Benchmarking ICT Literacy in Tertiary Learning Settings

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Abstract

For many years now, there have been many who have agonised over the concept of a minimum computing skills level as an important outcome of schooling and education in general. Numerous terms have been used to describe this set of skills. The more familiar descriptions have included such terms as, computer awareness, computer literacy, information literacy, and information and communications technologies (ICT) literacy. In contemporary tertiary education, the need for a basic set of computing skills and understandings has returned to the agenda with the growth of interest in generic skills and in the use of ICT as instructional media and information sources. This paper describes a component of a recently completed project which sought to determine contemporary views of ICT literacy in tertiary settings and to develop some form of benchmark which could be used to assess levels of ICT literacy appropriate to this domain.

Keywords

ICT literacy, Information literacy, Information and communications technology, Technology-based learning, Higher education

Introduction

The term computer literacy has long been used as a description of people's skills and predisposition to the use of computers and information technologies. Despite suffering a loss of reputation and popularity in recent years, *computer literacy* is still pervasive in educational literature and the concatenation of computer and literacy has come to include expectations of communication skills (Anderson & Collis, 1993). In recent years, many have argued the need for a more embracing definition for the term which assumes attributes beyond computing competency (eg. Bigum & Green, 1992). But competencies and skills still remain the underpinning elements of computer and ICT literacy and are those that still provide the basis for explorations of the extent and scope of ICT applications and uptake among the different cohort of computer users.

The emerging use of the broader term of *ICT literacy* has at its roots the need to include more recent dimensions of technology brought about by such developments as networks and the Internet. Use of a range of communication tools such as e-mail, video-conferencing and the World Wide Web (WWW) for the location of information, and the subsequent dissemination of information are now reasonably considered to be components of ICT literacy and yet not necessarily that of computer literacy. In addition, many of the skills, which previously had been associated with those that an individual would need to have acquired in order to be considered computer literate, are often now seen to be components of the more encompassing term of *ICT literacy*. Authors who describe the place of computer literacy as a component of a more encompassing list of ICT skills include Eisenburg (1996) and Shapiro and Hughes (1996).

Defining ICT literacy

There have been many definitions in the past for computer literacy but all have shared common themes. Scher (1984: 25) described computer literacy as "appropriate familiarity with technology to enable a person to live and cope in the modern world". About the same time, Hunter (1984: 45) described computer literacy as "the skills and knowledge needed by a citizen to survive and thrive in a society that is dependent on technology for handling information and solving complex problems". More recently Simonson, Maurer, Montag-Torardi & Whitaker (1987: 232) defined computer literacy as "*an understanding of computer characteristics, capabilities and applications, as well as an ability to implement this knowledge in the skilful and productive use of computer applications*

suitable to the individual roles in society". Such definitions have survived the tyranny of time and the advances of technology and are still very much what underpins our contemporary understandings of ICT literacy today (eg. Smith & Necessary, 1996).

Most definitions of ICT literacy include a breakdown of the knowledge and skills of a computer literate person. These typically are categorised in ways, which facilitate some form of measurement and assessment. This breakdown often provides further insights into understandings of the terms and concepts. For example, Simonson et al. (1987) discuss four categories as critical elements of computer literacy: computer attitudes, computer applications, computer systems, and computer programming. In contemporary views many of these elements are still present in ICT literacy although more recently, writers have moved to more functional description. What the student can demonstrate, in terms of measurable conceptual and skill development relative to computers, their uses and products, has given another direction for providing a means for assessing ICT literacy. In order to provide a framework for an international assessment of functional computer abilities. Collis and Anderson (1994) identified seven rationales, which underlie general computer education. These rationales were then translated into domain objectives, which had the intention of translating forward in time rather than backwards. History has shown the need for descriptions that can move forward with the progress of the technology. The rapid change of technology and the time frame over which the study was completed meant that objectives had to be as independent of time as possible. Collis and Anderson developed four themes from which the objectives and content for a curriculum to teach ICT literacy could be developed:

- the computer as part of information technology: what are computers and how do they operate?
- applications: what students can do with information technology,
- using computers: students' computer-handling skills,
- attitudes, opinions, social context and ethics.

A contemporary view of ICT literacy

There are many views on what constitutes an appropriate functional definition for ICT literacy in contemporary settings. Some people believe ICT literacy is an absolute term, and is a measure of a person's total functional skills in use of ICT. When defined this way, measures of ICT literacy enable comparisons to be drawn between the ICT skills of people, for example, between a farmer and a rocket scientist. In nearly every instance, the rocket scientist would be deemed the most ICT literate. On the

other hand, others see the term as a relative measure of functional ICT skills. When used this way the ICT literacy of a rocket scientist is measured on a different scale to that of a farmer. It serves little purpose to be comparing the ICT skills of farmers and rocket scientists and hence it makes little sense to assume a definition that supports this use.

