the literature of computer- and information-related literacies, we propose the following definition of Computer and Information Literacy.

> *Computer and information literacy refers to an individual's ability to use computers to investigate, create and communicate in order to participate effectively at home, at school, in the workplace and in the community.*

Computer and information literacy relies on and brings together technical competence (computer literacy), intellectual capacity (conventional literacies including information literacy) to achieve a highly context-dependent communicative purpose that presupposes and transcends its constituent elements.

Such a view of computer and information literacy is congruent with the conceptual model suggested by Audunson (2003) and is illustrated in the International ICT Literacy Panel ICT literacy construct that accompanies the first of the three definitions listed earlier (ETS 2002).

Structure of the CIL Construct

The CIL construct recommended to frame the proposed Information and Computer Literacy Study is divided into two strands each of which contains three constituent elements. We would envisage using the CIL construct as the framework for developing the ICILS instruments and later using student achievement data to develop an overall CIL achievement scale similar to the ICT Literacy scale developed in the Australian national assessment and shown in Appendix A. An empirically-based described achievement scale such as this can support both consistency of understanding of the nature and range of CIL achievement (within and between countries in the case of this proposed study) and also, as required, as the basis for establishing standards of minimal, reasonably expected and even aspirational CIL proficiency.

Figure 1 shows the structure of the proposed CIL construct. The following sections explicate the six aspects of CIL and provide some suggestions of how they may be operationalised in the proposed ICILS instruments.

Figure 1. Conceptual structure of the proposed ICILS Computer and Information Literacy construct

Computer and information literacy refers to an individual's ability to use computers to investigate, create and communicate in order to participate effectively at home, at school, in the workplace and in the community

Strand 1 Collecting and managing information	**Strand 2** Producing and exchanging information
Aspect 1.1 Knowing about and understanding computer use	**Aspect 2.1** Transforming information
Aspect 1.2 Accessing and evaluating information	**Aspect 2.2** Creating information
Aspect 1.3 Managing information	**Aspect 2.3** Sharing information

Strand 1: Collecting and managing information

Collecting and managing information focuses on the receptive elements of information processing including the fundamental and generic skills and understandings that are associated with using computers.

Aspect 1.1: Knowing about and understanding computer use

Knowing about, and understanding, computer use refers to student's declarative and procedural knowledge of the generic characteristics and functions of computers. This aspect focuses on the basic technical knowledge and skills that underpin our use of computers to work with information.

At a declarative level, students may, for example be required to show their knowledge that computers use processors and memory to run programs and that operating systems and word processors, games and viruses are examples of programs. They may demonstrate knowledge that computers can be connected to each other and "communicate" with each other through networks and that these can be local and/or global. They may understand that the Internet is a form of computer network that is run through computers and that websites, blogs, wikis, all forms of computer software designed to meet specific purposes.

At a procedural level, students may be required to execute basic, generic file and software functions such opening and saving files in given locations, resizing images, copying and pasting text. The procedural knowledge that students could be required to demonstrate in Aspect 1.1 would be limited to generic basic commands that are common across software environments.

Aspect 1.2 Accessing and evaluating information

Accessing and evaluating information refers to the investigative processes that enable students to find, retrieve and make judgements about the relevance, integrity and usefulness of computer-based information. The proliferation of information sources that use the Internet as a communication medium has meant that students are increasingly required to filter the vast array information to which they gain access before they can make use of it. This, combined with the increasing intuitiveness of computer-based information search programs (search engines) is leading to an increasing integration of the processes of accessing and evaluating information. For this reason, accessing and evaluating information are regarded as sufficiently integrated to warrant their inclusion as a single aspect, rather than separate aspects, of the CIL construct. The importance of accessing and evaluating information is also a direct result of the increasing quantity and range of available *unfiltered* computer-based (and delivered) information. As well as increasing in volume, the nature of computer-based information is also constantly changing. Accessing and evaluating information are rooted in conventional literacies, however the dynamic multimedia and multimodal nature of computer-based information mean that the processes of accessing and evaluating are different in the CIL construct than when they relate only to conventional literacies. The dynamic context of computer-based information necessitates the use of a different and broader range and combination of skills (typically associated with digital and media literacies) than can be associated solely with conventional literacies.

Students could be required to demonstrate their ability to access and evaluate information by, for example: selecting information from within a website or file list that is relevant to a particular topic; describing and explaining the functions and parameters of different computer-based information search programs; suggesting strategies for searching for information and/or adjusting the parameters of searches to target information better; recognising and explaining characteristics of computer-based information (such as hyperbole and unsubstantiated claims) that can be used to evaluate its credibility; and suggesting and implementing strategies to verify the veracity of information (such as through checking for multiple sources).

Aspect 1.3 Managing information

Managing information refers to students' capacity to work with computer-based information. It includes their ability to adopt, adapt and make use of information classification and organisation schemes students to organise information so that it can be used or reused efficiently. Managing information differs from Aspect 1.1 (knowing and understanding computers) at the point where students are required to make decisions about the way information is used (rather than simply knowing or demonstrating that it can be used) and from Aspect 1.2 (accessing and evaluating information) with respect to the requirement for students to manage information in environment over which they have some control of the organisational structure. Hence, for example, searching for a file that exists within a constrained file structure on a computer hard disk would be considered as managing rather than accessing and evaluating information.

Students could be required to demonstrate their ability to manage information by, for example: creating a file structure in a directory according to given parameters; sorting or filtering information on an Internet database; and recognising the most efficient data structure for a given purpose within a simple database.

Strand 2: Producing and exchanging information

Producing and exchanging information focuses on students' use of computers as productive tools for thinking, creating and communicating.

Aspect 2.1: Transforming information

Transforming information refers to students' ability to use computers to change the way in which information is presented to make it clearer for given audiences and purposes. Typically transforming information makes use of the formatting, graphics and multimedia potential of computers to enhance the communicative effect or efficacy of (frequently text-based) information.

