ACER Research Monograph No 64

ICT in the Teaching of Science and Mathematics in Year 8 in Australia

A Report from the IEA Second International Technology in Education Study (SITES) Survey

John Ainley,
Frances Eveleigh,
Chris Freeman
Kate O'Malley

December 2010

Australian Council *for* Educational Research

ACER

ISBN 978-1-74286-015-2

Published 2010 by
Australian Council for Educational Research Ltd
19 Prospect Hill Road, CAMBERWELL VICTORIA 3124 AUSTRALIA

CONTENTS

TABLES

EXECUTIVE SUMMARY

Information and communication technologies (ICT) have changed the environment in which students develop and impacted on the way they learn in schools. The importance of ICT in education is recognised in the policy documents of many countries (MCEETYA, 2008; Plomp et al, 2009). In Australia, the *Digital Education Revolution* which commenced in 2008 is providing significant support for improving ICT provision in schools through the provision of computer equipment, enhanced internet connectivity, digital curriculum resources and teacher development in ICT.

Australian Strengths in ICT in Education

The evidence from the IEA *Second International Technology in Education Study* (SITES) survey in this report supports evidence from other surveys that indicates Australia is well placed to take advantage of the opportunities provided through ICT in education. Data from international surveys such as PISA and TIMSS indicate that Australia has high levels of computer provision in primary and secondary schools and high percentages of Australian students have access to ICT resources at home (Anderson & Ainley, 2009). This SITES survey was conducted internationally in 22 countries during 2006 and then implemented in Australia as a comparison study in 2007. The SITES survey provides more detailed results for Year 8 mathematics and science that are consistent with these overall findings. With an average ratio of 2.5 students per computer (or 3.2 students per student-accessible computer), at the time of the survey in 2006-2007 Australia was one of a group of three education systems (the others being Norway and the Alberta province in Canada) with the highest levels of computer provision amongst Year 8 students in secondary schools.

The SITES survey also indicates that Australian science and mathematics teachers are relatively high users of ICT compared to their counterparts in other countries. A higher percentage of Year 8 science teachers in Australian secondary schools used ICT in the past year than in most other countries surveyed (similar to Singapore, Hong Kong SAR, and Alberta). In addition, Australia was one of a group of countries in which a high percentage of Year 8 mathematics teachers used ICT (behind only Norway). Compared with their peers in other countries, Year 8 science and mathematics teachers in Australia are confident users of ICT. In terms of confidence in using ICT, science teachers in Australia were not significantly different from those in Singapore, Hong Kong, Alberta, Ontario, Chile, and Norway and more confident their peers in other countries. Year 8 mathematics teachers in Australia have similar levels of confidence to those in Hong Kong, Singapore, Ontario, Alberta, Denmark, Chile and Norway and are more confident than their peers in other countries.

Areas for the Development of ICT in Education

At the time of the survey, computers in Australian secondary schools were less often located in classrooms (and more often in computer laboratories) than in countries such as Hong Kong, Norway, Canada and Finland. The survey found that Australia is also a moderately high user of other ICT resources such as smart boards but is relatively low in terms of providing email facilities for students and data logging technologies for use in science classes.

Despite their confidence in being able to use ICT, fewer Australian science and mathematics teachers than their peers in countries such as Chinese Taipei, Hong Kong, Israel, Estonia or Denmark participated in ICT-related professional development. The data from SITES suggest that there remains much to be done in extending professional development for teachers but that this should not be at the level of introductory courses.

Factors Associated with the Pedagogical Use of ICT

The use of ICT is greater when teachers have a higher level of or confidence in ICT, when teachers have participated in ICT-related professional development, and when there are fewer contextual obstacles (infrastructure, digital learning resources, ICT access). In most countries the percentage of teachers reporting ICT use is significantly higher for science teachers than for mathematics teachers. This result has also been reported in other studies (Kozma and McGhee, 2003; Law et al, 2008 Jones, 2004). One inference to be drawn from this is that the subject (or discipline) context is an important aspect of the uptake of ICT in teaching. It may be that some subjects lend themselves more readily to the pedagogical use of ICT, that there are stronger traditions of innovation in some subjects or that digital resources are more available in some subjects than others.

Factors Impeding the Pedagogical Use of ICT

The most frequently cited obstacle to incorporating ICT in teaching was the time required to develop and implement activities. Another factor mentioned was the availability of digital learning resources in schools and student access to ICT tools. Infrastructure was seen as an obstacle to ICT use by only about one quarter of Australian teachers and a similar number cited their own knowledge of using ICT in pedagogy as a limiting factor. These patterns were similar for science and mathematics teachers. School principals also indicated that a lack of time for teachers to use ICT was an obstacle to incorporating it in teaching.

Education System Strategies for the Use of ICT in Teaching and Learning

The SITES survey also suggests that the implementation of ICT in teaching would be enhanced by building the capacities of teachers (through an expansion of professional development) as well as removing contextual obstacles by improving the resources available to students and teachers. Three of the four top priorities nominated by school principals for enhancing the use of ICT in their schools, involved teachers: improving the ability of teachers to make good pedagogical use of ICT, improving the technical skills of teachers and increasing the number of teachers using ICT for teaching/learning purposes.

Conclusion

Comparative international studies such as SITES can provide a context for national perspectives on educational issues such as the use of ICT in teaching. When data from SITES in Australia are compared with data from other countries they suggest that ICT has been relatively widely adopted (at least in science and mathematics in Year 8 at secondary schools), that there is a relatively strong provision of computers in schools and that teachers are more confident in their ICT capability than their peers in other countries.

ICT in the Teaching of Science and Mathematics in Year 8 in Australia

A Report from the IEA Second International Technology in Education Study (SITES) Survey

1
INTRODUCTION

The IEA Second International Technology in Education Study (SITES) is an international comparative research program studying the use of Information and Communications Technology (ICT) in education (Law, Pelgrum & Plomp, 2008). Its central focus is on understanding how ICT affects the way teaching and learning takes place in schools. In many educational systems there is a desire to use ICT to support changes in teaching and learning and policies have been implemented to promote the use of ICT by equipping schools with computers and network connections, training teachers in the use of ICT and providing digital resources. Although there is a growing body of research on the educational effects of ICT, much of it is based on intensive studies of small samples. SITES, however, surveyed large representative samples of schools using questionnaires with established psychometric properties so that variations within, and among, countries in the links between ICT and pedagogy could be investigated. The SITES project was conducted internationally in 22 countries during 2006 and then implemented in Australia as a comparison study in 2007.

ICT in Australian Education

There are two strands to the application of ICT in school education. The first concerns developing the ICT proficiency of students so that they can participate fully in modern society. It is captured in Goal 1.6 of the *National Goals for Schooling*, which states that when students leave school they should 'be confident, creative and productive users of new technologies, particularly information and communication technologies, and understand the impact of those technologies on society' (MCEETYA 1999). The second strand refers to the use of ICT to facilitate new approaches to teaching and learning in schools and is captured in the MCEETYA document entitled *Contemporary Learning: Learning in an Online World* (MCEETYA 2005). The first of these strands is evaluated through the National Assessment Program in ICT Literacy (MCEETYA 2007). The second of these strands is evaluated by studies such as SITES.

Overall, the plan entitled *Learning in an On-line World* (MCEETYA 2000) established strategies such as implementing an ICT infrastructure, developing digital resources for schools, and developing teacher competence in the effective use of ICT. It aimed to facilitate the uptake and use of ICT in schools and establish a framework to support the use of ICT to enhance learning.

Australian Students and ICT

Large scale international assessments such as the IEA Trends in International Mathematics and Science Study (TIMSS) and the OECD Programme for International Student Assessment (PISA) have provided evidence that Australian school students have levels of access to computers at home and school that are among the highest in the world. In 2003, 90 per cent of 15-year-old students in Australia indicated that they had used a computer for more than three years, and 69 per cent said they had used a computer for more than five years (OECD 2006).

More than half (55 per cent) of the students indicated that they used a computer at home almost every day, and a further 32 per cent that they used a computer at home several times each week. Three out of five (59 per cent) 15-year-old students used a computer at least several times each week at school. Among OECD countries, Australia records the second highest level of computer use at school, after the United Kingdom.

Overall, a higher percentage of students use computers on a weekly basis for accessing the internet, or for entertainment purposes, than for accessing software applications. Of the listed activities in this category, 'looking up information' and 'communication' had the highest percentage of males and females reporting usage on at least a weekly basis. A smaller percentage of students reported at least weekly use of various software programs and applications; only the use of word-processing programs was reported by a high percentage of students.

PISA data show that Australian 15-year-old students report high levels of confidence (compared to their peers in other countries) in their ability to use computers for routine- and higher-level tasks (OECD 2005; Thomson & de Bortoli, 2005). Nine out of 10 students said they were confident they could perform routine computer tasks, and a substantial majority (approximately eight out 10) said they were confident of their ability to perform various internet tasks. The average number of Australian 15-year old students confident in their capacity to perform these tasks was higher than the average number of students across the OECD.

However, the question that remains has to do with the extent to which ICT is used in schools to influence the ways in which teaching and learning take place. SITES 2006 is designed to address this question in the context of secondary school science and mathematics teaching.

Previous SITES Modules

Prior to the commencement of SITES 2006, two modules in the SITES sequence had been undertaken. Module 1 (SITES-M1) was a 1998 school survey of principals and technology coordinators designed to help the participating countries compare their use of ICT in teaching and learning with the other countries taking part. A total of 26 education systems from Europe, North America and Asia participated in the study (Pelgrum & Anderson 1999). SITES-M1 established that, in most countries, there had been a significant investment in computers in schools and in connecting schools to the Internet. It also suggested that school principals considered ICT to be important in their schools and that a significant proportion of teachers had used ICT to change approaches to teaching and learning.

Module 2 (SITES-M2) explored the relationship between ICT and teaching in greater depth. It was an international study of pedagogical practices which were seen to use information and communication technology (ICT) in an innovative way (Kozma 2003). In total, 28 education systems from around the world, including Australia, took part in the study and a set of 174 qualitative case studies of innovative pedagogical practices using ICT were identified by national panels from the participating education systems. Australia contributed five of those case studies. Each case was investigated intensively using qualitative and quantitative methods using a common framework. The results were synthesised so as to provide an overview that utilised the variation that is present across so many education systems.

SITES Module 2 identified the following seven patterns of innovation using ICT (Kozma, 2003):

- Tool use including communication and productivity tools such as word processing, spreadsheets, databases, and multimedia;
- Student collaborative research involving groups collecting and analysing data;
- Information management focussing on searching for, organising, managing and using information for teaching and learning;
- Teacher collaboration that often focussed on design of instructional materials and activities (the majority of these were from upper secondary schools);
- Outside communication that involved students working with others outside the classroom and was characterised by the use of email, the Internet, conferencing software and listserves;
- Product creation that focused on the design of digital products; and
- Tutorial projects in which software was used to provide opportunities to practice and refine skills.

Characteristics of Countries in SITES

There were 22 countries that participated in SITES 2006, with Australia participating as a benchmarking country in 2007. Demographic characteristics and indicators of information technology use are shown in Table 1.1. The participating countries ranged in population from 1.3 million (Estonia) to 144 million (Russia), in urbanisation from 32 per cent (Thailand) to 100 per cent (Singapore and Hong Kong) and in GDP per capita from US$8,039 (Thailand) to US$38,454 (Norway). In terms of technology use the countries ranged from 78 internet users per 1,000 people (South Africa) to 696 internet users per 1,000 people (Denmark).

Compared to the countries in SITES 2006, Australia was relatively wealthy in terms of GDP per capita, relatively highly urbanised, and had a high ratio of internet users (but only an average ratio of mobile phone usage). Australia had a spread of income inequality about average for this group of countries.

Major Research Questions

SITES 2006 took the view that teaching practices that use ICT are part of the overall teaching approach of teachers. In other words, the way ICT is used in classrooms is shaped by broader teaching orientations, by the school and systemic contexts in which they operate, and by the availability of the technological resources. SITES 2006 was guided by two broad questions.

1. How and to what extent is ICT used in education and how does it influence pedagogical practice?

2. How are various factors hypothesised to indicate readiness to adopt ICT actually associated with the use of ICT in teaching and learning in mathematics and science?

Table 1.1 Country (Educational System) Characteristics for SITES 2006

Country/ System	Population (Millions)	% Urbanisation	GDP Per Capita (in US$)	Income Inequality (in US$)	Cell Phone Users Per 1,000	Internet Users Per 1,000
Alberta, Canada	3.3	70	29,263	9,400	469	646
Australia	**19.9**	**90**	**30,331**	**12,500**	**818**	**646**
Catalonia, Spain	7.2	82	29,645	10,300	905	336
Chile	16.1	87	10,874	40,600	593	267
Chinese Taipei	23.0	60	12,941	18,400	677	273
Denmark	5.4	86	31,914	8,100	956	696
Estonia	1.3	69	14,555	6,500	931	497
Finland	5.2	61	29,951	5,600	954	629
France	60.3	77	29,300	9,100	738	414
Hong Kong SAR	7.0	100	30,822	17,800	1,184	506
Israel	6.6	92	24,382	13,400	1,057	471
Italy	58.0	68	28,180	11,600	1,090	501
Japan	127.9	66	29,251	4,500	716	587
Lithuania	3.4	67	13,107	10,400	996	282
Moscow, Russia	10.9	79	9,902	13,700	617	211
Norway	4.6	77	38,454	6,100	861	390
Ontario, Canada	12.5	82	32,663	9,400	489	689
Russian Federation	143.9	73	9,902	12,700	517	111
Singapore	4.3	100	28,077	17,700	910	571
Slovak Republic	5.4	56	14,623	6,700	794	423
Slovenia	2.0	51	20,939	5,900	951	476
South Africa	47.2	59	11,192	33,100	428	78
Thailand	63.7	32	8,090	12,600	430	109

Notes:
Primary source of all indicators was the UNDP Human Development Report, 2006. Except where otherwise noted, the statistics were based on 2004 data.
(u1) Total population in millions
(u2) Percent of population in urban areas
(u3) Gross Domestic Product per person in US$.
(u4) Income inequality is measured by subtracting the average per capita income of the lowest-earning 10% of the population from top-earning 10% (figures in US$)
(u5) Cell Phone users are the number of users per 1,000 people in 2003
(u6) Internet users per one thousand people in 2003

Report Outline

This report is organised around five chapters. This first chapter provides an introduction to the study in Australia. Chapter 2 outlines the research methodology including the design, instrumentation, population definition and sample design, scales and data collection. Chapter 3 provides information about teachers and their teaching practices in mathematics and science that make use of ICT. In Chapter 4 the characteristics of schools (and of teachers within schools) that are associated with the use of ICT are discussed. This includes a consideration of the support structures that appear to be linked to the uptake of ICT in teaching. Chapter 5 summarises the conclusions and interpretations that can be drawn from this study.

2
FRAMEWORK, DESIGN AND METHODS

The Second International Technology in Education Study (SITES) was initiated in 1997 by the International Association for the Evaluation of Educational Achievement (IEA) in order to investigate the role of Information and Communication Technology (ICT) in education. This study aimed to address the forms and extent of ICT use in schools, the factors associated with the use of ICT and the relationship of ICT use to identified pedagogical practices. Furthermore, this study was undertaken to provide international benchmarks of both the extent to which ICT is used and how it is associated with pedagogical practices, and the outcomes of this study will assist national policy-makers to make informed judgments about developments in their national education system as compared to other countries.

Research Questions and Hypotheses

The final component of the study, SITES 2006, was a large-scale survey involving teachers, principals and ICT coordinators from schools in education systems from Australia and across the globe. It addressed two general research questions.

Research Question 1: How and to what extent is ICT used in education and how does it influence pedagogical practice?

(a) Does the extent and nature of use of ICT differ in mathematics and science?

(b) What pedagogical practices utilise ICT?

(c) How is the pedagogical use of ICT supported by school policies and goals?

Research Question 2: How are various factors identified in previous modules of SITES associated with the use of ICT in teaching and learning in mathematics and science? Some readiness factors include:

(a) The availability of various ICT resources and technical support for their use.

(b) The expertise of teachers in ICT and communication among teachers.

(c) ICT-related vision of, and established practice in, pedagogy.

Furthermore, results from the previous SITES modules led to the formulation of the following research hypotheses which were tested in this most recent SITES study:

1. The extent of use of ICT for pedagogical purposes in mathematics and science will be related to the level and nature of ICT resources available.

2. The use of ICT in teaching and learning will depend on the expertise or competence of teachers in ICT.

3. The pedagogical use of ICT will depend on the support available to teachers.

Design and Instrumentation

SITES 2006 applied online data collection (ODC) for the school and teacher surveys. In doing so, the design of the study acknowledged that in the forthcoming years international comparative assessments will enter a transition stage in which the traditional paper-and-pencil approach would be gradually replaced by online data collection. The online data collection technology developed by the IEA Data Processing and Research Centre (DPC) uses a thin client technology that requires minimal resources and is designed to look like the paper version of the questionnaire. The use of ODC was considered appropriate for a survey about the use of ICT for teaching and learning purposes in schools. Paper versions of the instruments, however, were always available to participants who requested them. Data were collected, stored and processed on a central location at the ACER offices in Sydney. Basic scaling and weighting were performed by the IEA DPC.

Instruments

The three questionnaires which were used in the survey were developed by the IEA. The first of these, the teacher questionnaire, was administered to Year 8 teachers of mathematics and/or science. It covered issues concerned with:

- curriculum goals;
- teachers' practices;
- students' practices;
- teaching materials;
- organisation of learning tasks;
- assessment of student learning;
- specific use of ICT in teaching; and
- teacher characteristics (including experience with and competence in ICT, and approaches to the use of ICT in teaching).

The second questionnaire, the school questionnaire, was administered to school principals and covered issues concerned with:

- school educational profile;
- school policies and practices on ICT;
- staff development;
- orientation to the use of ICT;
- technical and pedagogical support; and
- perceived obstacles to the use of ICT.

The third questionnaire, the technical questionnaire, was administered to the ICT coordinator at each school and covered issues concerned with:

- school history of using ICT;
- resource materials (mainly ICT based resources – including software);
- ICT equipment;
- staff development;
- support facilities for ICT; and
- perceived obstacles to the use of ICT.