For the purpose of this study, we embraced the contemporary view of ICT literacy, as the set of skills and understandings required by people to enable meaningful use of ICT appropriate to their needs. In this setting, the ICT literacy of a student is a relative measure of the student's capacity to make appropriate use of ICT for educational and learning purposes. One of the early activities in the project undertaken in conjunction with the review of the literature was to talk with such stakeholders as teachers, students and educational administrators within the University and TAFE sectors. The purpose of this communication was, in part, to establish contemporary views on this subject which could inform the development of a set of scales by which appropriate ICT skills needed to make meaningful use of ICT for educational purposes could be defined.

One of the factors that is having considerable influence on contemporary perceptions of ICT literacy as it applies to the tertiary education sector, is the growing use of ICT as a medium for the flexible delivery of programs and courses (eg. Collis, 1998). Large numbers of courses across both the VET and university sectors are being delivered through ICT and this process necessarily leads to the need for a re-examination of the skills and experiences that now constitute the notion of ICT literacy. In fact, the use of ICT as a delivery medium is in itself a benchmarking process and can provide strong guidance to those exploring the needs of tertiary learners in terms of ICT skills and expertise. The level of skills needed by learners to independently function in a Web-based on-line learning environment became a benchmarking standard that guided the development of ideas in this project.

Four distinct areas of skill and expertise emerged from the interviews and literature review and these led to the determination of discrete areas that consistently emerged as being seen to be important and essential attributes of ICT literate students. These areas were: an ability to independently operate personal computer systems, (as might be found in the home), an ability to use software for preparing and presenting work, an ability to use the Internet and its various features as a communications device, and an ability to access and use information from the WWW.

An ICT literacy questionnaire

Having established what general forms of skill and expertise were characteristic of our perceptions of the ICT literate tertiary student, we undertook a process that sought to develop an instrument that could be used to ascertain the ICT literacy levels of tertiary students. Guided by previous approaches to obtaining measures of ICT literacy (eg. Meredyth et al., 1999), it was our intention to create a multiple choice instrument by which students could indicate their ICT skills and expertise by reporting the extent of their previous performance of the tasks considered appropriate to independent ICT use in tertiary education. The intention was to develop and validate a set of questions that could be used to ascertain students' skills and expertise and to use this information to develop some benchmarks against which students' self-reported skills could be measured.

The four areas identified above, were used to provide an organisational structure for the questionnaire and within each discrete skills were considered. A number of skills were selected for each scale with the view of creating a form of continuum which described the development of students' skills. It was intended to include skills that were representative of independent use but that also suggested an hierarchy so that the relative scores obtained for each scale was suggestive of a student's progress towards the independent capability indicative of ICT literacy. A set of defining skills was created for each of the four scales and discussed at length with members of the Reference Group to generate both an absolute and progressive measure of skills development. The various skills for each scale are shown in Table 1.

Computer Operations	Applications Software	Internet Skills	WWW Skills
Turning a computer on	Creating a new word processor document	Using the World Wide (WWW)	Using a WWW search engine eg. Yahoo
Opening a computer file	Modifying an existing word processor document	Sending an email message	Using keywords or phrases to search for information on the WWW
Making a backup copy of a computer file	Printing out a document	Using the WWW to find specific information	Using more advanced searching techniques than keywords or phrases
Deleting a computer file	Placing an image or graphic into a document	Taking part in an on-line discussion or chat	Finding useful information from WWW searching
Creating a directory or a folder	Creating a picture or graphic using a	Sending an attachment with an	Using information from the WWW in

	computer	email message	projects and/or assignments
Copying a file from one disk to another	Using an extended word processing feature eg. tables, styles or templates	Downloading a file from the Internet or WWW eg. music, games	Copying and pasting information from searches into personal documents
Connecting to the Internet from a remote computer eg. from home	Creating a graph using a spreadsheet	Saving an image or graphic from a WWW page	Using a bookmark to record a useful WWW address
Installing a program onto a computer eg. Office Netscape	Making a multimedia presentation eg. Powerpoint	Creating a WWW page	Using a known WWW address to find useful information

Table 1: Tasks demonstrative of tertiary students' independent ICT skills and expertise

These sets of ICT skills were organised as items in a survey form that was generated and reproduced as a computer-marked form from which could be efficiently administered to students. Students were asked to nominate which of the skills they had previously performed and the extent of that performance using the responses, never, once or twice, occasionally and many times. For the purpose of the validation process, the number of discrete tasks which students reported having performed at least once were recorded and summed to provide a number between 0 and 8 for each student across each scale.