Students could be required to demonstrate their ability to transform information by, for example: reformatting the titles in a document or presentation to enhance the flow of information; using, modifying or creating images to supplement or replace text in a document; creating a chart to represent a table of data; transferring data (such as temperature or velocity data) from a data logger and displaying it to illustrate patterns of change; and creating a short animated sequence of images to illustrate a sequence of events.

Aspect 2.2: Creating information

Creating information refers to students' ability to use computers to design, and generate original information products for specified purposes and audiences. These original products may be entirely new or may build upon a given set of information to generate new understandings.

Students could be required to demonstrate their ability to create information by, for example: using a simple graphics program to design a birthday card; designing and writing a presentation that explains the key elements of an historical event; and using a given set of information to make recommendations in a report that integrates text, data and graphics.

Aspect 2.3: Sharing information

Sharing information refers to students' understanding of the use of and ability to use computers to communicate and exchange information with others. Sharing information focuses on students' knowledge and understanding of a range of computer-based communication media, such as: email, wikis, blogs, instant messaging, media sharing and social networking web interfaces. Given the rapidly changing nature of this area the focus of sharing information is on knowledge and understanding of the information and social conventions and, at the higher end of the achievement spectrum, the social impact of information sharing using computer-based communication media.

Students could be required to demonstrate their information sharing ability by, for example: recognising some key differences between computer-based communication media; using software to disseminate information (such as attaching a file to an email or adding or editing an entry in a wiki); evaluating the appropriateness of information in a given context; and creating or modifying information products to suit a specified audience or purpose.

The detail of what is involved in CIL is elaborated in the hypothesised progress map shown in Table 1. For each of the two strands the progress map indicates what is meant by progress in computer and information literacy. It does so by describing the tasks that students at each of five proficiency levels would be expected to complete successfully. Of course the actual progress map might be different from this hypothesised structure but the hypothesised map indicates what is envisaged and the idea of progress that will inform the process of task development.

It is important to note that hypothesised progress map envisages expertise in terms other than the process of operating a computer. Rather the successive stages embody the intersection of computer and information literacy. For the strand concerned with collecting and managing information the highest performance level is described as students evaluate the credibility of information from electronic sources and select the most relevant information to use for specific communicative purposes, they create structures for simple databases and file management systems and evaluate the efficacy of simple data structure. Similarly the top level for the strand concerned with producing and exchanging information is described as students create information products that show evidence of planning and technical competence, they use software features to reshape and present information consistent with presentation conventions, and they design information products that combine different elements and accurately represent their source data.

Table 1 Hypothesised Progress Map for Computer and Information Literacy

<table>
<tr><th>Level</th><th>Strand 1: Collecting and managing information</th><th>Strand 2: Producing and exchanging information</th></tr>
<tr><td>5</td><td>Students working at level 5 evaluate the credibility of information from electronic sources and select the most relevant information to use for specific communicative purposes. They create structures for simple databases and file management systems and evaluate the efficacy of simple data structures. Students working at level 5 for example:
select and include information from electronic resources in an information product to suit an explicit communicative purpose
explain how the features of a web-based text such as hyperbole, or extreme bias contribute to the credibility of the text
identify some common “hooks” used in phishing and other common web-based deceptions such as unsubstantiated requests for information, or extraordinary claims or offers
apply specialised software and file management functions such as using the history function on a web-browser to return to a previously visited page or sorting data in a spreadsheet according to a specified criterion
specify field parameters that can be used to organise data relevant to their content
suggest ways an existing database or file system could be reorganised to make it more efficient.</td><td>Students working at level 5 create information products that show evidence of planning and technical competence. They use software features to reshape and present information consistent with presentation conventions. They design information products that combine different elements and accurately represent their source data. They use available software features to enhance the appearance of their information products. Students show awareness of the power of information and the contexts in which information sharing can be socially constructive or destructive.
create an information product in which the information flow is clear and logical and the tone and style are consistent and appropriate to a specified audience
use graphics and text software editing features such as font formats, colour and animations consistently within an information product to suit a specified audience
create tables and charts that accurately represent data and include them in an information product with text that refers to their contents.
give examples of social contexts in which information can be used to disseminate socially significant information
explain how communicative networks can be used to promulgate misinformation and suggest ways of protecting against these actions.</td></tr>
</table>

4	Students working at level 4 generate well targeted searches for electronic information sources and select relevant information from within sources to meet a specific purpose and suggest strategies for checking the veracity of information sources. They recognise and make use of metadata in retrieving and managing files: Students working at level 4 for example: ▪ independently select and use appropriate software and/or hardware to suit specific tasks, purposes and social contexts ▪ independently modify the settings for an individual tasks using a peripheral device such as a printer to print two-sided ▪ suggest ways that the veracity of web-based information can be confirmed ▪ use fields with identifying characteristics of a data to search, sort and retrieve within a database (such as an electronic media manager or web-based catalogue) ▪ identify the features/uses of common file types according to their extensions (such as: .doc, .xls, .gif.) ▪ generate searches that target relevant resources for a specified purpose ▪ select sections relevant to a given purpose from within electronic resources.	Students working at level 4 create information products with simple linear structures and use software commands to edit and reformat information products in ways that demonstrate some consideration of audience and communicative purpose. They create information products in which the flow of information is clear and the tone is controlled to suit a specified audience. They recognise that shared information can be tailored to suit and can have different effects on different audiences. They also recognise that there are risks associated with sharing information with others and suggest ways of minimising these risks. ▪ restate with some modification and supporting text, in an information product ▪ select and apply graphics and text software editing features such as, font formats, colour and image placement consistently across a simple information product ▪ combine mixed media resources such as graphics, text, audio and video ▪ use software to draw graphs of tables of data to demonstrate patterns ▪ create a flow chart to represent a decision-making system ▪ identify security risks associated with internet data and explain the importance of respecting and protecting the intellectual property rights of authors ▪ suggest ways of using software to present a given set of information for different audiences ▪ suggest the different potential size, and breadth of audience for information presented using different electronic communication systems ▪ identify ways of minimising undesirable access or use of electronically shared information using software options and parameters to restrict access or limit use.