The questionnaires were extensively field tested and then used in 22 education systems by the IEA as part of the SITES international survey in 2006. There was a process of piloting of draft materials in the middle of 2005 (including a pilot of the ODC process) and a field test in late 2005. The main survey was then conducted in 20 countries in the middle of 2006, and then in Australia from late 2007 to early 2008.

Populations and Sampling

The SITES survey was structured around two distinct populations: a school population, in which each sampled school had to include the necessary target grade; and a teacher population, from which mathematics and science teachers of the aforementioned target grade would be selected.

The target grade within the school population was defined as that which 'represented eight years of schooling, counting from the first year of ISCED Level 1' (SITES 2006 MS Sampling Manual, 14). In most education systems, including Australia, this is called Year 8 or Grade 8. The school target population was therefore defined as all schools in which students were enrolled in Year 8 classes.

School sample

The IEA standards required a sample that would produce confidence intervals of means that were one tenth of a standard deviation and of percentages (at 50 per cent) that were less than five percentage points. In practice, this meant that a minimum of 400 schools needed to be sampled. After consultation with the international sampling referee, it was suggested that in order to validly sample small states and territories (and non-urban locations) a little more than 400 schools would be needed in Australia. The total number of sampled schools in Australia was consequently set at 416. As advised by the IEA, the Australian national school sample was selected by the IEA DPC. This centralised sampling selection was undertaken primarily to maintain a standardisation with respect to sample implementation and documentation across education systems internationally.

The sample of schools involved explicit stratification by school size with equal probability sampling within five explicit strata based on school size. State and sector was used for implicit stratification[1]. The sample was checked to ensure that geolocation and socioeconomic characteristics of the area were representative of the population.

Teacher sample

The teacher sample was sourced from each of the participating sampled schools. Schools were asked to provide lists of all Year 8 maths and Year 8 science teachers currently employed at that school. From these supplied lists, a designated number of teachers from both the Maths and Science subjects were selected. The number of teachers selected from each subject was determined by the level of ICT usage in the classroom demonstrated by the listed teachers. That is, the within-school sample of teachers for each subject was determined by the percentage of teachers on the Teacher Listing Form who used ICT for teaching and learning purposes at least once a year, so that:

- two teachers per subject were selected for any school with an estimated percentage of ICT users between 76 and 100 per cent;
- three teachers per subject were selected for any school with an estimated percentage of ICT users between 51 and 75 per cent;

[1] Tasmania was explicitly stratified and over-sampled to increase the sample size in this state.

- four teachers per subject were selected for any school with an estimated percentage of ICT users between 1 and 50 per cent;
- two teachers per subject were selected for any school with no estimated ICT users[2].

ICT using teachers were defined as 'teachers who use computers (or an equivalent with the same functionalities as a computer) at least once a year with their students for teaching/learning purposes' (SITES 2006 MS Sampling Manual, 12). This percentage was estimated by the designated School Coordinator at each school.

Replacement schools

For each of the sampled schools in the sampling frame, two replacement schools (R1 and R2) were also provided by the IEA. In the event of an originally sampled school being unable to participate in the study, their respective replacement schools were approached (first R1, then R2). Replacement schools were determined by the use of implicit stratification variables. The school sampling frame was ordered by size, and for each sampled school, the schools immediately preceding it and immediately following it on the sampling frame were labelled R2 and R1 respectively.

Designated replacement schools limit the potential for bias in the response data. Identifying replacement schools in advance for non-participating sampled schools helps to avoid both large sample size losses and the arbitrary use of alternate replacement schools. Moreover, as the IEA asserts, the use of designated replacement schools is 'conceptually more palatable than over-sampling to accommodate a low participation rate' (SITES 2006 MS Sampling Manual, 34).

Scales and Indicators

The testing of the research hypotheses outlined previously involved several approaches based on indicators developed as part of the international study. The indicators include single-item indicators (usually reported as a percentage) and multiple-item indicators of concepts such as ICT utilisation or pedagogical approach. These scales have been established using the data from other countries and were applied to the Australian data after testing whether they fit the Australian data. Relationships between the key variables in the research hypotheses were examined using bivariate measures of association (such as cross-tabulations and correlations) and multivariate analyses of associations (such as regression analysis).

Data Collection and Data Quality

The first step in administering the questionnaires involved seeking permission from all government and non-government school authorities in Australia to conduct the survey in schools in their jurisdiction. Approval was also required from the ABS Statistical Clearinghouse because the survey involved contacting more than 50 non-government schools. Letters to the Chief Executive Officers of school authorities seeking approval to conduct the survey were lodged with State and Territory education authorities on 28 August 2007. Approvals were received over the period from 20 September to 29 October.

---

[2] Teachers who taught both Maths and Science could be sampled in either subject but once selected were replaced by another double-subject teacher. In small schools where there was only one teacher who taught both Maths and Science the teacher was selected at random as either Maths or Science.

Once permission to approach schools in each jurisdiction was obtained, an invitation package was sent to each school principal in the sample. The package contained a letter outlining the details of the study and requesting the involvement of the school, an approval letter from the relevant authority for ACER to approach schools, and a fax-back form asking the principal to nominate a school coordinator and to supply the contact details for both themselves and this coordinator. Details were also provided on sources for additional assistance: a freecall 1800 number and the SITES email address. Clarification was provided to principals through these avenues. To improve the response from contacted schools, principals were contacted directly by phone, fax and email. If a sampled school refused to participate (or was unable to participate for another reason), the first replacement school was approached, followed by the second replacement school if necessary. The survey administration extended to 31 March 2008 to enable sufficient time to build the sample.

Upon the initial agreement from school principals for the administration of SITES in their schools, the nominated school coordinator was contacted via email and asked to provide the Maths and Science Teacher Listing Forms and estimate the ICT usage of the teachers listed. Once the School Coordinator returned the list of teachers who met the criteria for inclusion, ACER sampled between two and four teachers from each subject to participate in the survey utilising the variables of gender and year of birth to obtain as accurate a representation of teachers as possible. All principals and ICT coordinators were invited to take part.

Following the drawing of the maths and science teacher sample, ACER sent a SITES pack to the schools via the school coordinators. This pack contained a Teacher Tracking Form listing all sampled teachers, instructions on how to administer the questionnaire if paper copies were requested, and individual, sealed letters for the principal, technical coordinator and all sampled teachers containing unique login details and information on how to complete the survey online. Participants were provided with the option of completing the survey on-line or in paper form (in some instances participants elected to omit some personal information). From previous studies it was discerned that most teachers now prefer to complete surveys online, which has the ultimate effect of improving participation rates and reducing data entry costs.

The online system ran over a secure connection, ensuring that all data travelling over the network were encrypted. Participants who preferred to complete a paper copy of the questionnaire were supplied with the requested paper instrument. The total number of participants (teachers, principals and technical coordinators) who completed the paper version of the questionnaire came to 263, which was equal to just over 16 per cent of total participants. These participants were supplied with individual, ACER-addressed, FreePost envelopes to ensure that confidentiality was maintained (so that the completed questionnaire was not subject to the involvement of the designated school coordinator), and that no financial costs were borne by the participants themselves.

ACER maintained regular contact with schools and emphasised that all responses to the survey would be strictly confidential, and that no results would be reported for individual teachers or schools. Schools were also informed that they would be sent a summary of the main results and that all publications would refer to aggregated data.

Participation Rates

All participation rates are outlined in Tables 2.1 to 2.6. The concepts of school 'response rates' and 'participation rates' are distinct in that the former includes schools that initially agreed to take part in the study, but whose within-school participation rates were not high enough to be included in the data. The latter includes only schools whose within-school participation rates were adequate and who were consequently included in the data. With respect to within-school figures, teachers who 'responded' (that is, teachers who returned a non-empty questionnaire) were automatically deemed as 'participating'. The tables below therefore refer to within-school participation rates in order to maintain consistency with the aforementioned school participation rate nomenclature.

School participation rates

A summary of school response and participation rates is presented in Table 2.1. As outlined on pages 23 and 24 of the SITES 2006 MS Sampling Manual, a school was defined as a participating school if:

1. The school returned the school principal questionnaire OR the technical coordinator questionnaire AND at least 2 teacher questionnaires; or
2. The school returned at least 50 per cent of the teacher questionnaires.

There were 416 schools in the original Australian school sample. Data were received from 181 first-choice sampled schools (giving a response rate before replacement of 44 per cent), and 135 replacement (R1 and R2) schools (giving a response rate after replacement of 76 per cent). The total number of responding schools was 316. Of this number, however, 17 schools failed to reach the necessary within-school participation rates and could not be included in the final data. This then left a total of 299 participating schools, which represents a final school participation rate of 72 per cent.

Table 2.1 School Response and Participation Rates for Australia (Before and After Replacement)

Number of schools sampled	Number of responding schools (before replacement)	School response rate (before replacement)	Number of responding schools (after replacement)	School response rate (after replacement)	Number of participating schools (after reduction for low-within school response)	**Final school participation rate**
416	181	44%	316	76%	299	**72%**

Table 2.2 Teacher Participation Rates for Australia

Number of schools sampled	Number of participating schools	School participation rate	Number of teachers sampled	Number of participating teachers	Within-school teacher participation rate	**Final teacher participation rate**
416	299	72%	1281	1104	86%	**62%**

Table 2.3 Principal Participation Rates for Australia

Number of schools sampled	Number of participating schools	School participation rate	Number of principals sampled	Number of participating principals	Within-school principal participation rate	**Final principal participation rate**
416	299	72%	299	254	85%	**61%**

Table 2.4 Technical Coordinator (TC) Participation Rates for Australia

Number of schools sampled	Number of participating schools	School participation rate	Number of TCs sampled	Number of participating TCs	Within-school TC participation rate	**Final TC participation rate**
416	299	72%	299	265	89%	**64%**

Table 2.5 Final School and Teacher Participation Rates by State and Territory

State	Number of schools sampled	Number of participating schools	School participation rate	Number of teachers sampled	Number of participating teachers	Within-school teacher participation rate	**Final teacher participation rate**
New South Wales	126	96	76%	416	345	83%	**63%**
Victoria	88	69	78%	274	249	91%	**71%**
Queensland	79	57	72%	267	229	86%	**62%**
South Australia	32	27	84%	114	100	88%	**74%**
Western Australia	48	26	54%	106	90	85%	**46%**
Tasmania	30	18	60%	77	70	91%	**55%**
Northern Territory	7	2	29%	10	7	70%	**20%**
Australian Capital Territory	6	4	67%	17	14	82%	**55%**

Table 2.6 Final School and Teacher Participation Rates by School Sector

Sector	Number of schools sampled	Number of participating schools	School participation rate	Number of teachers sampled	Number of participating teachers	Within-school teacher participation rate	**Final teacher participation rate**
Catholic	79	51	65%	230	196	85%	**55%**
Government	251	180	72%	800	678	85%	**61%**
Independent	86	68	79%	251	230	92%	**73%**

Tables 2.5 and 2.6 show the final school participation rates by state and sector respectively. As can be seen from Table 2.5, South Australia, Victoria, New South Wales and Queensland all achieved school participation rates of over 70 per cent. The Australian Capital Territory, Tasmania, Western Australia and the Northern Territory all achieved school participation rates of less than 70 per cent. As can be seen from Table 2.6, Independent school participation rates were the greatest at 79 per cent, followed by Government schools at 72 per cent, and finally Catholic schools at 65 per cent.

Within-school participation rates

Tables 2.2, 2.3 and 2.4 present the participation rates for teachers, principals and technical coordinators (TCs) respectively. As outlined on page 24 of the SITES 2006 MS Sampling Manual, a teacher, principal or technical coordinator was defined as participating if he/she returned a non-empty questionnaire.

The participation rates for all three groups were high when taken as a percentage of only the schools which had participated in the study (86 per cent for teachers, 85 per cent for principals and 89 per cent for TCs). When taken as a percentage of all sampled schools, however, these rates dropped to a little over 60 per cent for all three groups (62 per cent for teachers, 61 per cent for principals and 64 per cent for TCs).

Tables 2.5 and 2.6 present teacher participation rates by state and sector respectively. In all instances, teacher participation rates reached 70 per cent or above. Participation rates in Tasmania and Victoria were particularly high at 91 per cent, and Independent schools reached a teacher participation rate of 92 per cent. Final teacher participation rates exceeded 50 per cent in all states and sectors apart from Western Australia and Northern Territory which can be attributed to the low school participation rates in these two regions (54 per cent and 29 per cent respectively).

Summary

SITES was conducted in Australia using instruments developed internationally with online data collection methods. The sample was designed to provide representative national data with known precision that satisfied international standards for precision. School participation rates of 72 per cent were obtained and 86 per cent of sampled teachers in those schools completed the survey. This means that there can be confidence that the survey results are unlikely to be biased by differential participation.

3
MATHEMATICS AND SCIENCE TEACHING AND THE USE OF ICT

ICT Use by Mathematics and Science Teachers

One question in the survey of mathematics and science teachers asked if they had used ICT in any type of teaching activity during that school year. Teachers who answered that they had used ICT were then asked about the impact of ICT-use on them and their students.

Table 3.1 shows the percentages of mathematics and science teachers who reported having used ICT with their classes. There are large differences across the systems. The lowest usage levels were reported by mathematics teachers (18 per cent) and science teachers (16 per cent) in South Africa. At the other end of the spectrum, very high percentages (more than 80 per cent) of science teachers in Australia, Singapore, Hong Kong and Alberta and of mathematics teachers in Norway reported using ICT in their Year 8 teaching.

Table 3.1 Percentages of Teachers of Science and Mathematics at Year 8 who Report Using ICT in their Teaching

	Science			Mathematics	
	Percent	Std. Err		Percent	Std. Err
Australia	**86.06**	**1.74**	Norway	80.29	2.33
Singapore	83.69	1.71	Denmark	76.97	2.20
Hong Kong, SAR	82.38	1.77	Ontario	75.15	2.33
Alberta	79.19	2.25	Singapore	73.10	1.84
Ontario	75.26	2.31	Hong Kong, SAR	70.16	2.15
Norway	74.23	2.69	**Australia**	**68.59**	**2.53**
Denmark	69.98	2.57	Lithuania	62.10	2.75
Slovenia	67.99	2.02	Alberta	61.97	2.47
Chile	65.79	2.47	Italy	57.50	2.07
Lithuania	65.63	2.67	Chile	55.66	2.14
Finland	60.78	2.55	Slovak Republic	51.17	2.23
Italy	58.21	2.24	France	49.10	2.56
Thailand	57.54	2.69	Finland	47.72	2.54
Moscow	57.23	1.91	Moscow	44.80	2.35
Slovak Republic	56.06	2.12	Thailand	44.32	2.56
Spain, Catalonia	55.75	2.23	Russian Federation	40.85	3.47
France	54.35	2.50	Estonia	40.14	3.49
Estonia	53.80	2.63	Slovenia	39.86	1.98
Israel	53.46	2.17	Spain (Catalonia)	38.41	2.02
Russian Federation	48.71	2.67	Chinese Taipei	35.19	1.63
Chinese Taipei	47.74	1.79	Japan	22.84	1.92
Japan	43.75	2.36	Israel	22.26	1.58
South Africa	15.85	1.87	South Africa	17.95	1.97

Note: Standard errors based on replication methods to take account of sample design effects.
Shaded area indicates countries not significantly different from Australia.

In terms of science teaching at Year 8, and taking account of the standard errors, it can be concluded that:

- Australian teachers are leaders in the use of ICT together with teachers from Singapore, Hong Kong SAR and Canada (Alberta); and

- a significantly greater percentage of Australian Year 8 science teachers use ICT in teaching than in all other 18 countries.

In terms of mathematics teaching at Year 8, and taking account of standard errors, it can be concluded that:

- a significantly smaller percentage of teachers in Australia use ICT than in Norway;
- a similar percentage of teachers in Australia use ICT as in Denmark, Canada (Ontario), Singapore, Hong Kong, SAR, Lithuania and Canada (Alberta); and
- a significantly higher percentage of teachers in Australia use ICT than in Italy, Chile, Slovak Republic, France, Finland, Russian Federation (Moscow), Thailand, Russian Federation, Estonia, Slovenia, Spain (Catalonia), Chinese Taipei, Japan, Israel and South Africa

In a majority of the participating systems (including Australia), the percentage of teachers reporting ICT-use was significantly higher for science teachers than for mathematics teachers within the same system. In the remaining countries the difference in ICT use between science and mathematics teachers was not statistically significant.

In general the higher the percentage of science teachers in a country using ICT in Year 8 teaching the higher the percentage of mathematics teachers using ICT in their Year 8 teaching. The correlation coefficient was 0.84.

Teacher Confidence in Using ICT

The survey of teachers included a series of questions in which teachers rated their own confidence in using various aspects of ICT. The response categories were: not at all; a little; somewhat; and a lot. The aspects of ICT about which the question was asked covered general use of ICT and pedagogical use of ICT as outlined below.

General Use of ICT

- I can produce a letter using a word-processing program.
- I can e-mail a file (e.g., the notes of a meeting) to a colleague.
- I can take photos and show them on the computer.
- I can file electronic documents in folders and sub-folders on the computer.
- I can use a spreadsheet program for budgeting or student administration.
- I can share knowledge and experiences with others in a discussion forum/user group on the Internet.
- I can produce presentations with simple animation functions.
- I can use the Internet for online purchases and payments.

Pedagogical Use of ICT

- I can prepare lessons that involve the use of ICT by students.
- I know which teaching/learning situations are suitable for ICT use.
- I can find useful curriculum resources on the Internet.
- I can use ICT for monitoring students' progress and evaluating learning outcomes.
- I can use ICT to give effective presentations/ explanations.
- I can use ICT for collaboration with others.
- I can install educational software on my computer.
- I can use the Internet (e.g., select suitable websites, user groups/discussion forums) to support student learning.

Table 3.2 records each item, the group from which it was drawn and the percentage of mathematics and science teachers who were confident (either somewhat or a lot) in accomplishing each of these tasks.