Benchmarking ICT Literacy

There are no firm benchmarks of ICT literacy that are currently available and that can be used unquestionably to provide a means for comparing students. In previous studies of ICT literacy, the measures obtained have been usually used to compare only those students in the populations sampled. There are no firm unifying concepts that have to date provided a universal structure or guidance. In most instances, levels of student ICT literacy have never meant much outside their immediate context. In this study, it was planned to choose a benchmark figure that could be applied beyond the immediate setting. For the purposes of this study, it was decided to benchmark levels of ICT literacy against the minimal needs of tertiary students exposed to ICT-based modes of flexible delivery of programs and courses. Using this setting as a benchmark figure provided a means to argue the need for particular skills and expertise.

There were a number of factors that suggested this was an appropriate approach to take. In the first instance, the literature describing the concept of generic skills for tertiary students often includes discussions of

appropriate ICT skills and expertise. The generic ICT skills that are mentioned tend to be drawn from, and based upon, the forms of ICT experiences that are evident in technology-facilitated learning environments. Secondly, the link to learning is often emphasised in discussions of generic ICT skills by the explicit assumption that amongst other things, they also serve the particular purpose of facilitating lifelong learning. ICT is seen as a valuable vehicle supporting lifelong learning, but its use demands appropriate ICT skills and expertise.

The forms of contemporary flexible courses and programs that support lifelong learning often involve the use of the Internet as a means of delivering WWW-based on-line courses. To participate in on-line courses, students need a degree of expertise in the various scales described in this study. The students need to be able to independently operate their own personal computer and to manage the various peripherals and associated software applications. Independent learners involved with Web-based learning materials need also to be self-sufficient in their management and use of a computer and an Internet connection.

For assistance in this benchmarking process, we turned to members of the Reference Group who helped to determine different task lists. Discussions with members of the group revolved around determining the minimum skills from the chosen lists each would consider necessary for independent use of the various resources and technologies to support tertiary learning in flexibly-delivered environments.

Consensus was that within each of the four skills areas, a minimum level of competence in at least 6 of the 8 tasks represented a level of competence indicative of a capacity for independent use of the various forms of ICT represented. The tasks describing operation skills, software applications, Internet usage and WWW usage were carefully considered and the figure of 6 agreed upon. It was agreed that such a score represented the level of competence that could reasonably be expected of a tertiary student who could use ICT independently and in a self-sufficient way for educational purposes.
It was clear that some students could be, and many students would be, using ICT for educational purposes with less skills than this level. But it was felt that students with less than this level of expertise could not comfortably be self-sufficient in their use of ICT and would require some form of help and assistance. For many students with marginally less than this level of skills, it was quite likely that self-instruction and experience was all that might be needed to elevate their skills to the benchmark level.

It was considered that those students demonstrating skills in less than three of the listed skills across each of the four scales would represent very dependent users of ICT, requiring the assistance of others for many of the tasks associated with Web-based flexible delivery. Students demonstrating expertise between these two ranges were considered to be developing independence. The various categories and the various cut-off marks are shown in Table 2.

Total	0	1	2	3	4	5	6	7	8
Computer operations		Dependent			Developing independence			Independent	
Applications software		Dependent			Developing independence			Independent	
Internet skills		Dependent			Developing independence			Independent	
WWW skills		Dependent			Developing independence			Independent	

Table 2: Suggested extent of skills needed for independence in ICT use for tertiary learning

Validation of the Benchmark

In order to provide some validation of the proposed benchmark figures, the survey form was administered among 3,500 university students in institutions throughout Australia. The institutions were chosen to provide a geographic spread, and to provide access to such groups as on-campus and off-campus enrollees in both full and part-time modes. Courses within the various institutions were targeted to provide a reasonable spread of discipline areas and years of study. It was not intended that the sample be representative of the Australian university population but more to provide a diverse group of students using ICT in a variety of ways as means for exploring possible ways to validate the benchmark figures.

In order to explore students' current access to, and use of, ICT, they were asked to indicate the regularity of their use of ICT both within and outside their educational programs. Table 3 shows the extent of this use reported by the students in the sample. It did not come as a surprise to find that over 95% of the students reported regular use of ICT (once or twice a week, or more) and that only very few did not make use of ICT in this regular fashion (4.8%). Among the sample we also found that 83.4% of the students reported making regular use of ICT at home and 64% of the students sampled also reported making regular use of the Internet from their homes.

Place	No use	Irregular use	Regular use
HE Institution	13.2%	21.9%	64.9%
HE Home	8.5%	8.1%	83.4%
HE Work	42.3%	13.6%	44.1%
Maximum use	**0.3%**	**4.5%**	**95.2%**

Table 3: Students' levels of ICT access and use

Table 4 shows the students' total number of responses against the four skills scales reported by each student as cumulative frequencies. There were very few students in the sample who reported having previously performed less than three of the skills listed in each scale. The skills which students had performed the least were those involving the Internet while the others demonstrated very high levels of performance among the tertiary students.