Table 1 (Cont.) Hypothesised Progress Map for Computer and Information Literacy

3	Students working at level 3 demonstrate some autonomy when using computers as information gathering and management tools. They generate simple general search questions and select the best information source to meet a specific purpose. They retrieve information from given electronic sources to answer specific, concrete questions and manage files effectively with in simple organizational structures. Students working at level 3 for example: ▪ recognise the role the role of the server and clients on a computer network ▪ retrieve information from a database such as a library catalogue ▪ recognise the purpose of including usernames and passwords to access files on shared networks ▪ create a meaningful organisational system for a set of files based on their type and/or content ▪ recognise the key features of an "operating system" ▪ recognise the difference between the "save" and "save as" commands. ▪ identify that two different search terms relating to the same topic can result in different numbers of "matches" on a search engine.	Students working at level 3 assemble information in a provided simple linear order to create information products. They follow instructions to use conventionally recognised software commands to edit and reformat information products. They recognise that communication with ICT has responsibilities for users and offers the potential for misuse. Students working at level 3 for example: ▪ use graphics and text software editing features to manipulate aspects such as colour, image size and placement in simple information products ▪ apply templates or styles, when instructed, to improve the appearance and layout of documents and text ▪ assemble a liner sequence of video clips with simple transitions ▪ apply simple animations to objects to demonstrate a process or dynamic action ▪ suggest different contexts in which different electronic communications systems may be most appropriate ▪ identify some of the responsibilities of contributors to collaborative online projects or information resources such as wikis and review sites ▪ recognise the potential for ICT misuse through information sharing \and communications networks such as plagiarism, and deliberate identity concealment; and suggest measures to protect against them.

Table 1 (Cont.) Hypothesised Progress Map for Computer and Information Literacy

2	Students working at level 2 use computers as tools to complete very basic and explicit information gathering and management tasks. They locate simple, explicit information from within a given electronic source, recognise common computer conventions and demonstrate basic knowledge of how computers function as tools. Students working at level 2 for example: ▪ recognise that file extensions such as ".txt" or ".gif" represent the type of information stored in a file ▪ add a web-page to a list of favorites (bookmarks) in a web-browser ▪ recognise that computers "run" programs that can be used to complete a range of functions ▪ click on buttons in a web-page with links to explicitly stated information ▪ recognise that information in a working document can only be retrieved if the file is "saved" ▪ recognise that individual files must each have a different name when saved to the same location in a directory tree ▪ move a file from one folder to another in a simple directory tree ▪ select the most relevant search term from a set of possible terms.	Students working at level 2 use computers to add content to and make simple changes to existing information products when instructed. They edit information products and create products that show limited consistency of design and information management. Students identify the efficiency of immediate communication with multiple parties using communications software and recognise common communications conventions. Students working at level 2 for example: ▪ make changes to some presentation elements in an information product ▪ apply simple software reformatting functions such as, copying and pasting information between columns in a spreadsheet ▪ use a drawing tool to copy and repeat design elements and create patterns ▪ send emails to groups of users or establish 'friends' on a social networking site ▪ recognise differences between the To, Cc and BCc functions in email, or different classifications of "friends" on social networking software. ▪ Recognise appropriate email greetings and sign-offs when communicating with different people.

Table 1 (Cont.) Hypothesised Progress Map for Computer and Information Literacy

1	Students working at level 1 demonstrate a functional working knowledge of computers as tools to complete tasks. They implement the most commonly used file management and software commands when instructed. They recognise the most commonly used ICT terminology and functions. Students working at level 1 for example: ▪ apply basic file and computer management functions such as opening and dragging-and dropping files on the desktop ▪ apply generic software commands such as the 'save as' and 'paste' function or selecting all the text on a page ▪ recognise basic computer use conventions such as identifying the main parts of a computer and that the 'shut-down' command is a safe way to turn off a computer ▪ recognise different types of commonly used software such as word-processors, internet search engines and web-browsers ▪ recognise the function of some computer peripheral devices such as USB drives, DVD drivers and printers.	Students working at level 1 perform basic communication tasks using computers and software. The recognise different software communications systems and can compile text and messages using the most basic features of these systems. Students working at level 1 for example: ▪ apply graphics manipulation software features such as adding and moving predefined shapes to reproduce the basic attributes of a simple image ▪ apply commonly used text formatting commands such as 'bold', 'italic' to modify the appearance of fonts ▪ recognise the difference between communication systems such as: email, instant messaging, blogs and social networking software ▪ prepare an email by inserting an address and subject ▪ identify that the appearance and layout of text and graphics can influence the communicative efficacy of an electronic text.

Computer-based assessment of CIL

Computer-based assessment tools

The assessment of CIL should be authentic and therefore computer-based. There are three complementary item types in the computer-based assessment of CIL that can be integrated in a single testing environment.

1. Using computer technology to deliver questions in traditional forms, including where computer technology is used only to present stimulus material (perhaps in a richer form than in paper-based methods) but the questions are multiple choice or constructed response questions that do not require any use of the technology other than to record an answer and provide a more efficient basis for data capture.

2. Using software simulations of generic or universal applications so that students are required to complete an action in response to an instruction and their action is recorded. These are typically single tasks (such as copying, pasting, using a web browser) but can also have more than one layer (where students navigate a directory structure for example). The items need to allow for all possible "correct" responses to be undertaken, and recognised by the testing software. These items can be automatically scored.

3. Requiring students to modify and create information products using authentic computer software applications. The applications may be existing commercial or open-source software (subject to licensing arrangements) and/or purpose-built applications, which no students will have used before but which follow software conventions. In this approach the student work is automatically saved for subsequent assessment by raters according to a prescribed set of criteria. This approach may require students to use multiple applications concurrently (such as email applications, wikis, blogs, other web-pages and web-applications from a closed environment, spreadsheets, word processors, graphics and presentation software) as one typically does when using computer software to perform larger (but specified) tasks.