Table 3.2 Teacher Confidence in Accomplishing Various ICT Tasks

Item	Type	Percentage "somewhat" or "a lot"
share knowledge and experiences with others in a discussion forum/user group on the Internet	G	37.1
use the Internet for online purchases and payment	G	38.6
use ICT for monitoring students' progress and evaluating learning outcomes	P	41.6
use the Internet (e.g., select suitable websites, user groups/discussion forums) to support student learning	P	42.8
use ICT for collaboration with others	P	44.3
produce presentations with simple animation functions	G	45.8
install educational software on my computer	P	46.8
prepare lessons that involve the use of ICT by students	P	49.8
use ICT to give effective presentations/ explanations	P	51.0
take photos and show them on the computer	G	54.5
find useful curriculum resources on the Internet	P	57.1
know which teaching/learning situations are suitable for ICT use	P	58.3
e-mail a file (e.g., the notes of a meeting) to a colleague	G	59.7
use a spreadsheet program for budgeting or student administration	G	59.8
file electronic documents in folders and sub-folders on the computer	G	68.2
produce a letter using a word-processing program	G	76.4

Note: G=General ICT Task; P=Pedagogical ICT Task

In Table 3.2 the tasks are arranged from the most difficult at the top to the least difficult at the bottom. The average difficulty of the general items and the pedagogical items were similar even though the general items tended to be at the two extremes of the scale.

These items formed one underlying dimension which could be described as 'confidence in ICT use'. The scale was highly reliable (the reliability coefficient alpha was 0.96) and it was possible to compute scale scores with an international mean set to 500 and a standard deviation to 100 (as is done for scales in PISA). Table 3.3 records the mean scores for each education system in the study. Science and mathematics teachers in Australia are near the top of the scale of confidence. Year 8 science teachers in Australia are not significantly different in ICT confidence from those in Singapore, Hong Kong, Alberta, Ontario, Chile, and Norway and are significantly more confident than other countries in the table. Year 8 mathematics teachers in Australia are not significantly different from those in Hong Kong, Singapore, Ontario, Alberta, Denmark, Chile and Norway.

Table 3.3 Mean Scores for Teacher Confidence in Using ICT for Science and Mathematics

	Science			Mathematics	
	Mean	Std err		Mean	Std err
Singapore	603	3.0	Hong Kong, SAR	588	3.3
Australia	**601**	**3.2**	**Australia**	**584**	**4.0**
Hong Kong, SAR	600	2.9	Singapore	583	4.1
Alberta Province, Canada	599	3.9	Ontario Province, Canada	582	3.3
Ontario Province, Canada	598	3.4	Alberta Province, Canada	578	3.9
Chile	587	3.9	Denmark	573	3.3
Norway	584	4.0	Chile	572	5.6
Denmark	583	4.0	Norway	570	3.9
Israel	581	3.6	Slovenia	545	4.3
Japan	569	3.2	Israel	545	2.9
Estonia	560	4.2	Catalonia, Spain	544	3.8
Catalonia, Spain	559	3.3	Estonia	544	3.8
France	557	4.1	Japan	542	3.4
Chinese Taipei	556	3.0	Slovak Republic	541	4.5
Slovenia	556	2.8	Chinese Taipei	539	4.2
Slovak Republic	550	3.3	Finland	539	4.8
Finland	544	3.6	France	522	4.8
Italy	527	3.5	Italy	518	2.8
Thailand	518	4.4	Thailand	501	3.7
Moscow	513	3.4	Lithuania	488	3.2
Lithuania	494	3.9	Moscow	483	4.5
Russian Federation	462	3.6	South Africa	449	3.2
South Africa	461	5.3	Russian Federation	442	5.4

Note: Standard errors based on replication methods to take account of sample design effects.
Shaded area indicates countries not significantly different from Australia.

When an analysis is conducted between countries it emerges that there is a positive association between teacher confidence in using ICT and actual use of ICT but the relationship is less than perfect and stronger for science teaching (r=0.71) than for mathematics teaching (r=0.58). However, a better test of the relationship between teacher use of ICT and confidence in using ICT is the within-country association. The correlation coefficients between reported use of ICT and confidence in using ICT are shown in Table 3.4. Those data show that:

- the median within-country correlation coefficient is approximately 0.3;
- the within-country correlation coefficients range from 0.07 to 0.56; and
- a similar association holds for science and mathematics teachers.

Table 3.4 Within-Country Correlation Coefficients between ICT use and ICT Self-Confidence

	Science	Mathematics
Australia	**0.22**	**0.22**
Alberta	0.31	0.28
Chile	0.40	0.39
Ontario	0.27	0.31
Denmark	0.25	0.21
Spain, Catalonia	0.31	0.27
Estonia	0.38	0.42
Finland	0.29	0.29
France	0.42	0.42
Hong Kong, SAR	0.07	0.12
Israel	0.35	0.14
Italy	0.49	0.47
Japan	0.32	0.22
Lithuania	0.41	0.41
Norway	0.31	0.25
Moscow	0.55	0.56
Russian Federation	0.42	0.52
Singapore	0.17	0.22
Slovak Republic	0.47	0.45
Slovenia	0.40	0.38
Thailand	0.43	0.41
Chinese Taipei	0.24	0.19
South Africa	0.12	0.06
Median	0.32	0.29

Across all participating systems the levels of self-reported general ICT competence for the populations of mathematics and teachers were the same while the science teachers' mean level of self-reported pedagogical ICT competence was slightly but significantly higher than that of mathematics teachers respectively.

ICT Use and Other Characteristics of Teachers

Overall there was only a small association between teacher age and ICT use in either science (the correlation was 0.07) or mathematics (the correlation was 0.05). Details are provided in Tables 3.5 and 3.6.

Table 3.5 Percentage of teachers in each age group who had used ICT with their target classes: *Mathematics teachers*

System	<30		30-39		40-49		>49		System mean	
	N	Use ICT (%)	N	Use ICT (%)	N	Use ICT (%)	N	Use ICT (%)	Use ICT (%)	SE (%)
Alberta Prov, Canada	*70*	*66*	*109*	*64*	*101*	*58*	*75*	*62*	*62*	*2.5*
Australia	78	70	140	74	144	66	134	68	69	2.5
Catalonia, Spain	44	51	194	46	223	38	202	26	38	2.0
Chile	55	42	94	58	179	57	219	57	56	2.1
Chinese Taipei	175	31	365	36	249	36	60	41	35	1.6
Denmark	*32*	*74*	*100*	*80*	*66*	*89*	*150*	*71*	*77*	*2.2*
Estonia	*22*	*36*	*46*	*52*	*94*	*40*	*72*	*33*	*40*	*3.5*
Finland	52	61	119	56	109	51	269	39	48	2.5
France	*73*	*57*	*142*	*54*	*64*	*39*	*138*	*45*	*49*	*2.6*
Hong Kong, SAR	176	67	215	73	122	69	55	67	70	2.1
Israel	102	17	266	22	244	24	226	23	22	1.6
Italy	6	85	61	63	174	61	411	55	57	2.1
Japan	105	24	125	28	164	21	71	17	23	1.9
Lithuania	*29*	*77*	*60*	*66*	*166*	*65*	*122*	*53*	*62*	*2.8*
Moscow	*52*	*70*	*108*	*52*	*187*	*46*	*249*	*35*	*45*	*2.3*
Norway	*28*	*83*	*95*	*78*	*53*	*85*	*117*	*79*	*80*	*2.3*
Ontario Prov, Canada	*82*	*71*	*144*	*76*	*119*	*82*	*65*	*68*	*75*	*2.3*
Russian Fed	*86*	*33*	*259*	*42*	*425*	*41*	*459*	*41*	*41*	*3.5*
Singapore	199	70	166	77	60	70	54	79	73	1.8
Slovak Republic	86	50	91	64	145	54	236	45	51	2.2
Slovenia	127	41	168	46	299	42	119	24	40	2.0
South Africa	*77*	*15*	*209*	*18*	*150*	*20*	*49*	*15*	*18*	*2.0*
Thailand	*168*	*44*	*161*	*45*	*193*	*51*	*142*	*33*	*44*	*2.6*

Systems in *italics* did not satisfy sampling criteria or sampling procedure.

Note: ICT use percentages are weighted statistics. However, N listed in the tables is the unweighted number of teachers.

Table 3.6 Percentage of teachers in each age group who had used ICT with their target classes: *Science teachers*

System	<30		30-39		40-49		>49		System mean	
	N	Use ICT (%)	N	Use ICT (%)	N	Use ICT (%)	N	Use ICT (%)	Use ICT (%)	SE (%)
Alberta Prov, Canada	*74*	*75*	*124*	*84*	*82*	*80*	*46*	*71*	*79*	*2.3*
Australia	*98*	*83*	*130*	*88*	152	87	126	85	86	1.7
Catalonia, Spain	30	65	159	61	193	57	150	44	56	2.2
Chile	41	68	102	64	177	71	200	62	66	2.5
Chinese Taipei	125	43	347	52	263	48	59	44	48	1.8
Denmark	*41*	*70*	*110*	*75*	*90*	*78*	*168*	*63*	*70*	*2.6*
Estonia	*45*	*53*	*75*	*60*	*117*	*59*	*137*	*48*	*54*	*2.6*
Finland	50	69	126	65	120	70	248	52	61	2.5
France	*107*	*55*	*169*	*65*	*45*	*58*	*95*	*33*	*54*	*2.6*
Hong Kong, SAR	98	88	181	77	115	85	55	85	82	1.8
Israel	73	55	232	57	239	50	160	52	53	2.2
Italy	6	55	69	69	210	63	386	54	58	2.2
Japan	68	46	106	44	188	48	77	32	44	2.4
Lithuania	*26*	*61*	*92*	*70*	*165*	*70*	*187*	*60*	*66*	*2.7*
Moscow	*140*	*56*	*275*	*64*	*481*	*66*	*675*	*48*	*57*	*1.9*
Norway	*27*	*78*	*97*	*77*	*47*	*68*	*103*	*74*	*74*	*2.7*
Ontario Prov, Canada	72	67	124	77	65	83	43	80	75	2.3
Russian Federation	*293*	*44*	*627*	*53*	*898*	*56*	*1195*	*42*	*49*	*2.7*
Singapore	176	81	143	85	70	87	57	84	84	1.7
Slovak Republic	173	61	248	65	242	65	407	44	56	2.1
Slovenia	58	65	205	70	309	70	124	59	68	2.0
South Africa	*63*	*19*	*174*	*15*	*143*	*16*	*45*	*15*	*16*	*1.9*
Thailand	*138*	*62*	*194*	*56*	*206*	*57*	*116*	*53*	*58*	*2.7*

Systems in *italics* did not satisfy sampling criteria or sampling procedure.

Note: ICT use percentages are weighted statistics. However, N listed in the tables is the unweighted number of teachers.

Table 3.7 Number of male and female teachers and the percentage of teachers in each gender group who used ICT with their classes

System	Mathematics teachers					Science teachers				
	Male		Female			Male		Female		
	N	Use ICT (%)	N	Use ICT (%)	Sig. of difference	N	Use ICT (%)	N	Use ICT (%)	Sig. of difference
Alberta Prov, Canada	*179*	*62*	*171*	*62*		*174*	*80*	*154*	*78*	
Australia	233	72	259	66	**	225	87	261	85	
Catalonia, Spain	318	37	344	40		215	54	318	57	
Chile	225	51	319	59	**	135	67	389	65	
Chinese Taipei	419	39	429	32	**	493	51	301	45	**
Denmark	*222*	*78*	*123*	*76*		*280*	*67*	*128*	*77*	**
Estonia	*25*	*45*	*209*	*39*		*70*	*56*	*302*	*54*	
Finland	224	51	327	45	**	213	63	331	59	*
France	*200*	*55*	*219*	*44*	**	*189*	*59*	*225*	*51*	**
Hong Kong, SAR	330	68	240	73		263	78	184	89	**
Israel	185	25	653	22		125	55	572	53	
Italy	121	59	533	58		124	64	545	57	**
Japan	315	25	151	18	**	345	46	94	36	**
Lithuania	*26*	*56*	*350*	*62*		*71*	*64*	*396*	*66*	
Moscow	*17*	*19*	*581*	*46*	**	*137*	*59*	*1435*	*57*	
Norway	*179*	*81*	*114*	*80*		*175*	*76*	*101*	*72*	
Ontario Prov, Canada	182	78	228	74	**	128	76	177	76	
Russian Federation	*53*	*38*	*1182*	*41*	**	*319*	*53*	*2702*	*48*	**
Singapore	179	73	301	73		169	82	279	85	
Slovak Republic	105	52	452	51		265	56	796	56	
Slovenia	143	51	568	37	**	137	77	555	66	**
South Africa	*230*	*19*	*259*	*17*	**	*183*	*15*	*242*	*17*	
Thailand	*200*	*47*	*457*	*43*	**	*188*	*60*	*466*	*56*	**

Systems in *italics* did not satisfy sampling criteria or sampling procedure.

* Differences between male and female teachers is significant at $p<0.05$; ** Differences between male and female teachers is significant at $p<0.01$.

Note: ICT use percentages are weighted statistics. However, N listed in the tables is the unweighted number of teachers.

Across all countries there was a small difference in the use of ICT between male and female teachers. Details for other countries are recorded in Table 3.7. For Australia 85 per cent of female science teachers and 87 per cent of male science teachers reported using ICT. This difference is not statistically significant. In mathematics, 66 per cent of female teachers and 72 per cent of male teachers had used ICT. This difference was statistically significant.

Overall, in both science and mathematics a slightly greater percentage of male teachers than female teachers had used ICT in Year 8 teaching. In science the difference was 59 compared to 52 per cent and in mathematics the difference was 52 compared to 46 per cent. However, these gender differences were different in different countries. In science there was a greater propensity to use ICT by male teachers in Slovenia, Italy and Chinese Taipei and a greater propensity to use ICT by female teachers in Hong Kong SAR and Denmark. In mathematics there was a greater propensity for male teachers to use ICT in Slovenia, France and Finland but a greater propensity for female teachers to use ICT in Moscow, Chile and Lithuania.

ICT Resources and Tools

The survey asked mathematics and science teachers how often they incorporated different ICT resources and tools in teaching of the target class:

- Equipment and hands-on materials (e.g., laboratory equipment, musical instruments, art materials, overhead projectors, slide projectors, electronic calculators);
- Tutorial/exercise software;
- General office suite (e.g., word-processing, database, spreadsheet, presentation software);
- Multimedia production tools (e.g., media capture and editing equipment, drawing programs, webpage/multimedia production tools)
- Data-logging tools;
- Simulations/modelling software/digital learning games;
- Communication software (e.g., e-mail, chat, discussion forum);
- Digital resources (e.g., portal, dictionaries, encyclopaedia);
- Mobile devices (e.g., Personal Digital Assistant (PDA), cell phone);
- Smart board/interactive whiteboard;
- Learning management system (e.g., web-based learning environments).

The response categories were: never, sometimes, often or nearly always. The percentages of science and mathematics teachers who used each tool or resource ‘sometimes’ or ‘nearly always’ are recorded in Tables 3.8 and 3.9. The resources most frequently used by science teachers were equipment and hands-on materials (e.g., laboratory equipment, musical instruments, art materials, overhead projectors, slide projectors, electronic calculators), followed by tutorial and exercise software. Australian Year 8 Science teachers were the most frequent users of hands-on materials.

Table 3.8 Percentages of Year 8 Science Teachers Using Various Resources and Tools 'Often' or 'Nearly Always' in Teaching

	Hands on materials	Tutorial software	General office	Multimedia prod tools	Data logging tools	Modeling software	Comm. software	Digital resources	Mobile devices	Smart board	Learning systems
Australia Rank	1	12	7	8	17	8	15	17	21	2	9
Australia	92	16	39	13	4	10	12	20	2	10	9
Chile	57	29	39	29	22	24	27	53	15	6	21
Chinese Taipei	48	20	54	28	31	10	27	34	17	4	8
Denmark	64	14	42	11	3	3	14	32	5	6	4
Estonia	56	46	19	6	4	6	18	21	16	4	4
Finland	88	13	21	7	12	4	9	11	3	1	5
France	91	9	15	7	7	11	1	12	3	4	1
Hong Kong, SAR	84	39	73	31	6	14	31	32	14	4	17
Israel	73	27	32	12	21	13	24	30	10	5	19
Italy	33	10	18	6	8	5	5	23	3	2	4
Japan	65	2	17	8	1	4	1	4	1	1	11
Lithuania	54	26	32	18	27	6	30	36	24	3	5
Norway	71	10	28	5	3	3	9	15	2	1	22
Russian Federation	75	54	15	7	2	5	3	20	13	2	2
Singapore	82	28	52	25	3	16	15	14	7	6	11
Slovak Republic	67	4	13	5	2	4	13	24	5	4	4
Slovenia	87	23	33	11	22	11	24	21	3	2	6
South Africa	34	15	7	4	4	3	5	13	8	9	4
Thailand	55	12	20	9	8	5	13	29	6	3	8
Moscow	80	51	25	12	6	7	14	35	19	3	3
Catalonia, Spain	66	27	18	6	6	6	8	21	5	2	8
Ontario, Canada	85	15	58	25	9	10	14	28	3	5	10
Alberta, Canada	75	12	46	24	4	8	17	20	3	10	10
Total	72	37	19	8	5	6	6	21	10	3	4

Systems in *italics* did not satisfy sampling criteria or sampling procedure.
Note: ICT use percentages are weighted statistics.