Total	0	1	2	3	4	5	6	7	8
	0.2%	0.3%	0.9%	1.7%	2.9%	4.9%	9.8%	16.5%	62.8%
Operational skills	dependent 1.4%				9.5%		independent 89.1%		
	0.8%	0.9%	1.5%	2.7%	3.2%	5.4%	7.6%	21.5%	56.4%
Application skills	dependent 3.2%				11.3%		independent 85.5%		
	2.5%	2.0%	5.4%	7.8%	8.8%	11.2%	14.2%	22.7%	25.4%
Internet skills	dependent 9.9%				27.8%		independent 62.3%		
	3.2%	1.2%	0.8%	1.3%	3.4%	6.0%	11.1%	21.0%	52.0%
WWW skills	dependent 5.2%				10.4		independent 84.1%		

Table 4: Students' reported skills performances

When the skills levels were compared to the previously determined benchmark figure for independent use, the results indicated that 89.1 % of the sample appeared capable of independent use of personal computers, 85.5% capable of independent use of the applications software, 62.3% were capable of independent use of the Internet and 84.1% independent use of the WWW.

These figures in themselves are quite interesting from the prospect of considering the ICT literacy levels of Australian tertiary students. While

they seem high, it is important to remember that the skills that they represent are not particularly difficult and are representative of skills that most teachers would want their students capable of performing as a matter of course. But the purpose of this paper is not to discuss the levels of achievement but to discuss the benchmarks suggested by these results.

To provide some empirical form of validation to the relatively arbitrary choice of the benchmark figure of 6, the results of the students were considered in light of students reported levels of ICT use. The number of students reporting regular use of ICT was nearly 95%. The number of students reporting regular home use of the Internet was approximately 65%. Since ICT skills and expertise are usually closely linked to access and usage (eg. Selwyn, 1998), these figures provided a means to test our benchmarking processes.

There were a number of ways to test its accuracy. Table 5 provides a summary of the students' scores against each of the scales and shows the number of students whose scores in each scale exceeded the score indices of 5, 6 and 7. With a benchmark score index of 6, the results suggest that the number of students with independent ICT skills roughly matches the number with regular home access and use. Table 5 shows that at this figure, the numbers of students that could be classified as "having a capability for independence" were 89.1%, 85.5%, 62.3% and 84.1% respectively. These figures are slightly less than the proportions of university students reporting regular use of ICT. For example, while 95.2% of the students reported using ICT regularly, 89.1% of the students achieved the benchmark score suggesting a capacity indicative of independence in operational skills, and 85.5% achieved a the benchmark score indicative of independence in applications skills. If we assume that the vast majority of students who make regular use of ICT either in their work, home or at their institution, would be independent users, the benchmark figure of six seems appropriate. This argument is also supported by the scores associated with independent Internet use. 65% of the students reported home Internet access and with a benchmark score of 6, 62.3% of the students appear capable of independent Internet use. The benchmark score of 6 appears to stand up to scrutiny in such comparisons.

Score index	Computer operations	Applications software	Internet skills	WWW skills	Regular use	Regular home use	Regular home Internet use
5	94.0%	90.9%	73.5%	90.1%	95%	83%	64%
6	89.1%	85.5%	62.3%	84.1%	95%	83%	64%

7	79.3%	71.9%	48.1%	73.0%	95%	83%	64%

Table 5: Benchmarking ICT literacy for HE students

The discussion of which score index provides the better benchmark figure is more academic than practical and was really only undertaken as a means of establishing some form of standard that could be used to assess progress. Clearly, it would be in the interests of every university student to achieve a score of 8 across all these scales because the scales list skills representative of what is needed by students for independent use of ICT studying in contemporary settings.

Another phase of the study was to compare these results against other groups of students using ICT for teaching and learning in the TAFE sector. It is beyond the scope of this paper to report these results, but as can be imagined, the TAFE results showed lower levels of ICT use and access among their students but provided similar data to support the process of attempting to create a benchmark figure. In future papers, we intend to present further data and analyses that should enable this instrument to be used as a means to identify and compare levels of ICT skills and literacy in some normative way among Australian tertiary students.

Summary and Conclusion

This paper has reported on a study undertaken among Australian university students which has explored the prospect of creating a means to measure and benchmark tertiary students levels of ICT literacy through a determination of their skills and expertise with various components of ICT. The paper has discussed the rationale behind the development of a survey instrument and provided details of the results of students in a country-wide implementation. The results suggest that it is possible to benchmark ICT literacy when it is defined in the functional way used in this project. The results also suggest that while ICT skills levels appear quite high in the university sector, there are still many university students whose access to ICT and use of ICT would likely impede their learning and progression in courses and programs where use is made of contemporary forms of ICT. The paper is part of a large project and future publications will be used to explore these issues further.

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