Structure of the assessment instrument

The proposed assessment instrument will be made up of three 30 minute modules each comprising items and tasks from the three categories described in the previous paragraphs. Each student will complete two of the three modules. Each module will have a unifying theme and students will work through the different items and task in sequence to as part of an *authentic* process. The modules, items and tasks will be delivered seamlessly as part of an integrated environment.

The modules typically will follow a basic structure in which the students are first presented with details of the *context and purpose* of the module and then complete simulation, multiple-choice and short-constructed response items in the lead-up to a large task using at least one live software application. Typically the lead-up tasks required students to: manage files; perform simple software functions (such as inserting pictures into files); search for information; collect and collate information; evaluate and analyse information; and perform some simple reshaping of information. When completing the large tasks, students typically needed to select, assimilate and synthesise the information they have been working with in the lead-up tasks and reframe the information to fulfil a specified communicative purpose. The audience and software related communicative context will be specified to the students as part of the communicative purpose of the large task. Students will spend between 40 per cent and 50 per cent of the time allocated for a module on the large task.

The contents of the modules and tasks will be determined during the instrument development process described in the following section. At least two of the three final modules will relate to CIL contexts and tasks that students can reasonably be expected to complete at school. The third module can deal either with school or out-of-school contexts and tasks depending on the outcomes of consultations with NRCs and stakeholders. In the final assessment the three modules will be presented in a fully balanced rotation to account for order effects. Table 1 below shows this module rotation. A 20-minute student questionnaire would be included with the assessment instrument. Characteristics of this student questionnaire are described later in the proposal.

Table 1 Proposed balanced module rotation for student instruments

First module (30 minutes)	Second module (30 minutes)	Student survey (20 minutes)
A	B	S
A	C	S
B	C	S
B	A	S
C	A	S
C	B	S

Notes

A: Assessment module A
B: Assessment module B
C: Assessment module C
S: Student survey

Creating electronic assessment items

The development of interactive ICT simulation and live application assessment materials requires the development of both the assessment content and the software to deliver the content. ACER has successfully done this over two cycles of the Australian assessment of computer literacy (in total over 15,000 students in 1200 schools will have completed the assessments) in co-operation with a local IT company (SoNET systems) and could build on this expertise.

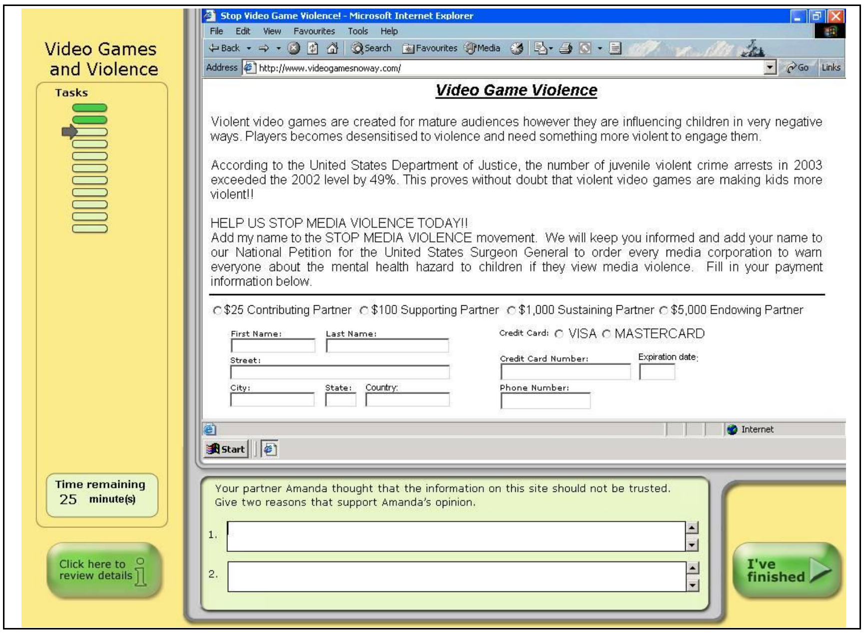
Ideally the process of developing an assessment instrument begins with a clear understanding of the nature of both the CIL construct and the ways in which CIL is being addressed across participating countries. In the first stage the assessment framework is elaborated, in consultation with participating countries and other experts, so that the characteristics of high and low levels of CIL are articulated. We also propose at this stage that participating countries are surveyed with respect to the CIL curriculum approaches, infrastructure and the nature of computer-based activities (including software types) that are typically used in schools to help build a picture of what can reasonably be expected that students in the target grade may have experienced at school (keeping in mind the expectation that much of students' CIL use and "learning" may take place away from school). Sets of items are developed to represent different levels of the hypothesised achievement scale. It is possible that these items could be structured to form one or more narrative sequences so that there is a flow through various authentic tasks. These items could be traditional MCQ or CR items, simulated single tasks, or larger tasks that incorporate multiple applications. The sets of items would first be represented as static storyboards with details of how they would operate in their fully functional electronic formats. At this stage of the development process the items would be reviewed by expert panels for their relevance, grade-level and cultural appropriateness and with respect to the suitability of the nature and range of software tasks that the items represent for the target grade.

Once the assessment materials have been reviewed by panels of experts and refined in an iterative process of development, they are enacted as electronic computer-based assessments. This process is a collaborative process between the test developers and the software engineers to ensure that the materials are enacted in such a way as to maintain the necessary measurement properties of their constituent items/tasks. The way in which the materials are enacted as electronic forms has ramifications for computer resources and bandwidth requirements.

Small-scale pilot studies are then conducted with small convenient samples of students analysing the student responses to the items and tasks and, where possible, discussing the students' experiences of completing them. The piloting is based on the enacted and operating electronic assessment materials. Information from the pilot studies provides a basis for revising and refining the assessment materials prior to the field trial.