Table 3.9 Percentages of Year 8 Maths Teachers Using Various Resources and Tools 'Often' or 'Nearly Always' in Teaching

	Hands on materials	Tutorial software	General office	Multi media tools	Data logging tools	Modeling software	Comm. software	Digital resources	Mobile devices	Smart board	Learning systems
Australia Rank	9	8	11	10	18	6	15	16	15	2	7
Australia	49	22	21	8	2	7	10	10	3	11	8
Chile	35	25	34	25	21	23	26	41	16	10	18
Chinese Taipei	8	14	44	17	26	6	19	22	12	2	6
Denmark	47	13	32	5	2	1	16	17	4	3	3
Estonia	49	50	14	5	5	3	16	10	27	4	6
Finland	74	9	8	2	8	2	5	3	3	1	2
France	43	12	12	3	3	2	1	2	1	2	2
Hong Kong, SAR	41	27	51	22	7	8	24	21	10	4	16
Israel	24	15	14	7	12	5	11	9	15	3	7
Italy	35	10	20	6	8	3	6	18	5	2	5
Japan	8	3	14	3	0	2	1	1	1	2	10
Lithuania	33	19	31	13	15	6	24	21	27	7	6
Norway	37	20	24	5	1	2	11	11	1	1	23
Russian Federation	62	41	13	9	2	4	2	15	13	1	1
Singapore	55	26	34	19	4	7	13	9	6	8	16
Slovak Republic	48	4	11	3	1	2	11	10	6	3	1
Slovenia	50	9	23	4	13	4	14	7	2	1	6
South Africa	26	16	8	5	3	4	4	11	10	11	4
Thailand	26	9	15	7	4	4	9	18	5	4	6
Moscow	62	41	14	10	3	4	10	21	18	3	3
Catalonia, Spain	24	24	13	6	3	5	6	13	3	1	7
Ontario, Canada	79	19	53	20	8	12	12	25	2	5	10
Alberta, Canada	62	18	28	11	3	7	14	11	2	10	6
Total	45	24	17	8	5	4	6	13	8	3	4

Systems in *italics* did not satisfy sampling criteria or sampling procedure.
Note: ICT use percentages are weighted statistics.

Modern digital technology (aside from calculators) was much less frequently used by science teachers than traditional hands-on equipment. Tutorial software, general digital resources and general office software were used by between one fifth and two fifth of science teachers overall but modeling software and smart boards were used (sometimes or nearly always) by only one-tenth of Australian science teachers. In addition, relatively small proportions (one in 25) of Australian science teachers were frequent users of "data-logging tools". However, a relatively high percentage of Australian science teachers were frequent users of smart boards or interactive whiteboards. With one tenth of Australian science teachers using smart boards they were the second highest users of this technology among the participating countries. This possibly reflects initiatives taken in several Australian states and territories in recent years.

Overall, the pattern of differences among countries in the use of the listed resources for mathematics teachers among countries was similar to that for science teachers (a canonical analysis supported the visual interpretation of the data in Table 3.8 and those in Table 3.9). However, there are departures from the overall similarities. In the case of Australia, a relatively smaller proportion of mathematics teachers than science teachers used equipment and hands-on materials (e.g., laboratory equipment, musical instruments, art materials, overhead projectors, slide projectors, electronic calculators). This possibly reflects general approaches to teaching mathematics rather than the use of ICT. Australian Year 8 mathematics teachers were also the second most frequent users of interactive or smart boards but the overall use of these tools was fairly low at around 10 per cent of teachers.

Use of ICT in Aspects of Teaching

Science and mathematics teachers were also asked to indicate whether they had used ICT in various teaching activities during the current school year. The activities were:

- Extended projects (2 weeks or longer)
- Short-task projects
- Product creation (e.g., making a model or a report)
- Self-accessed courses and/or learning activities
- Scientific investigations (open-ended)
- Field study activities
- Teacher's lectures
- Exercises to practice skills and procedures
- Laboratory experiments with clear instructions and well-defined outcomes
- Discovering mathematics principles and concepts
- Studying natural phenomena through simulations
- Looking up ideas and information
- Processing and analysing data

Relevant data are recorded in Table 3.10 for science teachers and 3.11 for mathematics teachers.

Table 3.10 Percentages of Year 8 Science Teachers Using ICT in Specified Teaching Activities

Science	Extended Projects		Short Projects		Product Creation		Self Assess		Scientific Investigate		Field Study		Teacher lectures		Practice Skills		Lab Experiment		Math Principles		Nat Phen Simulation		Look up Information		Data Analysis	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Australia	86	2	76	2	71	3	45	3	61	3	26	3	55	3	37	3	29	3	23	3	63	3	91	2	68	3
Chile	67	3	70	3	65	3	58	3	58	3	25	3	56	3	49	3	36	3	30	3	45	3	83	2	63	3
Chinese Taipei	28	2	40	2	46	2	53	2	44	2	27	2	61	2	34	2	36	2	17	2	43	2	70	2	52	2
Denmark	85	2	80	3	86	2	68	3	38	3	19	2	48	3	45	3	19	2	22	2	36	3	89	2	65	3
Estonia	38	3	63	3	32	3	56	4	19	3	17	3	52	3	49	3	20	3	6	1	39	3	79	3	41	3
Finland	42	3	64	3	40	3	30	3	24	2	15	2	34	3	32	3	13	2	8	2	32	3	63	3	38	3
France	49	3	46	3	42	3	35	3	41	3	8	2	29	3	24	3	22	3	6	2	50	3	57	3	31	3
Hong Kong, SAR	61	3	70	3	57	3	61	3	55	3	21	2	96	1	58	3	66	3	22	2	58	3	75	3	60	3
Israel	59	3	65	2	57	3	49	3	62	2	26	2	37	2	44	3	26	3	17	2	44	3	73	2	55	3
Italy	46	3	47	3	42	2	23	2	38	2	33	2	41	2	32	2	18	2	21	2	23	2	66	2	52	2
Japan	17	2	16	2	21	2	17	2	33	2	9	1	26	2	11	2	9	1	8	1	37	2	38	3	20	2
Lithuania	66	3	80	2	88	2	62	3	34	3	56	3	57	3	58	3	46	3	23	2	38	3	87	2	81	2
Norway	78	3	88	2	60	4	53	4	39	4	25	3	40	4	26	4	25	3	18	3	25	3	89	3	43	4
Russian Fed.	33	2	48	3	46	3	31	2	28	2	7	1	44	3	38	2	23	2	8	1	25	2	51	3	41	3
Singapore	62	3	59	3	52	3	54	3	40	3	21	3	85	2	37	3	29	3	18	2	57	3	77	3	50	3
Slovak Republic	33	2	61	2	80	2	69	2	19	2	14	1	49	2	42	2	19	2	13	1	39	2	78	2	45	2
Slovenia	56	2	77	2	71	2	55	2	51	2	23	2	55	2	43	2	30	2	19	2	61	2	72	2	64	2
South Africa	20	2	17	2	16	2	11	2	19	2	12	2	20	2	13	2	9	1	10	2	14	2	24	2	18	2
Thailand	54	3	55	3	60	3	58	3	43	3	28	3	53	3	46	3	34	3	30	3	45	3	64	3	46	3
Moscow	56	2	65	2	60	2	28	2	37	2	11	1	50	2	41	2	29	2	15	1	39	2	68	2	55	2
Catalonia, Spain	50	3	57	3	52	3	40	3	35	3	30	3	38	3	40	3	26	2	11	2	40	3	80	2	37	3
Ontario, Canada	88	2	72	3	80	2	39	3	55	3	23	3	37	3	45	3	36	3	43	3	39	3	89	2	64	3
Alberta, Canada	78	2	74	2	82	2	38	3	55	2	24	3	47	3	43	3	38	3	30	3	48	3	89	2	60	3
Average	54	2	60	2	57	2	45	1	40	1	22	1	48	1	39	1	28	1	18	1	41	1	72	1	50	2

Systems in *italics* did not satisfy sampling criteria or sampling procedure.
Note: ICT use percentages are weighted statistics.

Table 3.11 Percentages of Year 8 Mathematics Teachers Using ICT in Specified Teaching Activities

Math	Extended Projects		Short Projects		Product Creation		Self Assess		Scientific Investigate		Field Study		Teacher Lectures		Practice Skills		Lab Experiment		Math Principles		Nat Phen. Simulation		Look up Information		Data Analysis	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Australia	52	3	58	3	41	3	42	3	29	3	18	2	40	3	51	3	12	2	50	3	28	2	65	3	61	3
Chile	54	2	60	2	59	2	56	3	40	3	21	2	52	2	57	2	32	2	54	2	27	2	76	2	61	2
Chinese Taipei	14	1	24	2	31	2	34	2	26	2	15	1	37	2	18	1	18	2	30	2	13	1	48	2	39	2
Denmark	71	2	80	2	74	2	62	3	38	3	25	2	43	3	59	3	19	2	41	3	26	2	79	2	75	2
Estonia	18	3	38	4	19	3	38	3	12	3	9	2	32	3	50	3	17	3	23	3	11	3	62	3	43	4
Finland	16	2	42	2	23	2	20	2	12	2	11	1	22	2	43	3	6	1	30	2	13	2	46	2	31	2
France	15	2	31	2	21	2	39	3	22	3	2	1	23	2	38	2	5	1	41	3	9	2	31	3	38	2
Hong Kong, SAR	37	2	53	2	39	2	48	2	26	2	13	2	80	2	42	2	27	2	57	3	24	2	51	3	61	2
Israel	20	2	26	2	21	2	23	2	22	2	14	1	19	1	25	2	10	1	25	2	11	1	35	2	30	2
Italy	43	3	47	2	40	2	25	2	35	2	33	2	42	2	35	2	19	2	26	2	18	2	62	2	51	2
Japan	6	1	9	1	8	1	9	1	6	1	4	1	14	2	8	1	3	1	11	1	11	1	16	2	17	2
Lithuania	62	3	82	2	84	2	52	3	26	3	56	3	50	3	65	3	26	2	47	3	20	2	81	2	83	2
Norway	59	3	82	3	47	3	53	3	41	4	27	3	48	3	55	4	20	3	26	3	23	3	75	3	58	3
Russian Fed.	29	3	45	3	46	3	28	3	26	2	4	1	38	4	39	3	21	3	11	2	14	2	46	2	37	3
Singapore	40	2	43	3	32	2	50	3	15	2	11	2	73	2	44	3	11	2	55	2	17	2	60	2	46	2
Slovak Republic	19	2	43	2	54	2	60	2	13	2	7	1	44	2	51	3	5	1	35	2	19	2	70	2	48	2
Slovenia	24	2	49	2	50	2	26	2	21	2	13	1	36	2	39	2	6	1	36	2	19	2	45	2	57	2
South Africa	16	2	14	1	12	1	10	1	13	2	11	1	15	1	12	1	6	1	12	1	7	1	21	2	15	1
Thailand	42	3	47	2	54	3	57	3	34	2	29	2	42	3	43	2	30	2	41	3	27	2	61	3	54	2
Moscow	39	2	50	2	46	2	27	2	26	2	4	1	38	2	36	2	21	2	18	2	20	2	53	2	49	2
Catalonia, Spain	31	2	37	2	30	2	30	2	20	2	20	2	29	2	39	2	9	1	23	2	14	2	49	2	37	2
Ontario, Canada	77	2	71	2	78	2	41	2	47	2	26	2	36	3	55	3	29	2	60	3	29	2	84	2	76	2
Alberta, Canada	50	3	57	3	53	3	37	3	28	2	18	2	42	3	52	3	18	3	49	3	19	2	68	2	63	3
Average	31	1	42	1	39	1	32	1	25	1	12	1	34		37	1	17	1	26	1	16	1	47	1	41	1

Systems in *italics* did not satisfy sampling criteria or sampling procedure.
Note: ICT use percentages are weighted statistics.

From these data it can be seen that more science teachers than mathematics teachers report using ICT in these aspects of their teaching. Across all countries the relative order of the use of ICT for each of the tasks is similar for science and mathematics teachers (r = 0.8). The discrepancies from the regression line are for the "discovering mathematics principles and concepts" which is relatively higher for mathematics teachers (not surprisingly) and "studying natural phenomena through simulations" which is relatively higher for science teachers (which is as might be expected). There are also smaller discrepancies for "exercises to practice skills and procedures" which is relatively higher for mathematics and "extended projects (2 weeks or longer)" which is relatively higher for science than mathematics.

For both science and mathematics the two activities where ICT was reported to be used by the highest proportions of teachers were "looking up ideas and information" and "short-task projects". The activity in which ICT was reported to be used by the smallest proportions of both science and mathematics teachers was "field study activities".

Australian science teachers differ from the average of science teachers in other countries in the higher proportion who use ICT in "extended projects (2 weeks or longer)" (86% compared to 54%), "studying natural phenomena through simulations" (63% compared to 41%) and "scientific investigations (open-ended)" (61% compared to 40%). There were also smaller but significant differences in the proportions of Australian and other science teachers who used ICT in "looking up ideas and information", "processing and analysing data", "short-task projects" and product creation (e.g., making a model or a report)".

Australian mathematics teachers differ from the average of mathematics teachers in other countries in the higher proportion who use ICT in "discovering mathematics principles and concepts" (50% compared to 26%), "extended projects (2 weeks or longer)" (52% compared to 31%) and "processing and analysing data" (61% compared to 41%). There were also smaller but significant differences in the proportions of Australian and other mathematics teachers who used ICT in "looking up ideas and information", "short-task projects", "exercises to practice skills and procedures" and "studying natural phenomena through simulations".

ICT in Assessment

Year 8 science and mathematics teachers indicated whether or not they used specified forms of assessment and whether or not they used ICT as part of that assessment form. The forms of assessment that were specified were:

- Written test/examination
- Written task/exercise
- Individual oral presentation
- Group presentation (oral/written)
- Project report and/or (multimedia) product
- Students' peer evaluations
- Portfolio/learning log
- Assessment of group performance on collaborative tasks

Table 3.12 and 3.13 contain data that summarise teacher responses.

Table 3.12 Percentages of Year 8 Science Teachers Using Specified Forms of Assessment Overall and Using ICT

	Written test/examination		Written task/exercise		Individual oral presentation		Group presentation (oral/written)		Project report or (multimedia) product		Students' peer evaluations		Portfolio/ learning log		Group performance collaborative tasks	
	%	% ICT	%	% ICT	%	% ICT	%	% ICT	%	% ICT	%	% ICT	%	% ICT	%	% ICT
Australia	98	35	99	59	69	55	73	60	89	82	46	19	37	19	62	27
Chile	98	63	97	67	88	48	95	64	58	53	77	29	56	35	86	38
Chinese Taipei	99	37	94	47	52	22	54	31	25	23	29	10	43	26	66	20
Denmark	79	28	95	47	80	29	80	43	77	65	43	7	19	8	53	15
Estonia	93	43	99	48	81	33	66	32	30	27	51	7	12	5	74	18
Finland	100	39	94	45	35	16	59	31	40	29	28	7	13	7	43	6
France	97	17	99	24	49	11	47	18	30	21	20	2	13	4	53	9
Hong Kong, SAR	98	36	98	41	59	32	75	54	77	66	45	14	25	13	61	20
Israel	96	39	98	55	73	31	68	40	70	57	39	18	47	28	63	33
Italy	95	32	98	30	97	8	66	19	58	46	47	6	18	7	56	15
Japan	99	52	95	35	71	17	54	14	84	31	24	6	60	22	45	11
Lithuania	93	54	98	49	72	31	70	33	64	49	71	12	22	10	76	22
Norway	99	39	99	54	83	37	86	53	83	59	39	3	51	19	49	11
Russian Fed.	96	42	99	36	97	31	74	31	39	26	83	10	30	11	81	14
Singapore	98	23	96	35	51	32	70	52	65	56	37	6	22	10	57	25
Slovak Republic	97	40	96	35	96	5	68	30	49	35	78	3	12	4	62	9
Slovenia	95	41	91	50	93	44	63	40	65	48	47	7	22	10	29	12
South Africa	99	23	99	23	84	16	94	18	84	21	85	14	91	18	91	16
Thailand	97	43	98	50	89	25	97	40	65	44	87	19	94	32	95	31
Moscow	95	40	99	34	98	43	82	48	63	53	81	11	28	14	82	18
Catalonia, Spain	96	29	98	49	58	16	65	30	31	27	20	4	73	25	63	15
Ontario, Canada	96	45	98	65	89	55	96	67	91	76	69	19	45	13	88	31
Alberta, Canada	100	33	99	55	78	52	87	63	87	74	61	11	25	12	78	23
Average	96	38	97	45	76	30	73	40	62	46	52	11	37	15	66	19

Note: Data on standard errors are recorded in an appendix but are typically from one to three percentage points for each country.
Systems in *italics* did not satisfy sampling criteria or sampling procedure. ICT use percentages are weighted statistics.

Table 3.13 Percentages of Year 8 Mathematics Teachers Using Specified Forms of Assessment Overall and Using ICT

	Written test/examination		Written task/exercise		Individual oral presentation		Group presentation (oral/written)		Project report or (multimedia) product		Students' peer evaluations		Portfolio/ learning log		Group performance collaborative tasks	
	%	% ICT	%	% ICT	%	% ICT	%	% ICT	%	% ICT	%	% ICT	%	% ICT	%	% ICT
Australia	99	33	92	42	27	18	35	25	53	44	27	10	27	17	35	17
Chile	97	57	98	64	81	35	85	45	43	40	73	24	52	32	84	35
Chinese Taipei	99	32	92	34	54	13	33	18	16	13	34	6	41	20	47	12
Denmark	96	25	100	36	77	20	66	26	45	39	40	7	22	10	42	11
Estonia	90	42	100	43	51	13	39	14	13	12	54	3	15	5	57	10
Finland	99	33	95	36	14	5	19	8	21	15	23	5	6	3	20	5
France	97	12	97	19	50	4	21	4	11	7	18	2	11	3	17	4
Hong Kong, SAR	97	31	97	30	47	18	49	29	55	45	37	11	24	10	36	14
Israel	98	38	98	36	66	13	41	15	27	18	34	12	36	16	41	14
Italy	95	32	99	31	97	9	63	19	52	43	47	6	18	6	54	13
Japan	99	45	88	29	64	10	31	6	43	15	18	3	57	15	21	6
Lithuania	90	45	96	45	60	24	65	38	62	51	67	15	30	13	77	27
Norway	96	33	97	55	62	19	59	37	50	43	33	4	40	12	44	11
Russian Fed.	95	38	100	36	96	24	63	27	30	22	86	7	31	13	80	13
Singapore	99	24	99	34	49	20	57	36	47	34	48	6	29	11	46	15
Slovak Republic	99	43	100	41	92	3	55	18	24	18	78	5	12	4	57	9
Slovenia	97	34	85	40	83	23	31	18	34	23	45	3	22	7	12	5
South Africa	99	21	99	19	73	10	86	13	78	15	84	10	90	15	86	13
Thailand	99	41	99	48	86	17	92	36	61	39	82	18	94	32	93	29
Moscow	96	34	100	29	92	30	63	32	45	36	82	8	27	13	75	14
Catalonia, Spain	97	24	97	35	49	8	36	15	18	15	21	2	75	15	52	9
Ontario, Canada	99	44	100	63	80	43	83	53	80	66	71	17	52	17	80	26
Alberta, Canada	99	35	98	46	47	25	54	35	58	47	45	9	29	12	55	19
Average	97	35	97	39	65	18	53	25	42	30	50	8	37	13	53	14

Note: Data on standard errors are recorded in an appendix but are typically from one to three percentage points for each country.
Systems in *italics* did not satisfy sampling criteria or sampling procedure. ICT use percentages are weighted statistics.