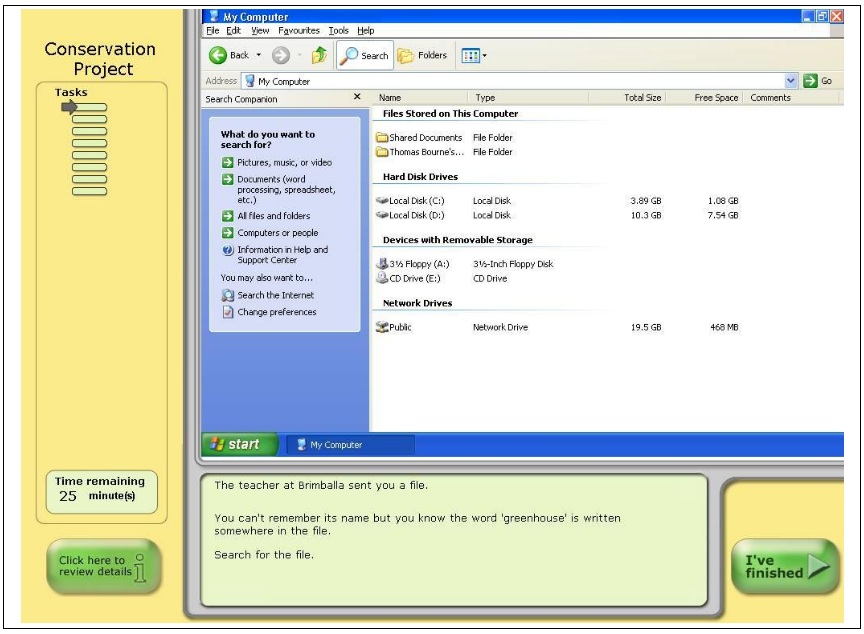
Some examples of enacted items are represented in the following screen shots.

Figure 2: Screenshot of example static open-ended response item



The example item in Figure 2 requires students to read a static web-page and write two reasons that the information on the web-page may not be trustworthy. Student responses to this item were stored as text fields and scored by raters according to a pre-defined scoring guide.

Figure 3: Screenshot of example simulated skills item



The example item in Figure 3 required students to use the search function (in this case simulated as the “My Computer” application in Microsoft Windows XP 2002) to look for a file when only part of the filename is known. Student responses to this item (both the commands and text) were automatically captured and scored by the testing software. Typically in the case of simulation items all possible ways of executing the required command (using menus, icons and keystrokes) are scored equally as “correct”.

Figure 4: Screenshot of example live software task

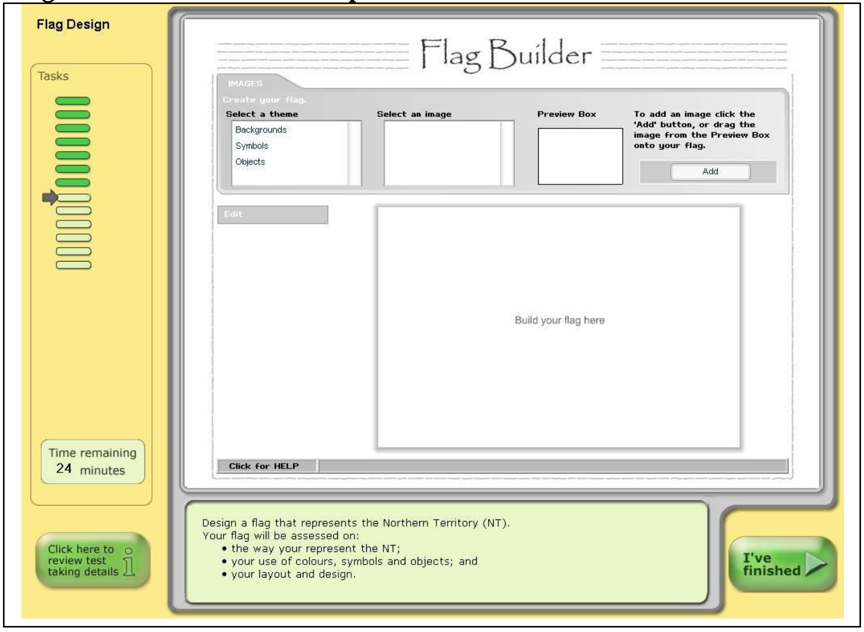
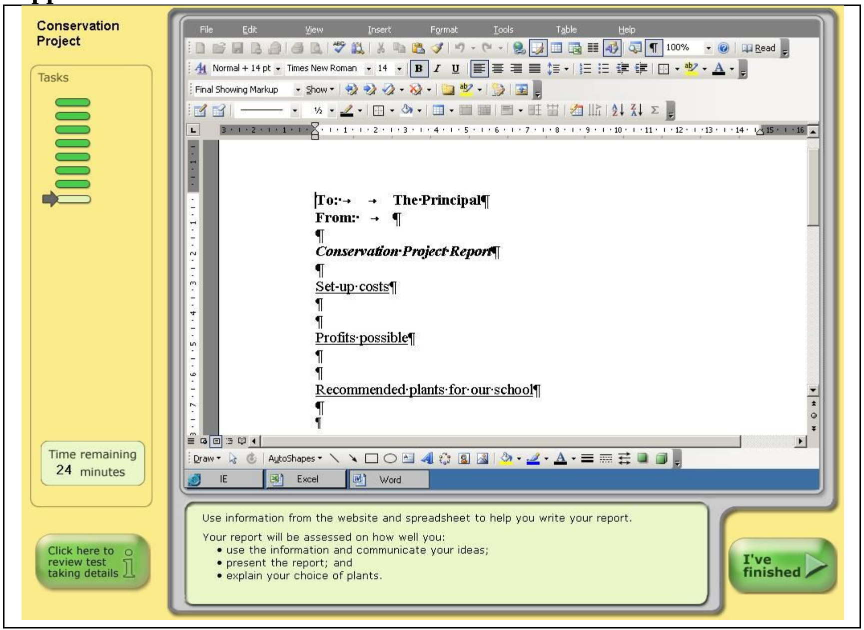


Figure 5: Screenshot of example live software task with multiple applications



Figures 4 and 5 show examples of the beginning screen for larger tasks requiring students to work with "live" software applications. The example item in Figure 4 requires students to use a purpose-built graphics program to design a flag for the Northern Territory in Australia. Students had been provided with information about the Northern Territory to inform their use of symbols and design for their flags. The example in Figure 5 requires students to complete a report to their school principal about a possible school conservation project. The requisite information for their report is contained in a closed web-environment and in a spreadsheet that they can access with the tabs at the bottom of the screen and use freely.

Student work for each of the live application tasks shown in Figures 4 and 5 was saved and scored by trained markers (using an online marking system) according to pre-defined assessment criteria. Typically the assessment criteria for each task correspond to a range of aspects of the CIL construct.

Associated Instruments

Student questionnaire

Associated with the student assessment will be a computer-administered student questionnaire that would enable students to answer questions about computer use. Typically these questions relate to students' access to, experience and use of, and familiarity with ICT at home and at school. The questionnaire can also collect evidence of students' attitudes towards using computer technology and aspects of their background characteristics (as is standard in IEA international surveys). It will utilise the capacity of computer administration to provide for a variety of responses such as drop-down boxes, clicking on options and open-response text boxes.

Student responses to these issues will be used to provide descriptive information about computer use across and within countries and to help interpret patterns of performance. The questions will be concerned with issues such as:

- the length of time for which students had been using computers;
- the types of computer used at school and home;
- the frequency with which students used a computer in each of these locations;
- the frequency with which students use a computer for various functions;
- the types of computer applications (software and interfaces) students use; and
- students interest in and attitudes towards using computers.

Aspects of student background to be covered will include closed format items on basic student characteristics (e.g. gender, age, study programme) and home background (e.g. parental education, parental occupations, books in the home, ICT resources in the home). Parental educational levels will be asked in categories corresponding to international classification standards (e.g. ISCED). It is also proposed to include open-ended questions on parental occupation, which could be coded according to international standards for the coding of occupational status.

Teacher Questionnaire

An on-line teacher questionnaire will ask about teacher use of computers at school and outside school and about self-reported competency in using computers. There will be a number of items that linked to SITES 2006 including the scale of self-reported competency (Plomp, Law & Pelgrum, 2008). The teacher questionnaire will be administered to a sample of all teachers teaching at least one class in the target grade. This reflects the pervasive belief and consequent policies across countries that CIL education be integrated across the curriculum and consequently teachers of all subjects play an essential role in CIL education. The technology for the teacher questionnaire would utilise the methods successfully developed at DPC and applied in other IEA studies.

School Questionnaire

An on-line school questionnaire to be completed by the school principal will also be included to ask about computing resources and policies and practices regarding the use of information technologies at the school as well as school characteristics. There would be a number of items that linked to SITES 2006 (Plomp, Law & Pelgrum, 2008). The technology for the school questionnaire would utilise the methods successfully developed at DPC and applied in other IEA studies. Consideration will be given to also including a questionnaire for the school information technology coordinator (as defined in SITES 2006) that had some link items to the SITES 2006 questionnaire.

National Context Survey

International surveys such as the succession of SITES projects, as well as TIMSS, point to differences in policies and priorities for the use of ICT in school education (Plomp, Anderson, Law & Quale, 2009). It seems reasonable to expect that variations in national policies, priorities and practices regarding ICT in schools will influence the ways that students develop CIL.

Proposed content

The national context survey will be designed to collect systemic data on: education policy and practice in CIL education (including curriculum approaches to CIL); policies and practices for developing the CIL expertise of teachers; and current debates and reforms in the introduction of digital technology in schools (including approaches to the assessment of CIL and the provision of ICT resources in schools). In addition, data about factors such as the structure of education systems and national curriculum orientations will be captured so that they can be taken into account when interpreting results from an international assessment of CIL.

Education policy and practice in CIL education

The national context survey will collect data on the definition of, and the priority given to, CIL education in the educational policy and provision of CIL education in each country including its name and national or official definition, its place in educational reforms and its main aims and goals. It will also ask specifically about CIL-related education and the influence of different institutions or groups on decisions about the goals and aims of CIL education.

Countries take different approaches to the implementation of CIL education in their curricula. Some educational systems have it in the curriculum as a subject whereas others include it through integration into other subjects. There are variations in the explicitness with which CIL curricula and learning outcomes are described across countries. In some countries there are explicit CIL described curricula and learning outcomes and in others CIL is described as an "implicit" curriculum through it being referenced across curriculum documents in different learning areas. The national context survey will gather data regarding the inclusion of CIL education (as separate subject, integrated into different subjects or as cross-curricular approach) in the formal curriculum at different stages of schooling and in different study programs. It will also capture the nomenclature for CIL-related curriculum subjects and whether they are compulsory or optional in each study program. It will include specific questions regarding the target grade in terms of curriculum emphasis and the amount of instructional time given to CIL education.

Development of teacher expertise in CIL

Teacher education programs often provide trainee teachers with opportunities to develop CIL-related competencies (Kirschner and Davis 2003; Markauskaite 2007). To assess the variety of different approaches to teacher education in the field, the national context survey will gather data regarding any CIL requirements for becoming a teacher and about licensing or certification procedures for teachers, and more specifically about the background of CIL teachers (where applicable). Furthermore, it will provide information on the extent to which CIL education is part of pre-service or initial teacher education, on the availability of in-service or continuing professional development education for CIL education, on the providers of these activities and how it is expected that teachers learn about developments in CIL education.

Reforms involving the introduction of digital technology

Countries differ in the extent to which they have introduced, or are introducing, digital technology into school education as well as the priority given to this development including the development of curriculum resources in the form of digital learning objects. Countries also differ in whether and how they assess CIL and whether ICTs are used in the assessment of other disciplines. The national contexts survey will gather data about the priorities accorded to these digital developments and the nature of debates surrounding them.