Table 3.12 records the percentages of Year 8 science teachers who reported using each form of assessment and whether or not they used ICT as part of that assessment. Those data indicate that the use of written tests or examinations and written tasks or exercises is nearly universal, that typically three-quarters of science teachers use oral presentations (either individual or group) as a form of assessment, and between half and two-thirds of teachers assess group performance, project reports or products and use peer evaluations. Australian science teachers differ from the average for other science teachers in that a higher proportion (89% compared to 62%) makes use of project reports or products in assessment. In this they are similar to teachers from Alberta and Ontario.

The data in Table 3.12 also indicate the proportions of teachers who use ICT in that form of assessment. Australian science teachers differ from the average for other science teachers in that a higher proportion (82% compared to 46%) makes use of ICT in project reports or products for assessment and in individual (55% compared to 30%) or group (60% compared to 40%) presentations. In these respects also they are similar to teachers from Alberta and Ontario. Composite use indicators with associated standard errors are recorded in Appendix A.

Table 3.13 records the percentages of Year 8 mathematics teachers who reported using each form of assessment and whether or not they used ICT as part of that assessment. The average across all countries for mathematics teachers can be compared with the corresponding data for science teachers. On average smaller proportions of mathematics than science teachers report using project reports (42% compared to 62%) and group presentations (53% compared to 73%) as part of student assessment. Fewer mathematics teachers than science teachers reported incorporating ICT when they did use these assessment methods. In addition fewer mathematics teachers than science teachers reported assessing group performance or individual presentations and incorporating ICT in these.

Differences in assessment practices between mathematics and science teachers appeared to be greater in Australia than in other countries. The gap was larger in the use of project reports (53% compared to 89%), group presentations (35% compared to 73%), oral presentations (27% compared to 69%) and the assessment of group performance on collaborative tasks (35% compared to 62%). In addition, fewer mathematics teachers than science teachers used ICT as part of these forms of student assessment. Across all listed forms of assessment the use of ICT in assessment was approximately 20 percentage points lower for Australian mathematics teachers than science teachers.

Obstacles to Using ICT in Teaching

Teachers were asked to indicate whether or not the following factors were an obstacle to them using ICT in their teaching.

- ICT is not considered to be useful in my school.
- My school does not have the required ICT infrastructure.
- I do not have the required ICT-related skills
- I do not have the necessary ICT-related pedagogical skills.
- I do not have sufficient confidence to try new approaches alone.
- My students do not possess the required ICT skills.

- My students do not have access to the required ICT tools outside of the school premises.
- I do not have the time necessary to develop and implement the activities.
- I do not know how to identify which ICT tools will be useful.
- My school lacks digital learning resources.
- I do not have the flexibility to make my own decisions when planning lessons with ICT.
- I do not have access to ICT outside of the school.

The percentages of Year 8 science teachers from each country who reported these factors were obstacles to using ICT are recorded in Table 3.14. The corresponding data for mathematics teachers are recorded in Table 3.15.

Across all countries, and specifically for Australia, the most frequently cited obstacle was "I do not have the time necessary to develop and implement the activities". Just fewer than 60 per cent of science teachers nominated this as an obstacle. On average for the participating countries just less than half of the science teachers reported that their "school lacks digital learning resources" was an obstacle to ICT use in teaching. Forty-four per cent reported that the fact that their "students do not have access to the required ICT tools outside of the school premises" was an obstacle to using ICT. Other obstacles mentioned by 30 per cent or more of respondents were "infrastructure", "ICT general skills", "ICT pedagogy", "self-confidence", "Student ICT skill", "basis for ICT choices" and "lack of flexibility".

Factors that were less frequently mentioned as obstacles by Australian science teachers than in other countries were access to digital learning resources (30% compared to 48%), flexibility to make own decisions when planning lessons with ICT (16% compared to 32%), students possessing necessary ICT skills (18% compared to 34%), sufficient confidence to try new approaches (19% compared to 34%), having the required ICT skills (18% compared to 32%), not having access to ICT outside of school (10% compared to 23%).

On average across participating countries the obstacles nominated by mathematics teachers were almost the same as for science teachers. Within Australia more mathematics teachers than science teachers (69% compared to 61%) saw "the time necessary to develop and implement the activities" as an obstacle to using ICT in teaching. In addition a greater proportion of mathematics than science teachers (36% compared to 30%) saw a lack of digital learning resources in their school as an obstacle to using ICT in their teaching.

Table 3.14 Percentages of Year 8 Science Teachers Reporting Various Factors as Obstacles to Using ICT

	Utility		Infra-structure		ICT general skills		ICT-pedagogy skills		Self-Confidence		Student ICT skill		Student ICT tool access		Time		Basis for ICT Choices		Lack of digital resources		Lack of flexibility		Out of school access	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Australia	6	1	27	2	18	2	26	2	19	2	18	2	38	3	61	3	26	2	30	2	16	2	10	2
Chile	30	2	39	2	32	3	34	2	30	2	36	2	44	2	50	2	34	2	69	2	27	2	34	2
Chinese Taipei	16	1	10	1	13	1	19	1	25	1	28	2	47	2	61	2	18	1	23	1	23	1	17	1
Denmark	8	1	36	2	29	2	37	3	22	2	24	2	35	2	66	2	34	2	58	2	23	2	13	2
Estonia	9	2	34	3	31	2	38	2	41	3	30	3	40	3	66	3	38	2	56	3	51	3	19	2
Finland	6	1	38	3	27	2	38	2	26	2	18	2	42	2	62	2	27	2	47	2	32	3	9	1
France	11	2	32	3	31	3	38	2	37	3	31	3	57	2	59	2	35	2	37	3	58	2	11	2
Hong Kong, SAR	17	2	19	2	21	2	21	2	24	2	28	2	32	2	61	2	25	2	36	3	26	2	21	2
Israel	27	2	32	2	25	2	22	2	21	2	28	2	29	2	47	2	24	2	50	2	21	1	19	1
Italy	20	2	21	2	26	2	43	2	47	2	32	2	46	2	56	2	33	2	27	2	39	2	14	1
Japan	15	2	27	2	39	2	34	2	52	2	41	2	37	2	73	2	49	2	67	2	45	2	20	2
Lithuania	7	1	28	3	29	2	27	2	33	2	36	3	41	2	30	2	10	2	63	3	31	2	24	3
Norway	9	2	39	3	30	3	41	3	31	3	38	3	44	3	73	3	34	3	44	3	22	2	8	2
Russian Fed.	11	1	78	1	74	2	75	2	71	2	71	2	66	3	59	2	59	2	77	2	52	2	54	2
Singapore	7	1	14	2	13	2	19	2	26	2	22	2	40	2	63	2	23	2	26	2	13	2	16	2
Slovak Republic	9	1	27	2	25	2	21	1	35	2	27	2	41	2	45	2	32	2	45	2	27	2	33	2
Slovenia	4	1	27	2	18	2	27	2	21	2	12	1	24	2	52	2	20	2	19	1	19	2	11	1
South Africa	25	2	65	2	57	2	64	2	40	2	74	2	77	2	40	2	54	2	75	2	49	3	54	2
Thailand	28	2	65	2	63	2	52	2	57	2	76	2	72	2	60	3	39	2	71	2	53	3	48	2
Moscow	8	1	61	2	60	2	59	1	54	2	43	2	30	1	58	1	48	2	61	2	40	1	34	2
Catalonia, Spain	13	2	38	2	31	2	34	2	33	2	31	2	39	2	64	2	30	2	47	2	29	2	20	2
Ontario, Canada	12	2	33	2	26	2	30	2	25	2	18	2	46	2	65	3	30	2	45	3	14	2	10	2
Alberta, Canada	11	2	29	3	20	2	24	2	21	2	19	2	45	3	60	3	24	3	42	3	15	2	19	2
Average	13	1	36	1	32	1	36	1	34	1	34	1	44	1	58	1	32	1	48	1	32	1	23	1

Note: Systems in *italics* did not satisfy sampling criteria or sampling procedure.

Table 3.15 Percentages of Year 8 Mathematics Teachers Reporting Various Factors as Obstacles to Using ICT

	Utility		Infra-structure		ICT general skills		ICT-pedagogy skills		Self-Confidence		Student ICT skill		Student ICT tool access		Time		Basis for ICT Choices		Lack of digital resources		Lack of flexibility		Out of school access	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Australia	5	1	30	2	22	2	28	2	24	2	17	2	33	2	69	2	26	2	36	3	19	2	11	2
Chile	23	2	39	2	33	2	34	2	31	2	35	2	45	2	53	2	33	2	67	2	27	2	33	2
Chinese Taipei	13	1	13	2	20	1	25	2	30	2	37	2	49	2	69	2	23	2	29	2	23	2	24	1
Denmark	7	1	35	3	23	2	32	2	23	2	26	3	32	3	70	2	33	2	53	3	18	2	12	2
Estonia	5	1	31	3	32	3	46	3	48	3	31	3	35	3	71	3	41	3	59	3	52	3	18	3
Finland	7	1	34	2	22	2	35	2	24	2	16	2	40	2	66	2	26	2	43	3	32	2	7	1
France	11	2	34	3	34	2	43	3	44	2	27	2	55	3	67	3	35	2	36	3	65	3	14	2
Hong Kong, SAR	20	2	26	2	25	2	27	2	27	2	29	2	32	2	64	2	26	2	35	2	25	2	27	2
Israel	34	2	33	2	32	2	34	2	25	2	29	2	28	2	50	2	32	2	48	2	28	2	22	1
Italy	20	2	26	2	27	2	44	2	47	2	32	2	42	3	58	2	34	2	26	2	42	2	16	2
Japan	18	2	22	2	43	2	47	2	64	2	39	2	40	2	76	2	59	2	59	2	54	2	25	2
Lithuania	6	1	26	2	26	3	29	3	34	3	37	3	43	3	31	3	9	1	62	3	32	2	25	3
Norway	10	2	39	4	31	3	44	3	30	2	39	3	47	3	74	3	29	3	47	4	23	3	8	2
Russian Fed.	11	2	79	3	73	3	76	2	72	2	74	3	69	3	64	2	66	2	78	3	51	3	53	3
Singapore	7	1	12	1	15	2	21	2	27	2	25	2	44	2	68	2	27	2	26	2	13	1	17	2
Slovak Republic	9	1	26	2	21	2	17	2	34	2	26	2	41	2	42	2	30	2	43	2	27	2	33	2
Slovenia	4	1	27	2	23	2	31	2	24	2	18	1	28	2	57	2	24	2	20	2	21	2	13	1
South Africa	26	2	66	2	57	2	63	2	41	2	74	2	76	2	41	2	55	2	78	2	51	2	52	2
Thailand	26	2	63	2	66	2	60	2	58	2	77	2	74	2	61	3	42	2	67	2	50	3	52	3
Moscow	8	1	58	2	65	2	64	2	61	2	44	2	36	2	68	2	56	2	63	2	45	2	37	2
Catalonia, Spain	13	1	37	2	30	2	32	2	34	2	27	2	37	2	65	2	31	2	46	2	29	2	17	1
Ontario, Canada	9	1	33	3	27	2	32	2	25	2	19	2	42	2	60	2	32	2	41	3	16	2	7	1
Alberta, Canada	9	2	31	2	24	3	30	3	26	2	17	2	42	3	65	3	29	3	39	2	14	2	14	2
Average	13	1	36	1	34	1	39	1	37	1	35	1	44	1	61	1	35	1	48	1	33	1	23	1

Note: Systems in *italics* did not satisfy sampling criteria or sampling procedure.

Participation in ICT-Related Professional Development

Science and mathematics teachers also indicated whether they had participated in professional development activities concerned with ICT. The activities to which they responded were:

- Introductory course for Internet use and general applications (e.g., basic word-processing, spreadsheets, databases, etc.)
- Technical course for operating and maintaining computer systems
- Advanced course for applications/standard tools (e.g., advanced word processing, complex relational databases)
- Advanced course for Internet use (e.g., creating websites/developing a home page, advanced use of the Internet, video conferencing)
- Course on pedagogical issues related to integrating ICT into teaching and learning
- Subject-specific training with learning software for specific content goals (e.g., tutorials, simulation, etc.)
- Course on multimedia operations (e.g., using digital video and/or audio equipment)

The percentages of Year 8 science and mathematics teachers indicating that they had participated in professional development activities over the past year are recorded in Tables 3.16 and 3.17. On average there are no statistically significant differences between science and mathematics teachers so they can be discussed together. On average 59 per cent of these teachers had participated in an introductory course for Internet use and general applications (e.g., basic word-processing, spreadsheets, databases, etc.). Approximately one quarter had participated in a course on pedagogical issues related to integrating ICT into teaching and learning. Between one fifth and one sixth had participated in professional development activities concerned with each of the other aspects of ICT (from 17% concerned with multimedia operations to 20% concerned with subject specific training on learning software).

A smaller percentage of Australian Year 8 science and mathematics teachers reported having participated in an introductory course for Internet use and general applications (48% for Australia compared to 59% for the international average) or a technical course for operating and maintaining computer systems (10% compared to 18%).

Table 3.16 Percentages of Year 8 Science Teachers Reporting Participation in ICT-Related Professional Development

	Introductory application		Technical operating		Advanced applications		Advanced internet		ICT and Pedagogy		Subject specific		Multimedia operations	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Australia	46	3	11	1	16	2	16	2	23	2	21	2	18	2
Chile	63	2	21	2	17	2	12	1	16	2	14	2	9	1
Chinese Taipei	69	2	32	2	32	2	38	2	52	2	23	2	38	2
Denmark	73	2	19	2	18	2	20	2	37	3	24	2	25	2
Estonia	82	2	17	2	18	2	21	2	32	3	41	3	18	2
Finland	68	2	27	2	20	2	27	2	19	2	15	2	16	2
France	48	2	9	2	17	2	21	2	26	2	18	2	21	2
Hong Kong, SAR	60	2	24	2	29	2	30	2	36	2	33	2	28	2
Israel	69	2	17	2	35	2	25	2	44	2	29	2	15	1
Italy	68	2	16	1	17	1	14	2	20	2	7	1	8	1
Japan	54	3	24	2	18	2	22	2	16	2	21	2	20	2
Lithuania	69	2	16	2	24	2	21	2	35	2	28	2	17	2
Norway	64	3	12	2	14	2	15	2	28	2	17	2	14	2
Russian Fed.	29	2	9	1	3	1	6	1	9	1	10	1	4	1
Singapore	54	3	13	2	13	2	24	2	32	2	27	2	21	2
Slovak Republic	81	1	20	1	16	1	11	1	21	2	6	1	12	1
Slovenia	73	2	27	2	25	2	20	2	23	2	18	1	16	1
South Africa	23	2	13	2	10	1	5	1	8	1	8	1	8	1
Thailand	52	2	24	2	11	1	18	2	23	2	15	2	11	1
Moscow	39	1	9	1	6	1	7	1	17	1	26	1	11	1
Catalonia, Spain	75	2	11	1	30	2	22	2	24	2	17	2	13	2
Ontario, Canada	47	3	16	2	17	2	18	2	20	2	25	2	21	2
Alberta, Canada	51	3	12	2	15	2	24	3	17	2	20	2	22	2
Average	59	1	17	1	18	1	19	1	25	1	20	1	17	1

Note: Systems in *italics* did not satisfy sampling criteria or sampling procedure.

Table 3.17 Percentages of Year 8 Mathematics Teachers Reporting Participation in ICT-Related Professional Development

	Introductory application		Technical operating		Advanced applications		Advanced internet		ICT and Pedagogy		Subject specific		Multimedia operations	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Australia	49	2	9	1	17	2	13	2	22	3	26	2	17	2
Chile	68	2	22	2	23	2	16	2	22	2	22	2	12	1
Chinese Taipei	70	2	27	2	28	2	37	2	55	2	23	2	34	2
Denmark	75	2	20	3	18	2	19	2	38	2	27	2	29	2
Estonia	83	2	23	3	18	2	26	3	33	3	37	3	17	3
Finland	70	2	33	2	25	2	31	2	18	2	11	1	15	2
France	48	3	10	1	13	2	14	2	31	3	19	2	7	1
Hong Kong, SAR	58	2	24	2	31	2	32	2	31	2	30	2	28	2
Israel	67	2	24	2	34	2	28	2	35	2	21	1	14	1
Italy	72	2	19	2	16	1	13	1	22	2	9	1	9	1
Japan	52	2	26	2	17	2	19	2	13	2	23	2	15	2
Lithuania	73	3	17	2	24	2	24	2	33	2	35	3	18	2
Norway	69	3	13	2	13	2	13	2	24	3	14	2	16	3
Russian Fed.	28	3	7	1	2	1	5	1	6	1	10	1	3	1
Singapore	58	2	19	2	15	2	24	2	30	2	25	2	20	2
Slovak Republic	86	2	22	2	16	2	13	1	23	2	7	1	11	1
Slovenia	69	2	25	2	27	2	22	2	22	2	16	2	13	1
South Africa	28	2	17	2	11	1	8	1	9	1	8	1	9	1
Thailand	48	2	23	2	9	1	20	2	22	2	14	2	10	2
Moscow	29	2	8	1	3	1	3	1	10	1	20	2	5	1
Catalonia, Spain	70	2	13	1	33	2	26	2	26	2	17	1	14	1
Ontario, Canada	44	2	13	2	15	2	20	2	20	2	30	2	20	2
Alberta, Canada	55	3	16	2	16	2	20	2	18	2	25	3	22	2
Average	60	2	19	2	18	2	19	2	24	2	20	2	16	2

Note: Systems in *italics* did not satisfy sampling criteria or sampling procedure.

In replying to the question about ICT-related professional development, teachers not only indicated whether they had participated in an activity in the past year but, if they had not, whether they "would like to attend if a course was available". Relevant data for Australia and the international average are recorded in Table 3.18.

Table 3.18 Interest and Previous Participation in ICT-Related Professional Development

	Science teachers			Mathematics teachers		
	No interest %	No, but interest %	Yes %	No interest %	No, but interest %	Yes %
Australia						
Introductory course	40	14	46	41	10	49
Technical course	62	27	11	66	25	9
Advanced applications	42	42	16	47	37	17
Advanced Internet	30	54	16	37	51	13
Pedagogical ICT issues	25	53	23	22	56	22
Subject specific learning system	16	63	21	19	55	26
Multimedia	26	55	18	37	45	17
International Average						
Introductory course	17	23	59	17	24	60
Technical course	39	43	17	39	43	19
Advanced applications	29	53	18	29	52	18
Advanced Internet	21	60	19	23	57	19
Pedagogical ICT issues	14	61	25	13	62	24
Subject specific learning system	14	66	20	14	65	20
Multimedia	19	65	17	22	62	15

Note: Data on standard errors are recorded in an appendix but are typically one to three percentage points for Australia and one percentage point for the international average.

For Australian teachers of science and mathematics and for the international average the four areas of professional development in which there was greatest interest were:

- subject specific learning systems software for specific content goals (e.g., tutorials, simulation, etc)
- pedagogical issues related to integrating ICT into teaching and learning
- advanced Internet use (e.g., creating websites/developing a home page, advanced use of the Internet, video conferencing) and
- multimedia operations (e.g., using digital video and/or audio equipment).

There was relatively little interest (especially in Australia) in introductory courses for Internet use and general applications (e.g., basic word-processing, spreadsheets, databases, etc.) and limited interest in technical courses for operating and maintaining computer systems.

Teacher Factors Associated with the Use of ICT in Teaching in Australia

In order to examine factors associated with the use of ICT Australian data were investigated. This was to focus ICT use within a specified context and thus eliminate the possibility that unmeasured contextual variables might confound the results.

Multivariate techniques were used to identify the influence of various factors on the use of ICT in teaching. The reason for using multivariate techniques was that there was no single determinant of the use of ICT in teaching. Instead, there was a range of inter-connected influences on participation. Multivariate analyses provided an assessment of the net effect of each factor considered by controlling for the effects of other factors included in the analysis. In other words they provided an "other things equal" estimate of the effect of one factor if all the other influences were held constant. Logistic regression was used because the outcome (or dependent) variable was dichotomous. For the analyses all continuous independent variables were standardised to a mean of 50 and a standard deviation of 10 but all binary variables remained as categorical.

This investigation began with the inclusion of a large number of potential correlates of the pedagogical use of ICT. Those variables that had no statistical association with ICT use (such as gender and age) were removed from the analysis and the final results are reported in Table 3.19. In this analysis only measures from individual teachers have been included.

Table 3.19 Results of Logistic Regression Analyses for Use of ICT in Teaching in Australia

Variable	Variable type	Regression coefficient	Standard error	Significance	Odds ratio Exp(B)
Subject (science cf. maths)	Categorical	1.116	.173	.000	3.05
Teacher ICT competence	Scale	.035	.008	.000	1.04
Participation in ICT professional development.	Scale	.055	.011	.000	1.06
Obstacles to using ICT in school	Scale	-.034	.008	.000	.97

These data show the regression coefficients and standard errors, the significance level and the odds ratio (the exponent of the regression coefficient). A positive coefficient means that the factor increased the chances of using ICT in teaching. The significance level indicates the degree of certainty that the relationship existed in the wider population. By convention a result is accepted if the significance level is less than 0.05. The exponent of the regression coefficient indicates the odds ratio for influence of the factor on having used ICT in teaching, other things equal.

The results in Table 3.19 indicate that teaching in science is more likely to make use of ICT than teaching in mathematics, that the use of ICT is more likely when teachers have a higher level of competence (or confidence) in ICT, when teachers have participated to a greater extent in ICT-related professional development, and when they perceive fewer contextual obstacles (such as poor infrastructure) to the use of ICT. The distinction between teacher-level barriers and school or system-level barriers to ICT is made by Balanskat, Blamire and Kefala (2006) in their review of European research literature. In the present analysis contextual obstacles refer to school and system level obstacles or barriers.

Summary

Compared to their peers in other countries, a high proportion of Australian teachers of science and mathematics at Year 8 use ICT in teaching, In addition Australian teachers of science and mathematics have relatively high levels of confidence in their capacity to use ICT. Within Australia the use of ICT is higher for science than mathematics but is not associated with age or gender. A study of associations indicates that higher levels of ICT use is associated with self-rated ICT competence, participation in ICT-related professional development and lack of perceived contextual (e.g. infrastructure, resources) obstacles to ICT use within schools.

4
SCHOOL CHARACTERISTICS AND THE USE OF ICT

Data from a number of international surveys have indicated that Australia has a high level of computer provision in its secondary schools (de Bortoli and Thomson, 2007). Those data also indicate that a high percentage of Australian students have computers at home that they could use for school work, are linked to internet, and have educational software. Findings from the Trends in International Mathematics and Science Study (TIMSS) suggest that primary school students enjoy a similar level of access (Thomson & Fleming, 2004).

Although in Australia most school computers are networked within schools, affordable access to high capacity telecommunications services has been an issue for schools, especially in rural and remote areas. Although the provision of bandwidth has improved, over half of all schools were still using services of 256 kilobits or less (MCEETYA, 2005). The Australian government has a program for improving ICT provision in schools, and providing schools with fibre to the premises (FTTP) broadband connections to deliver internet speeds up to 100 mbps.

Infrastructure

Table 4.1 records the ratio of computers to students in schools containing Year 8 (i.e. secondary schools) in 2007 based on the SITES survey. Those data record computer ratios to students based on all computers, computers connected to the Internet, computers that are part of a local area network (LAN), multimedia computers, and computers accessible to students (i.e. excluding those only for use in administration or by teachers). Those data confirm the strong level of computing infrastructure in Australian secondary schools.

The ratio of all computers per student is 0.40 and that for student accessible computers is 0.31. On the basis of internet connected computers, LAN networked computers and multimedia computers the ratios were 0.36, 0.36 and 0.30. This means that Australian secondary schools operate with an overall ratio of 2.5 students per computer or, perhaps as a better index, 3.2 students per accessible computer. These data in Table 4.1 indicate that the level of computers per student in Australia is not significantly different from that in Norway or Alberta (or, in the case of multimedia computers, Singapore).

Table 4.1 Mean Computer to Student Ratio for Countries

	Overall Computer Ratio		Internet Computer Ratio		Networked Computer Ratio		Multimedia Computer Ratio		Student Accessible Computer Ratio	
	Mean	Std err.	Mean	Std err.	Mean	Std err.	Mean	Std err.	Mean	Std err.
Australia	0.40	0.02	0.36	0.02	0.36	0.02	0.30	0.02	0.31	0.01
Norway	0.37	0.01	0.35	0.01	0.32	0.02	0.26	0.02	0.26	0.01
Alberta, Canada	0.34	0.02	0.31	0.02	0.28	0.02	0.23	0.02	0.26	0.02
Singapore	0.28	0.01	0.25	0.01	0.24	0.01	0.26	0.01	0.19	0.01
Hong Kong, SAR	0.28	0.01	0.25	0.01	0.25	0.01	0.25	0.01	0.19	0.01
Japan	0.26	0.01	0.23	0.01	0.22	0.01	0.23	0.01	0.20	0.01
Denmark	0.23	0.01	0.22	0.01	0.20	0.01	0.18	0.01	0.19	0.01
Ontario, Canada	0.22	0.02	0.20	0.02	0.19	0.02	0.16	0.02	0.19	0.02
Finland	0.21	0.01	0.20	0.01	0.18	0.01	0.18	0.01	0.17	0.01
France	0.18	0.01	0.15	0.01	0.13	0.01	0.14	0.01	0.14	0.01
Chinese Taipei	0.18	0.01	0.17	0.01	0.16	0.01	0.15	0.01	0.11	0.01
Catalonia, Spain	0.14	0.01	0.13	0.01	0.13	0.01	0.13	0.01	0.11	0.01
Estonia	0.14	0.01	0.13	0.01	0.13	0.01	0.10	0.01	0.09	0.00
Slovenia	0.14	0.00	0.13	0.00	0.12	0.00	0.12	0.00	0.09	0.00
Italy	0.13	0.01	0.09	0.01	0.08	0.01	0.11	0.01	0.10	0.01
Lithuania	0.13	0.01	0.08	0.00	0.05	0.01	0.05	0.01	0.08	0.00
Israel	0.13	0.01	0.10	0.01	0.06	0.01	0.08	0.01	0.10	0.01
Slovak Republic	0.09	0.0	0.07	0.00	0.06	0.00	0.06	0.00	0.06	0.00
Moscow	0.08	0.01	0.03	0.00	0.04	0.00	0.04	0.00	0.05	0.00
Russian Federation	0.08	0.01	0.01	0.00	0.02	0.00	0.03	0.00	0.04	0.00
Thailand	0.07	0.00	0.04	0.00	0.04	0.00	0.04	0.00	0.06	0.00
Chile	0.06	0.01	0.04	0.00	0.03	0.01	0.04	0.01	0.04	0.00
South Africa	0.03	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.00

Note: Values shaded in grey are not significantly different from the Australian value.
Systems in *italics* did not satisfy sampling criteria or sampling procedure.
Standard errors have been computed to take account of the sampling design.

Location of Computers

The SITES survey indicates that computers for teaching and learning in secondary schools are most commonly (in more than 90% of schools) located in computer laboratories and to a slightly lesser extent in libraries (but to a large extent in Australia). Only in a few education systems were computers located in most classrooms for a significant number of schools: Hong Kong (69%), Alberta (51%), Ontario (62%) and Norway (48%). In Australia just over one quarter of schools (27%) indicated that computers were located in most classrooms. Relevant data are recorded in Table 4.2.

Table 4.2 Location of Computers Used for Teaching and Learning in Schools

	Most classrooms		Some classrooms		Computer laboratories		Library		Other places	
	%	SE	%	SE	%	SE	%	SE	%	SE
Australia	27	3	41	3	93	2	88	2	45	3
Chile	2	1	3	1	97	1	23	2	10	1
Chinese Taipei	20	2	26	2	99	1	54	2	29	2
Denmark	14	3	27	4	93	2	84	3	63	4
Estonia	11	3	40	4	98	1	51	4	17	3
Finland	37	3	46	3	97	1	42	3	23	3
France	6	2	70	3	93	2	93	1	40	4
Hong Kong, SAR	69	2	16	2	99	1	95	1	77	3
Israel	1	1	22	2	96	1	54	3	34	3
Italy	3	1	14	2	96	1	27	2	35	3
Japan	13	2	20	2	99	0	35	2	23	2
Lithuania	3	1	41	3	78	3	73	3	33	3
Norway	48	4	25	4	84	3	73	4	67	4
Russian Federation	0	0	9	2	89	2	35	3	21	1
Singapore	32	4	17	3	100	0	93	2	63	4
Slovak Republic	0	0	7	1	98	1	9	1	20	2
Slovenia	22	2	55	3	97	1	79	2	28	2
South Africa	1	0	2	1	39	2	7	1	9	2
Thailand	4	1	17	2	93	2	39	2	43	3
Moscow	4	1	52	3	96	1	77	2	37	2
Catalonia, Spain	1	1	34	3	97	1	56	3	32	3
Ontario, Canada	62	3	18	3	80	2	73	3	27	2
Alberta, Canada	51	4	21	3	91	3	75	4	41	4
International Avge.	19	2	27	3	91	1	58	2	36	3

Note: Systems in *italics* did not satisfy sampling criteria or sampling procedure.
Standard errors have been computed to take account of the sampling design.

Other ICT Resources

Table 4.3 records the availability of a range of ICT resources in Australian secondary schools. These data, based on reports by the technical coordinators in schools, confirm the strong position of Australian schools with respect to some resources such as smart boards and some areas, such as email accounts for students, where resources are not so abundant.

Table 4.3 Percentages of Schools in which Some Common Types of Technology Applications and Facilities are available

	Equipment	Tutorial software	General software	Multimedia production	Data-logging	Simulation	Comm software	Digital resources	Mobile devices	Smart board	LMS	Mail accounts teachers	Mail accounts students
Australia	95 (2)	71 (3)	100(1)	87(3)	67 (3)	71 (3)	92 (2)	88 (2)	21 (3)	51 (3)	65 (3)	98 (0)	6 (2)
Chile	47 (2)	45 (2)	90 (1)	54 (2)	63 (2)	48 (2)	79 (28)	72 (2)	13 (2)	06 (1)	39 (2)	68 (2)	52 (2)
Chinese Taipei	96 (1)	48 (3)	99 (0)	89 (2)	54 (3)	21 (2)	93 (1)	74 (3)	10 (2)	07 (1)	42 (3)	95 (1)	74 (2)
Denmark	94 (2)	93 (2)	99 (1)	89 (2)	44 (4)	53 (4)	97 (1)	93 (2)	11 (2)	25 (3)	51 (4)	96 (1)	89 (2)
Estonia	66 (4)	64 (4)	98 (1)	57 (4)	35 (3)	21 (3)	93 (2)	67 (4)	22 (3)	21 (3)	21 (3)	94 (2)	57 (4)
Finland	96 (1)	66 (3)	99 (1)	77 (3)	64 (3)	20 (2)	92 (2)	78 (36)	11 (2)	10 (2)	46 (3)	97 (1)	59 (3)
France	86 (3)	80 (4)	99 (1)	68 (3)	76 (4)	50 (4)	71 (3)	83 (3)	18 (3)	14 (3)	26 (4)	78 (3)	48 (4)
Hong Kong	97 (1)	72 (3)	100(0)	97 (1)	77 (3)	47 (3)	98 (1)	89 (2)	20 (3)	26 (3)	91 (2)	98 (1)	88 (2)
Israel	70 (3)	46 (3)	96 (1)	44 (3)	55 (4)	16 (2)	84 (3)	53 (3)	13 (2)	08 (2)	46 (3)	54 (3)	40 (3)
Italy	85 (2)	60 (3)	99 (1)	63 (3)	70 (3)	37 (3)	73 (3)	60 (3)	11 (2)	11 (2)	19 (2)	64 (3)	14 (2)
Japan	94 (1)	58 (2)	97 (1)	76 (2)	22 (2)	39 (2)	62 (3)	51 (2)	03 (1)	20 (2)	35 (2)	56 (2)	22 (2)
Lithuania	72 (3)	74 (3)	90 (2)	70 (3)	70 (3)	37 (4)	94 (1)	87 (2)	38 (3)	32 (3)	19 (3)	62 (4)	58 (4)
Norway	92 (2)	88 (3)	100(0)	78 (3)	28 (3)	34 (4)	95 (1)	83 (3)	13 (3)	07 (2)	70 (4)	89 (3)	54 (5)
Russian Federation	47 (4)	61 (3)	73 (4)	34 (3)	10 (2)	27 (3)	36 (3)	49 (4)	15 (2)	02 (1)	05 (1)	18 (2)	13 (2)
Singapore	98 (1)	85 (3)	100(0)	93 (2)	95 (2)	66 (4)	98 (1)	92 (2)	34 (4)	28 (3)	95 (2)	100 (0)	58 (4)
Slovak Republic	75 (2)	48 (3)	97 (1)	68 (3)	25 (2)	40 (3)	97 (1)	83 (2)	21 (2)	17 (2)	25 (3)	81 (2)	72 (3)
Slovenia	92 (1)	87 (2)	100(0)	80 (2)	93 (1)	55 (3)	98 (1)	78 (2)	21 (2)	04 (1)	48 (3)	97 (1)	91 (2)
South Africa	17 (1)	10 (1)	35 (2)	07 (1)	11 (2)	04 (1)	14 (1)	20 (2)	13 (2)	09 (1)	07 (1)	13 (1)	08 (1)
Thailand	40 (2)	17 (2)	51 (3)	22 (2)	04 (1)	06 (1)	44 (2)	49 (3)	05 (1)	06 (1)	13 (2)	11 (1)	10 (1)
Moscow	65 (3)	65 (2)	81 (2)	47 (3)	24 (2)	24 (2)	81 (2)	55 (3)	26 (2)	21 (2)	09 (1)	53 (3)	38 (2)
Catalonia, Spain	88 (2)	57 (3)	99 (1)	84 (2)	73(3)	59 (3)	89 (2)	87 (2)	21 (2)	07 (2)	44 (3)	88 (2)	49 (3)
Ontario, Canada	81(3)	78 (3)	99 (1)	83 (2)	75 (3)	59 (3)	64 (3)	90 (2)	09 (2)	21 (2)	54 (3)	100 (0)	32 (3)
Alberta, Canada	88 (3)	68 (4)	100(0)	81 (3)	44 (4)	43 (4)	76 (4)	87 (3)	22 (3)	47 (4)	48 (4)	95 (2)	53 (4)

Note: Standard errors are shown in brackets. Standard errors have been computed to take account of the sampling design
Systems in *italics* did not satisfy sampling criteria or sampling procedure.