Resource provision

The national context survey will collect data on the infrastructure, hardware and software provisions to and expectations of schools. Included in these data will be: the number of computers per student, computers per teacher, internet connectivity (coverage and speed); software licensing arrangements and the availability of digital curriculum resources. This will support evaluation of the premise that where digital resource provision is greatest students will have greater experience of an access to the use of CIL and consequently develop higher levels of CIL.

Characteristics of educational systems

Education systems differ in other general characteristics and the national contexts survey will gather data about these general characteristics: length of schooling, age-grade profiles, educational finance, structure of school education (study programs, public/private management) and autonomy of educational providers. Other data sources will be used to provide complementary context data about levels of ICT access and use in each country as well as the economic and social context.

Data collection methods and application

The national contexts survey will be administered as an on-line survey completed by NRCs or their delegates drawing on appropriate expertise in each country (as was done for the International Civic and Citizenship Education Study –ICCS). Data from the national context survey will be used for comparing profiles of CIL education in participating countries. In addition, it will provide data on contextual factors concerned with structure of the education system other aspects of education policy that for the analysis of differences among countries in CIL education.

Delivery methods

Providing computer-based assessments in school settings must take account of the level and variability of computer resources in schools and school systems in order to enable a representative sample of schools to be achieved. At a most basic level this refers to having sufficient computers located in one place in a school so as to be able to administer the assessment to a group of students (we suggest ten appropriately configured computers in a school to enable the assessment to be conducted in two sessions). Beyond this there are conditions such as bandwidth for internet connectivity and access through school and education system security provisions (e.g. firewalls) that apply depending on the way the assessment is delivered.

Background

In the first cycle of ICT Literacy assessment in Australia (2005) mini-labs of laptop computers were taken to schools by trained test administrators who conducted the assessment with three sessions of randomly selected students in each day. This worked effectively but involved significant logistic demands and cost. In the second cycle of ICT Literacy assessment in Australia (2008) greater use was made of school computers by means of:

1) an SSL internet connection to a central server farm (where all the software was located) with the school computers functioning as remote terminals; and
2) taking a laptop computer with all software installed to each school and connecting it to the local area network (LAN) using specially designed software that assigns an IP address so that it can function as a local server on the local network.

In practice, among secondary schools (those sampled for Grade 10) only one in five schools (21%) were able to run the test remotely over the Internet (because of both bandwidth and security restrictions) but a large proportion (70%) were able to use the local server laptop solution. The remaining schools (9%) required a mini-lab of laptops to be delivered to the school because these schools did not have ten co-located networked computers.

New developments

Following on from our experience of the 2008 ICT Literacy assessment, our partner organisation (SoNET systems) has been developing some approaches to the delivery of ICT-based tests to users in schools (and other institutions). In the new developments the database engine has been changed from *MS SQL Server* to *Postgress SQL DB* which removes dependency on Microsoft. Following are possible CIL assessment delivery options.

Local operation.
Two approaches operate locally within schools.

1. The assessment can be delivered on *Memory Sticks (USB or Thumb Drives)* despatched to schools. The assessment software can work now entirely from a memory stick on any computer with a USB interface. No software is installed on the local computer and the system has a database engine on the stick as well. This is self contained environment that can be used to securely run the assessments and capture the student responses. Data can then be delivered either manually (e.g. by mailing the memory sticks to the NRC) or electronically (e.g. by uploading data to an ftp site).

2. The assessment can be delivered on a *Network Appliance* (basically an ordinary computer configured with the assessment software) that can be remotely managed via wireless broadband service (if required) and has all components of the assessment software installed. This requires the Network Appliance to be installed to function within the LAN in the school so that school computers function as terminals. When the testing is complete the student response data can delivered either manually (e.g. burned to CDs or memory sticks and mailed to the NRC) or electronically (e.g. by uploading to a ftp site).

Internet operation.
Two other approaches operate with an internet connection from the school to a server farm.

3. The assessment software resides on a remote server can be accessed using a thin client that works from memory stick without any installation to the local workstation and bypasses security restrictions imposed by organisations. This client uses port 80/http protocol or port 443/ssl protocol. This will enable more efficient use of hosting facility and fewer operational issues for the users. This approach still requires sufficient bandwidth at the school level and capacity of the server farm at the country level to run the assessment.

4. The assessment on a remote server can accessed using a Web thin client that requires installation of the client on the local computer but it overcomes security restrictions as per solution 3 (above).

Recommended Approaches

Delivery methods
It is recommended that the local operation delivery method by USB memory stick (method 1 above) be the priority method because it avoids the difficulties associated with internet connectivity and the logistics and expense of establishing server farms in

different locations around the world and the potential problem of educational systems or schools preventing project servers being connected to school computer networks.

It will also be possible to offer countries the option of delivery to some or all schools through an internet connection from the school to a server farm (method 3 above). The method involves using a thin client that works from memory stick without any installation to the local computer. This method requires sufficient bandwidth at the school level and establishing a server farm in the country level. Choosing more than one delivery method (such as USB and local server, or USB and internet) will increase costs by duplicating some development costs and (at country level) the cost of operating the server farm.

In some countries it may also be necessary to take laptop computers to schools that lack basic computer facilities.

Test Administration and Support

In the Australian experience a trained test administrator attended every school to supervise the testing session. In many countries this may not be necessary if the Memory Stick delivery method is used. In addition in the Australian experience a technical support help desk was used to provide technical support for test administration. This level of support ensured a high return of data, but is expensive and extends the duration of the data collection period as each test administrator needs to attend many different schools.

Some schools in some countries may not have sufficient computer facilities (not enough computers or old monitors with poor resolution for example) to conduct the assessment. It may be necessary to take a set of laptop computers to these schools to administer the assessment. In these schools it is recommended that a test administrator conduct the assessment.