Table 4.4 Percentages of Schools by Country in Which More than 10 per cent of Students Bring Specified Forms of ICT to School

	Personal digital assistant (PDA)		Graphical calculator		Laptop Computer	
	%	SE	%	SE	%	SE
Australia	11	2	44	3	13	2
Chile	9	1	10	1	1	1
Chinese Taipei	3	1	1	0	0	0
Denmark	5	2	18	3	8	2
Estonia	4	2	5	2	2	1
Finland	9	2	12	2	0	0
France	3	1	26	3	2	1
Hong Kong, SAR	4	1	2	1	7	2
Israel	14	2	9	2	1	0
Italy	2	1	5	1	3	1
Japan	2	1	1	1	11	2
Lithuania	12	2	7	2	1	1
Norway	2	1	2	1	25	3
Russian Fed	5	1	10	1	1	0
Singapore	15	3	14	3	6	2
Slovak Republic	7	1	4	1	1	1
Slovenia	7	1	10	2	2	1
South Africa	6	1	9	2	1	0
Thailand	2	0	2	0	3	1
Moscow	26	2	12	2	4	1
Catalonia, Spain	1	1	21	2	2	1
Ontario, Canada	1	1	5	1	0	0
Alberta, Canada	12	3	37	4	3	1
Total.	7	0	10	0	3	0

Note: Standard errors shown in brackets take account of the sampling design.
Systems in *italics* did not satisfy sampling criteria or sampling procedure.

As shown in Table 4.4, ICT resources brought to school by students were not very common. In only seven per cent of schools (11% in Australia) did more than ten per cent of students bring a personal digital assistant (PDA) to their school. In only four per cent of schools (but 13% in Australia and 25% in Norway) did more than ten per cent of students bring a laptop computer to school. Internationally, there were only ten per cent of schools in which more than ten per cent of students brought a graphical calculator to school. However, in Australia 44 per cent of schools indicated that more than ten per cent of students brought a graphical calculator to school. In Alberta and France the corresponding figures were 37 per cent and 26 per cent respectively.

Managing ICT in Schools

There is a range of management issues for operating ICT in schools. Table 4.5 records the percentages of schools in each country which had undertaken each of a set of ICT management tasks over the previous year. Some of these such as “setting up security measures to prevent unauthorized system access or entry” (89% internationally and 99% in Australia), “honouring of intellectual property rights (e.g., software copyrights)” (92% and 98%) and “prohibiting access to adult-only material” (e.g., pornography, violence) (92% and 99%) were almost universal.

Table 4.5 Percentages of Schools in which Specified Actions for the Management of ICT had been Taken

	Security access		Restrict hours		Access outside hours		Access out of class		IP rights		Restrict sites		Restrict games		Specify required ICT skill		Comm. access		Provide digital resources		Provide teacher laptops		Provide student laptops	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Australia	99	1	34	4	58	3	93	2	98	1	99	1	94	2	85	2	29	3	95	2	70	3	34	3
Chile	93	1	57	2	77	2	83	2	88	2	98	1	90	2	89	2	71	2	92	1	29	2	19	2
Chinese Taipei	96	1	52	3	42	3	67	2	99	1	99	1	83	2	87	2	37	3	97	1	86	2	25	2
Denmark	91	2	15	2	46	4	91	2	93	2	64	4	73	3	81	3	24	3	92	2	31	3	44	4
Estonia	79	3	69	3	80	3	97	1	97	1	88	2	86	2	85	3	34	3	82	3	44	4	3	1
Finland	97	1	66	3	18	2	59	3	100	0	78	2	93	2	74	3	22	3	83	3	46	3	12	2
France	93	2	37	4	28	3	83	3	95	1	99	0	96	1	85	2	22	3	60	3	50	3	12	2
Hong Kong, SAR	97	1	20	3	98	1	94	2	100	0	96	1	81	3	86	3	62	4	93	2	95	2	83	2
Israel	80	2	68	2	54	3	67	3	88	2	93	2	80	2	85	2	36	3	58	3	12	2	8	1
Italy	91	2	76	2	19	2	46	3	95	1	100	0	99	1	87	2	37	3	86	2	44	3	18	2
Japan	99	0	59	2	60	2	62	2	97	1	97	1	85	2	78	2	31	2	58	2	44	3	24	2
Lithuania	84	3	67	3	68	4	97	1	90	2	88	2	43	3	72	3	82	3	88	2	51	3	15	2
Norway	94	2	27	4	36	4	64	4	87	3	94	2	79	3	76	4	27	4	75	3	60	4	40	4
Russian Fed	77	3	85	3	81	3	79	2	88	3	96	1	85	3	91	2	26	3	79	3	23	3	15	2
Singapore	98	1	46	4	85	3	92	2	100	0	99	1	88	3	79	3	34	4	97	1	100	0	53	4
Slovak Republic	89	2	65	2	57	3	91	2	98	1	95	1	86	2	80	2	71	3	80	2	46	3	11	2
Slovenia	96	1	38	3	81	2	87	2	99	1	99	1	83	2	56	3	48	3	88	2	54	3	13	2
South Africa	60	3	45	2	28	2	34	2	56	3	58	2	53	3	47	3	21	2	40	2	11	1	7	1
Thailand	55	3	89	2	66	3	93	2	86	2	96	1	94	2	91	2	59	3	81	2	37	3	15	2
Moscow	85	2	90	1	86	2	82	2	92	1	97	1	90	2	97	1	14	2	87	2	40	2	27	2
Catalonia, Spain	92	2	61	3	40	3	58	3	81	3	92	2	91	2	87	2	40	3	82	2	42	3	7	1
Ontario, Canada	97	1	54	3	34	3	86	2	97	1	99	1	91	2	85	2	16	2	83	2	29	3	30	3
Alberta, Canada	99	1	40	4	51	4	94	2	97	2	99	0	89	3	91	2	31	3	92	2	40	4	26	4
International Avge.	89		55		56		78		92		92		84		82		37		82		49		24	

Note: Systems in *italics* did not satisfy sampling criteria or sampling procedure.
Standard errors have been computed to take account of the sampling design.

Other actions were common but not quite universal.

- Restricting the playing of games on school computers
- Specifying the compulsory computer-related knowledge and skills that students need
- Providing digital resources for teaching and learning (82% internationally but 95% in Australia).

For Australia allowing students to access computers outside class hours (but during school hours) was reported by more than 90 per cent of principals. "Providing teachers with laptop computers and/or other mobile learning devices" was reported by 70 per cent of schools in Australia. It was also reported by 100 per cent of schools in Singapore, 95 per cent in Hong Kong and 86 per cent in Chinese Taipei and it was moderately frequent in other countries resulting in an international frequency of 49 per cent.

In Australia 34 per cent of schools reported "providing students with laptop computers and/or other mobile learning devices". This was higher than the international average of 24 per cent but not as high as Hong Kong (83%), Singapore (53%) and Denmark (44%).

Support Services for ICT

The information technology coordinator provided information about the support provided for the use of ICT in the school. "Support" was defined to include any services (formal or informal, technical or pedagogical) that help teachers and students use ICT. IT coordinators were asked to indicate the number of hours, on average per week, provided by specified people on ICT support to teachers and students in the school. The specified people were:

- The IT coordinator
- ICT staff (not including the coordinator)
- Other administrators and staff (e.g., media specialist)
- Teachers
- Students from own school who are assigned to provide this service
- Volunteers from outside the school (e.g., parents)
- Personnel from external companies
- Others

Relevant data for each category are recorded in Table 4.6. In most countries most (just under 60%) ICT support was provided by a combination of the IT coordinator and other IT staff. In Australia this percentage was just over 60 per cent.

Table 4.6 Mean hours per week from specified sources providing ICT support to teachers and students

	IT Coordinator		Other ICT staff		Other admin staff		Teachers		Students		Outside volunteers		External personnel		Others		Total hours	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Australia	10.34	0.78	13.97	1.21	4.84	0.87	6.12	0.93	0.60	0.13	0.13	0.04	1.71	0.31	0.48	0.15	34.81	2.45
Chile	10.26	0.55	2.92	0.40	1.98	0.34	5.65	0.54	2.40	0.32	0.60	0.10	0.59	0.14	0.45	0.12	24.38	1.65
Chinese Taipei	11.25	0.54	5.65	0.47	3.13	0.33	3.29	0.28	1.08	0.11	0.26	0.08	1.30	0.15	0.34	0.19	26.03	1.30
Denmark	6.30	0.45	5.17	0.60	1.21	0.16	3.81	0.67	0.10	0.05	0.02	0.01	0.26	0.08	0.29	0.09	16.61	1.36
Estonia	13.55	0.92	5.01	0.81	2.01	0.41	5.34	0.73	0.38	0.12	0.10	0.04	0.20	0.06	0.13	0.05	27.03	2.30
Finland	4.80	0.48	1.92	0.29	0.45	0.11	1.75	0.27	0.13	0.06	0.01	0.01	0.32	0.14	0.10	0.03	9.62	0.86
France	4.92	0.45	3.36	0.62	0.87	0.18	3.97	0.68	0.12	0.07	0.03	0.01	0.27	0.14	0.08	0.04	11.29	1.27
Hong Kong, SAR	9.14	0.71	30.86	1.43	6.04	0.85	5.94	0.71	4.44	0.43	0.20	0.09	3.91	0.74	1.26	0.54	61.66	3.24
Israel	10.22	0.70	6.08	0.67	2.4o	0.56	4.26	0.61	1.43	0.26	0.19	0.05	1.54	0.37	0.27	0.08	25.40	1.84
Italy	4.82	0.30	1.49	0.19	0.5o	0.11	4.00	0.32	0.25	0.11	0.20	0.11	0.38	0.13	0.21	0.11	11.60	0.75
Japan	5.63	0.39	2.34	0.26	1.01	0.15	2.49	0.34	1.17	0.26	0.06	0.03	0.43	0.19	0.04	0.02	13.15	1.02
Lithuania	11.76	0.77	9.25	0.71	4.49	0.61	9.48	0.86	2.77	0.37	0.25	0.07	0.33	0.13	0.67	0.21	39.40	2.53
Norway	6.35	0.49	1.88	0.27	0.87	0.26	3.36	0.59	1.69	0.37	0.06	0.02	0.21	0.04	0.27	0.10	14.87	1.44
Russian Fed	9.84	0.82	4.06	0.47	4.46	0.56	4.85	0.39	2.68	0.3	0.50	0.11	0.75	0.16	0.52	0.13	27.32	1.10
Singapore	7.62	0.71	24.73	1.68	11.45	1.40	4.37	0.76	2.51	0.42	0.18	0.07	10.5	1.35	0.97	0.64	59.46	4.34
Slovak Republic	11.21	0.48	4.77	0.44	3.19	0.46	8.82	0.72	1.21	0.29	0.54	0.08	0.44	0.11	0.60	0.12	29.62	1.54
Slovenia	11.95	0.45	7.05	0.49	3.68	0.43	4.63	0.48	1.65	0.30	0.27	0.11	0.74	0.16	0.42	0.21	29.47	1.60
South Africa	3.99	0.38	2.30	0.34	1.6o	0.37	2.37	0.38	1.28	0.36	0.15	0.05	0.96	0.49	0.23	0.15	12.85	1.85
Thailand	6.57	0.45	5.65	0.34	2.77	0.25	6.27	0.43	2.96	0.33	0.12	0.03	0.28	0.05	0.22	0.05	24.58	0.88
Moscow	15.73	0.62	9.8	0.60	7.61	0.54	7.02	0.4	3.63	0.31	1.24	0.18	1.30	0.19	0.47	0.13	46.72	1.99
Catalonia, Spain	6.43	0.32	3.97	0.45	1.58	0.35	5.51	0.71	0.34	0.07	0.06	0.02	0.55	0.06	0.08	0.03	18.20	1.35
Ontario, Canada	3.49	0.31	1.64	0.38	1.04	0.36	3.40	0.51	0.74	0.36	0.06	0.02	0.13	0.05	0.25	0.16	10.41	1.36
Alberta, Canada	6.37	0.73	3.84	1.01	1.93	0.52	4.83	1.00	0.54	0.19	0.08	0.04	0.7	0.37	0.63	0.3	17.51	2.26
International Avge.	8.37	0.56	6.86	0.61	3.00	0.44	4.85	0.58	1.48	0.24	0.23	0.06	1.21	0.24	0.39	0.16	25.36	0.37

Note: Systems in *italics* did not satisfy sampling criteria or sampling procedure.
Standard errors have been computed to take account of the sampling design.

Hong Kong, Singapore and Moscow provided significantly greater hours per week of ICT support than Australia. Australia was not significantly different from Lithuania and Slovakia in the amount of ICT support provided. Australia provided significantly greater ICT support than other education systems in the table. If only ICT support provided by school IT staff is considered, only Hong Kong (40 hours per week) and Singapore (32 hours per week) provided significantly higher support than Australia (24 hours per week).

Singapore also provided substantial levels of support through personnel from external companies (10 hours per week). It was the only country to make extensive use of this mode of support provision. Hong Kong provided four hours of support per week in this form and Australia provided an average of two hours per week through personnel from external companies.

On average across the participating countries, teachers provided approximately five hours per week of ICT support. In Australia this figure was six hours per week. The highest level of teacher support of ICT was in Lithuania with nine hours per week.

IT coordinators filled a range of duties such as teaching IT to students (60% overall and 55% in Australia) as well as performing other teaching duties (46% in mathematics or science and 52% in other subjects). IT coordinators also taught ICT to teachers (41% overall and 55% in Australia). Fifty three per cent were formally the IT coordinator (61% in Australia) and 38 per cent indicated that they were informally the IT coordinator (22% in Australia). In the remaining schools (17% in Australia and 19% overall) the questionnaire was completed by a person nominated as knowing about the ICT facilities in the school and their use, usually the principal (6%) or deputy principal (15%).

Sources of Knowledge about the Use of ICT

IT coordinators provided their perspectives on the ways in which teachers in their school had acquired knowledge and skills in using ICT for teaching and learning. The methods mentioned most frequently (and nearly universally for Australia) were:

- Observation of and discussion with colleagues (97%)
- Informal contacts and communication (96%)
- From the ICT coordinator or technical assistant (94%)
- In-school courses (89%)
- Training from a teacher who has attended a course (88%)

These sources of knowledge are consistent with much of the research literature on knowledge utilisation. That literature stresses the importance of peers as a source of knowledge that becomes implemented in practice.

Newsletters were not seen as a source of knowledge and skills in Australian schools, whether they were electronic or printed.

Table 4.7 Percentages of Schools Indicating Various Ways in which teachers Acquired Knowledge and Skills in Using ICT for Teaching and Learning

	Informal contacts		ICT Coord & assistant		In-school courses		Teacher at a course		ICT commitee		Staff meetings		News-letter		Course by expert		Colleagues discussion		Professional journals	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Australia	96	1	94	2	89	2	88	2	58	3	61	3	20	3	71	3	97	1	63	3
Chile	67	2	76	2	64	2	64	2	21	2	35	2	10	2	43	2	81	2	40	2
Chinese Taipei	78	2	76	2	86	2	92	1	44	2	40	3	38	3	57	3	94	1	70	2
Denmark	82	3	93	2	91	2	70	3	50	3	39	3	15	3	80	3	70	3	52	4
Estonia	93	2	93	2	81	3	66	4	20	3	31	4	28	4	79	3	95	2	71	3
Finland	87	2	89	2	71	3	62	3	29	3	17	2	10	2	73	3	92	2	70	3
France	89	2	78	3	60	4	80	3	14	2	20	3	8	2	16	2	98	1	35	4
Hong Kong, SAR	95	1	99	1	94	2	91	2	94	2	51	3	39	3	65	3	91	2	72	3
Israel	60	3	75	2	70	3	69	3	23	2	23	3	10	2	47	3	37	3	26	3
Italy	66	3	76	2	83	2	63	3	29	3	17	2	3	1	69	3	55	3	41	3
Japan	85	2	67	2	58	3	59	2	26	2	19	2	10	2	45	3	91	1	64	2
Lithuania	69	3	85	3	74	3	90	2	21	3	26	3	38	3	82	3	88	2	74	3
Norway	95	2	97	1	93	2	71	4	25	3	18	3	17	3	75	4	86	3	50	4
Russian Fed	85	1	48	3	45	4	71	2	19	3	33	3	27	3	72	3	85	2	64	2
Singapore	96	2	94	2	98	1	91	2	82	3	77	3	36	4	93	2	92	2	56	4
Slovak Republic	86	2	85	2	74	2	57	3	14	2	26	2	17	2	73	2	53	3	77	2
Slovenia	90	2	96	1	87	2	53	3	13	2	27	2	53	3	72	2	93	1	71	3
South Africa	46	2	26	2	31	2	41	3	15	2	14	2	11	2	32	2	44	3	24	2
Thailand	90	2	70	3	76	3	87	2	67	3	50	3	59	3	74	2	77	2	74	3
Moscow	92	1	76	2	46	3	59	2	28	3	45	3	34	2	90	1	90	2	70	2
Catalonia, Spain	75	2	82	2	80	2	69	3	18	2	24	2	10	2	50	3	75	2	28	3
Ontario, Canada	94	2	89	2	67	4	83	3	45	3	47	3	28	3	57	3	94	1	48	3
Alberta, Canada	96	2	86	3	70	4	80	3	59	4	51	4	15	3	56	4	95	2	48	4
International Avge.	83	2	80	2	73	3	72	3	35	3	34	3	23	3	64	3	81	2	56	3

Note: Systems in *italics* did not satisfy sampling criteria or sampling procedure.
Standard errors have been computed to take account of the sampling design

Table 4.8 Percentages of School Principals Considering Various Factors as Hindering ICT "Somewhat" or "a Lot"

	Lack of technical; staff		Insufficient Internet computers		Inadequate bandwidth		ICT for SEN students		Insufficient ICT equipment		Obsolete computers		Too few digital resources		Lack ICT science tools		Lack of teacher ICT skills		Not enough time	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Australia	58	4	45	3	50	3	25	3	49	4	31	3	53	3	62	3	74	3	67	4
Chile	78	2	80	2	68	2	59	3	83	2	75	2	81	2	83	2	87	2	85	2
Chinese Taipei	65	2	34	3	38	3	47	3	51	3	45	3	56	3	64	3	51	3	64	3
Denmark	38	3	30	3	21	3	18	3	26	3	23	3	36	3	64	4	52	4	47	4
Estonia	66	3	41	4	40	4	57	4	59	3	57	3	83	2	90	2	81	3	88	2
Finland	53	3	44	3	21	3	11	2	51	3	36	3	67	3	74	3	59	3	83	3
France	52	3	32	3	22	3	19	3	46	4	40	4	42	4	49	4	65	3	76	3
Hong Kong	52	4	28	3	29	3	34	4	43	4	70	3	72	3	69	3	56	3	83	3
Israel	74	3	64	3	52	3	61	3	72	3	63	3	73	3	76	2	74	3	78	3
Italy	78	3	47	3	42	3	55	3	53	3	43	3	59	3	72	3	72	3	72	2
Japan	75	2	47	2	47	2	37	3	61	3	55	2	82	2	88	2	87	2	88	2
Lithuania	50	4	55	4	60	4	42	4	42	4	30	3	31	3	25	3	40	4	40	4
Norway	64	4	53	4	31	4	23	4	63	4	46	4	75	3	91	2	78	4	61	4
Russian Fed	77	2	87	2	67	3	60	4	85	2	61	4	87	2	91	2	82	3	70	3
Singapore	57	4	32	4	48	5	15	4	26	3	14	3	56	4	51	4	61	4	78	3
Slovak Republic	65	2	54	3	52	2	64	3	69	2	51	3	75	2	83	2	75	2	72	2
Slovenia	69	3	41	3	38	3	51	3	59	3	62	3	66	3	79	2	70	3	71	3
South Africa	78	2	81	2	79	2	74	3	80	2	59	3	79	2	82	2	79	2	74	3
Thailand	86	2	90	1	93	1	63	3	91	1	83	2	93	1	94	1	88	2	82	2
Moscow	73	3	78	2	54	3	49	3	83	2	69	3	82	2	88	2	70	2	65	2
Spain, Catalonia	66	3	38	3	23	2	36	3	51	3	29	3	45	3	52	3	63	3	74	3
Ontario, Canada	78	3	53	3	45	3	40	3	61	3	53	3	69	3	84	2	74	3	83	2
Alberta Canada	53	4	33	4	26	3	29	4	45	4	35	4	45	4	65	4	62	4	63	4
Total	75		72		63		54		75		61		80		84		80		75	

Note: Systems in *italics* did not satisfy sampling criteria or sampling procedure.
Standard errors have been computed to take account of the sampling design

Factors Hindering the Use of ICT in Teaching

There is a range of factors that impede the use of ICT in teaching and learning. The views of IT coordinators in schools are summarised in Table 4.8.