It is anticipated that the great majority of schools will have sufficient computer facilities to run the assessment. It is recommended that a nominated teacher (preferably self-selected by the school as having good IT skills) conduct the assessment. Following each test session the test administrator or nominated teacher would be required to upload the session data from each Memory Stick to an ftp site and then return the Memory Sticks by post. Each Memory Stick will be loaded with a batch file to manage and (as much as is possible) automate the uploading process. The teacher would then return the Memory Sticks by post.

ACER will provide a website with technical support for NRCs and National Study Centres. National Study Centres would be required to set up a test administration helpdesk in each country.

The recommended test administration method is the most cost and time effective system as well as minimising the risk of losing session data by uploading it immediately after each session.

Other methods investigated

The possibility of using web-based applications such as Google Apps has been explored. Google Apps includes word processor, spreadsheet and presentation software and software could be developed to utilise these applications. An advantage is that it provides the applications in many languages. A disadvantage is that if there was insufficient bandwidth in a school it would not be possible to locate the application on a local server brought to the school. In addition there would be less control of the data and the applications to be used and there is a possibility that Google (or any other company providing truly web-based software) may refuse for the software to be installed on ICILS project machines to run a local rather than web-based solution. The use of existing online web-based software has therefore been rejected at this stage.

Implementation

Populations and Sampling

Populations

It is recommended that the population to be surveyed will include all students enrolled in the grade that represents eight years of schooling, counting from the first year of ISCED Level 1, provided the mean age at the time of testing is at least 13.5 years. For most countries the target grade would be the eighth grade, or its national equivalent. This population definition has been used successfully in other IEA education studies and offers the following benefits:

- Students across a very large range of countries can be located in lower secondary school;
- A high proportion of students in participating countries are still in school;
- Students who have completed eight years of schooling have had sufficient exposure to schooling for meaningful interpretation of the influence of school experience on student achievement;
- Students in grade eight have sufficient literacy, numeracy and other learning skills to be able to complete authentic and substantive CIL tasks; and
- The nature and quality of CIL education outcomes reported in ICILS will be directly comparable to education outcomes in other learning areas reported on by other IEA studies such as TIMMS and ICCS in countries completing more than one study.

In addition an option is being offered for an additional assessment of students in the equivalent of Grade 4.

Sampling

Sampling will be based on a two stage cluster design. Sample sizes will be determined according to the sampling efficiency based on information from other national and international surveys in related domains (acknowledging that there will be little information that is directly comparable). At the school level a minimum sample size of 150 schools[2] would be drawn for each country using PPS (probability proportional by size) sampling procedures.

For the sampling of students within schools we recommend sampling a fixed number of 20 eligible students from across the target year level at each sampled school. This approach takes into account that computer education is seldom offered as a discrete

[2] We will confirm this in consultation with the TEG and the international sampling referee.

subject in schools and that it will not be feasible to assess a whole class at one time[3]. In addition, our experience in the Australian national assessments, it provides greater precision (smaller standard errors) than for an equivalent number of students used in whole-classroom sampling.

Administration

For the administration of the assessment it is proposed that in each sampled school two testing sessions (each with ten sampled students) be held on one day with students withdrawn from their regular class for the assessment. The sessions would be designed to be completed in 90 minutes.

Consideration will need to be given at the individual country level to the precise individual sample sizes. It is preferable for trained test administrators will visit the schools to administer the assessment. Test administrators will be able to supervise the groups of students and ensure that the system is set up and runs correctly.

Organisation

Timeline

The project could aim to collect data at the beginning of 2013 (Northern Hemisphere) and the end of 2013 (Southern Hemisphere). If this were to be realised then the following approximate timeline could be used as a guide.

March 2010 – December 2010	Development and elaboration of framework
May/June 2010	Proposed first NRC Meeting[4]
July 2010 – June 2011	Establishment and testing of delivery platform
January 2011 – December 2011	Development and pilot of assessment and survey materials
March 2012 – May 2012	Field trial
March 2013 – May 2013	Main Survey (Northern Hemisphere)
October 2013 – December 2013	Main survey (Southern Hemisphere)

Project Management Structure

As with other IEA studies, ICILS is proposed to be collaborative across the project management staff at the International Study Center, the IEA Secretariat and the IEA Data Processing and Research Center (DPC). It is also planned that participating countries (primarily through NRCs and their delegates) will have meaningful and systematic input into the major substantive elements of the study such as the development of the assessment framework and the assessment instruments.

3 We propose to conduct the assessment in two 90-minute sessions each with ten students withdrawn from class for the period. There is no advantage for school organisation of taking students in two segments from one classroom.

4 A detailed timeline will be produced including dates for the three subsequent NRC meetings. Broadly these will be held in the lead up to the field trial, main survey data collection and following the data collection from the main survey.

The Australian Council for Educational Research (ACER) is the proposed International Study Center for ICILS. ACER staff, including the project co-ordinator, Dr. John Ainley, and research director, Mr. Julian Fraillon, will be responsible for the day to day management of the project. Instrument development and some data analyses and psychometric work will also be centered at the International Study Center and overseen by Dr. Wolfram Schulz.

The DPC will manage sampling, data management and preliminary scaling analyses. The IEA Secretariat will manage preliminary country consultations and provide guidance and oversight of ICILS operations.

A Joint Management Committee (JMC) will be convened of senior project staff from ACER, the DPC and the IEA Secretariat. The JMC will meet routinely (every three weeks) via video conference and more frequently during critical times of the project. The JMC will be responsible for management and oversight of ongoing project operations.

A Project Advisory Committee (PAC) will be formed to provide feedback, advice and guidance at regular intervals during the project. The PAC will meet face-to-face at key times during the project (such as during framework and instrument development and analyses and reporting). The PAC will consist of a Chair appointed by the IEA, a representative(s) of the IEA Secretariat, a representative of the IEA Technical Expert Group and invited experts with a range of CIL assessment, psychometric and large-scale assessment expertise. It is possible that new members may be added to the PAC during the life of the project to bring specific expertise to the project at key times.

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