For Australia, the most frequently mentioned impediments involved were the lack of ICT skills among teachers (74%) followed by a lack of time for teachers to use ICT (67%). These two impediments also featured in the factors nominated across all countries. In that wider domain these were most frequently mentioned impediments: a lack of ICT tools for science laboratory work (84%); too few digital resources (80%); and a lack of time for teachers to use ICT (80 %).

There were four items that were seen less frequently as impediments in Australia than in other countries. These were:

- Computers are out of date (61% internationally and 31% in Australia)
- Insufficient numbers of computers connected to the Internet (72% internationally and 45% in Australia)
- Lack of special ICT equipment for disabled students (54% internationally and 25% in Australia)
- Insufficient ICT equipment for instruction (75% internationally and 49% in Australia)
- Not enough digital educational resources for instruction (80% internationally and 53% in Australia)

Priorities for Developing the Use of ICT

Principals were invited to indicate the priority level they gave to resource allocation in the school in order to enhance the use of ICT in teaching and learning for the Year 8 students in the school. For Australia, and internationally, three of the four highest priorities concerned teachers and the fourth concerned students' skills:

- To improve the ability of teachers to make good pedagogical use of ICT
- To improve the technical skills of teachers
- To improve students' ICT skills
- To increase the number of teachers using ICT for teaching/learning purposes

Factors concerned with resources were all rated as lower priorities than these. These included such actions as: increase the number of computers connected to the Internet; increase the range of digital learning resources; decrease the number of students per computer; increase the bandwidth for Internet access of the computers connected to the Internet; and establish or enhance an online learning support platform.

Table 4.9 School Principals' Ratings of Priorities for Resources to Enhance the Use of ICT in Teaching and Learning

	Improve students/ computer		Increase internet computers		Increase bandwidth		Expand digital resources		On-line learning platform		Technical skills of teachers		Teachers Pedagogy & ICT		Improve student ICT skill		Incentives to use ICT		Increase teacher use of ICT	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Australia	3.37	0.05	3.44	0.05	3.40	0.06	3.60	0.04	3.24	0.07	3.66	0.04	3.72	0.04	3.61	0.04	2.02	0.07	3.58	0.05
Chile	3.42	0.05	3.77	0.03	3.66	0.03	3.80	0.02	3.40	0.04	3.78	0.03	3.83	0.02	3.79	0.02	2.78	0.05	3.70	0.03
Chinese Taipei	3.33	0.04	3.44	0.04	3.57	0.03	3.49	0.03	3.50	0.03	3.71	0.03	3.81	0.02	3.43	0.03	3.07	0.05	3.49	0.03
Denmark	3.12	0.07	3.66	0.05	3.21	0.06	3.10	0.05	2.96	0.06	3.14	0.06	3.45	0.05	3.36	0.05	1.78	0.06	3.12	0.06
Estonia	2.93	0.06	3.06	0.08	3.05	0.06	3.23	0.05	2.93	0.06	3.54	0.04	3.63	0.04	3.46	0.04	2.62	0.06	3.40	0.04
Finland	2.93	0.05	3.05	0.05	2.62	0.06	2.97	0.04	2.80	0.05	3.43	0.04	3.53	0.03	3.25	0.04	2.25	0.05	2.91	0.05
France	3.17	0.07	3.26	0.08	2.88	0.09	3.20	0.06	2.58	0.07	3.56	0.05	3.61	0.05	3.57	0.05	2.35	0.09	3.48	0.05
Hong Kong, SAR	2.78	0.06	3.14	0.06	3.19	0.06	3.11	0.05	3.36	0.05	3.12	0.05	3.27	0.05	3.30	0.05	1.83	0.05	2.67	0.05
Israel	3.45	0.04	3.58	0.05	3.32	0.06	3.30	0.06	2.97	0.07	3.49	0.05	3.52	0.05	3.55	0.04	2.53	0.07	3.50	0.05
Italy	3.15	0.06	3.30	0.05	2.99	0.06	3.20	0.04	2.70	0.05	3.66	0.03	3.67	0.03	3.57	0.03	2.89	0.06	3.66	0.03
Japan	2.94	0.04	2.95	0.04	2.93	0.04	2.64	0.03	2.52	0.04	3.28	0.04	3.23	0.03	2.96	0.03	1.49	0.04	2.72	0.04
Lithuania	3.48	0.04	3.57	0.05	3.25	0.06	3.23	0.05	2.92	0.06	3.61	0.04	3.59	0.04	3.56	0.04	2.72	0.07	3.57	0.04
Norway	3.50	0.06	3.57	0.05	3.19	0.07	3.33	0.05	3.21	0.08	3.36	0.04	3.61	0.04	3.65	0.04	2.09	0.07	3.55	0.06
Russian Federation	2.88	0.08	2.50	0.07	2.29	0.06	2.64	0.08	2.14	0.08	3.27	0.05	3.33	0.05	3.27	0.06	2.94	0.07	3.25	0.06
Singapore	2.92	0.06	3.30	0.07	3.35	0.07	3.63	0.04	3.77	0.04	3.49	0.05	3.82	0.03	3.40	0.05	2.26	0.09	3.55	0.05
Slovak Republic	3.40	0.04	3.58	0.04	3.46	0.04	3.29	0.04	2.83	0.05	3.76	0.02	3.77	0.03	3.75	0.02	3.31	0.04	3.63	0.03
Slovenia	3.00	0.04	3.57	0.03	3.17	0.03	3.15	0.03	2.65	0.05	3.50	0.03	3.60	0.03	3.39	0.03	2.61	0.05	3.44	0.04
South Africa	2.71	0.07	2.91	0.06	2.73	0.06	2.88	0.06	2.82	0.06	3.23	0.06	3.23	0.06	3.16	0.06	2.58	0.06	3.16	0.06
Thailand	3.43	0.05	3.84	0.02	3.75	0.03	3.62	0.03	3.55	0.03	3.89	0.02	3.88	0.02	3.82	0.02	3.37	0.04	3.75	0.03
Moscow	3.26	0.05	3.36	0.05	3.07	0.05	3.32	0.05	2.68	0.05	3.65	0.03	3.66	0.03	3.68	0.03	3.36	0.05	3.62	0.03
Catalonia, Spain	3.33	0.04	3.55	0.04	3.32	0.05	3.36	0.04	2.71	0.05	3.56	0.03	3.65	0.03	3.61	0.03	1.94	0.05	3.49	0.04
Ontario Canada	3.21	0.04	3.21	0.06	2.59	0.07	3.09	0.05	2.47	0.06	3.50	0.04	3.53	0.04	3.53	0.03	1.71	0.06	3.34	0.04
Alberta, Canada	2.98	0.06	3.07	0.07	2.89	0.07	3.14	0.05	2.69	0.07	3.31	0.05	3.46	0.04	3.48	0.04	1.61	0.07	3.33	0.05
Total	3.21		3.39		3.19		3.28		2.95		3.57		3.62		3.53		2.63		3.45	0.01

Note: *Recorded as 1 = Not a priority; 2 = Low priority; 3 = Medium priority; 4 = High priority*
Systems in *italics* did not satisfy sampling criteria or sampling procedure.
Standard errors have been computed to take account of the sampling design

School Factors Associated with the Pedagogical Use of ICT

To investigate the school level factors associated with the pedagogical use of ICT a multi-level logistical regression was conducted similar to the logistical regression reported in Chapter 3. The major school-level variables included in the analysis were the ratio of student-accessible computers to students and the hours of IT support available (the total of hours provided by school-based IT staff and external staff engaged to support the school IT systems) and the IT support provided by teachers.

The initial analyses indicated that teachers perceived obstacles to using ICT were correlated with the measures of ICT resources (not surprisingly) and so the teacher level variable concerned with obstacles was removed from the analysis reported in Table 4.10. In addition the level of IT support (person-hours per week) was not significantly associated with ICT use and was dropped from the analysis. The results for the final model are reported in Table 4.10.

Table 4.10 Results of Logistic Regression Analyses of Use of ICT in Teaching in Australia: Teacher and School Variables

Variable	Variable type	Regression coefficient	Standard error	Significance	Odds ratio Exp(B)
Subject (science cf. maths)	Categorical	1.05	0.22	.000	2.87
Teacher ICT competence	Scale	0.05	0.01	.000	1.05
Participation in ICT professional development	Scale	0.05	0.01	.000	1.05
Computer to student ratio	Ratio	1.78	0.79	.025	5.90

These data show that there is an association between the computer infrastructures (measured as the ratio of student accessible computers to students) in a school and the pedagogical use of ICT, net of the effects of teacher ICT competence, participation in ICT-related professional development and the subject (science or mathematics being taught).

Summary

The data from the SITES survey implemented in 2007 indicates that Australian secondary schools are, in comparison to secondary schools in other countries, relatively well resourced in terms of computer equipment. Furthermore, IT coordinators in Australian secondary schools are less likely to perceive resources and infrastructure as impediments to the use of ICT than their peers in other countries. At the time of the survey computers in Year 8 of Australian secondary schools were less often reported as being available in classrooms than in countries with the highest levels of provision for ICT (such as Hong Kong and Singapore). Australian schools were also relatively well provided with IT support but rather less well provided than Hong Kong and Singapore (whether total support or only support from IT specialists is considered).

These data are consistent with the views of IT coordinators on factors hindering the use of ICT in teaching. Resource factors were much less frequently reported as impediments in Australia than in most other countries. In addition when asked about priorities for the future, the focus was on developing teachers' and students' skills rather than on resources.

The results of the regression analyses of factors associated with use of ICT confirmed the importance of building teacher capacities. However, those analyses also showed that resources were an influence on ICT use and that there were differences between science and mathematics that possibly reflected the nature of the fields of teaching and the curriculum. The extent to which the amount of IT support is associated with the pedagogical use of ICT remains unclear. It may be that support is associated with how ICT is used rather than how much it is used.

5
INTERPRETATIONS

The advent of ICT has changed the environment in which students develop in ways that impact on the way they learn in schools. Kozma and McGhee (2003) report evidence from the large body of 174 case studies in SITES M2 of the uptake of ICT in teaching and learning and the ways in which the use of ICT impacts on teaching and learning practices. They argue that these impacts take place either by facilitating connectedness with other people or information sources and by enabling the creation of products that incorporate a range of resources (such as multimedia).

In Australia the *National Goals for Schooling in the 21st Century* included the statement that when students leave school they should "be confident, creative and productive users of new technologies, particularly information and communication technologies, and understand the impact of those technologies on society" (MCEETYA, 1999). In 2000, the MCEETYA adopted a school education action plan titled *Learning in an Online World* (MCEETYA, 2000), which was updated as *Contemporary Learning: Learning in an Online World* (MCEETYA, 2005). Overall, the plan established areas in which strategies were to be implemented by: developing teacher competence in ICT; implementing an advanced ICT infrastructure in schools; and developing digital resources. These were to be part of a plan for facilitating the uptake and use of ICT in schools and supporting the use of ICT to enhance learning.

The federal government that was elected at the end of 2007 proposed a "digital revolution" as a centrepiece of its education platform. It proposed significant support for improving ICT provision in schools. It also proposed providing schools with fibre to the premises (FTTP) broadband connections to deliver much higher internet speeds. Teacher capacity was also to be addressed with new teaching students being required to obtain appropriate ICT skills before graduation. The purpose of these initiatives is to support teaching and learning in schools and to develop in students the competencies that they will need in order to participate effectively in modern society.

ICT in Australian Schools: A Comparative Perspective

Infrastructure

Data from the OECD Programme for International Student Assessment (PISA) indicate that Australia has one of the highest levels of computer availability in secondary schools among the OECD countries (OECD, 2005). In PISA 2000 there was a ratio of 4.5 students per computer in Australia. By 2003 this average had dropped to 3.3 students per computer and by 2006 this ratio had dropped further to 2.9 students per computer. Data from PISA 2003 also indicate that 93 per cent of Australian 15-year-old students have a computer at home that they could use for school work and 83 per cent have a link to internet, and 67 per cent had educational software for their computers.

The findings from SITES are consistent with these findings. It reports an average ratio of 2.5 students per computer or 3.2 students per student-accessible computer. The data from SITES indicate that Australia is one of a group of three education systems (the others being Norway and the Alberta province in Canada) with high levels of computer provision in its secondary schools. Singapore would also be included in this group if only multi-media computers were to be considered. The computers in Australian secondary schools appear to be less often located in most classrooms (and more often in computer laboratories) than in countries such as Hong Kong, Norway, Canada and Finland. Australia is also a moderately high user of many other ICT resources such as smart boards but is relatively low in terms of providing email facilities for students and data logging technologies for use in science classes.

Teachers

One measure of the uptake of ICT in teaching is the percentage of teachers who report having used ICT in the past year. According to SITES data a higher percentage of Year 8 science teachers in Australian junior secondary schools used ICT in the past year than in most other countries. Australia was one of a group of four systems (the others were Singapore, Hong Kong SAR, and Alberta) in which there was a significantly higher percentage of science teachers that had used ICT for teaching than in other countries. In mathematics Australia was one of a group of countries in which a smaller percentage of teachers than in Norway, but a larger percentage than in most other countries had used ICT for teaching in the past year. The other systems in this group of countries were Denmark, Canada (Alberta and Ontario), Singapore, Hong Kong and Lithuania. In most participating countries the percentage of teachers reporting ICT-use was significantly higher for science teachers than for mathematics teachers.

Compared with their peers in other countries, Year 8 science and mathematics teachers in Australia were confident users of ICT. On a self-reported scale of confidence or competence in using ICT in general and for teaching, Year 8 science teachers in Australia were not significantly different in ICT confidence from those in Singapore, Hong Kong, Alberta, Ontario, Chile, and Norway and are significantly more confident than other countries. Year 8 mathematics teachers in Australia were not significantly different from those in Hong Kong, Singapore, Ontario, Alberta, Denmark, Chile and Norway but more confident than other countries.

Despite their confidence in being able to use ICT competently fewer Australian science and mathematics teachers than their peers in other countries had participated in ICT-related professional development (over introductory, technical, applications, internet, pedagogical use of ICT and multimedia). Fewer Australian science or mathematics teachers than in Chinese Taipei, Hong Kong, Israel, Estonia or Denmark had participated in ICT-related professional development in these broad areas. According to the IT coordinators in schools, science and mathematics teachers most frequently acquired knowledge about ICT and teaching through observation of and discussion with colleagues, informal contacts and communication with other teachers, the ICT coordinator or technical assistants, in-school courses and training from a teacher who had attended a course.

A national review of teaching and teacher education (Committee for the Review of Teaching and Teacher Education, 2003) argued that ICT should be used widely in schools, and form part of the repertoire of all teachers. It recommended that teacher education programs prepare prospective teachers to use ICT to support student learning. The review also argued that opportunities should be created for teachers to upgrade their ICT expertise and that expertise in the use of ICT should be a requirement for graduation from teacher education courses.

A national investigation of models of teacher professional development designed to facilitate integration of ICT into classroom practice identified the principal barriers as funding, time, and a lack of linkages (Downes et al., 2001). They pointed to a lack of connection between pre-service and in-service teacher education, in areas associated with ICT and argued for support for the integration of ICT, and a portal for resources and research by extending the existing website operated through the Education Network Australia. They emphasised that integration of ICT in education required targeting staff responsible for professional development programs, school leaders, in-school ICT coaches, leaders of professional associations, and teacher educators.

The data from SITES suggest that there remains much to be done in extending professional development for teachers but that this should not be at the level of introductory courses.

Factors that Support or Impede the Pedagogical Use of ICT

Information from SITES provides two bases for examining factors that support the pedagogical use of ICT. The first is information about those factors that are seen to impede the use of ICT in teaching. The second is from the analyses of factors that are associated with the use of ICT in teaching.

Obstacles to the use of ICT in teaching

Across all countries, and specifically for Australia, the most frequently cited obstacle to incorporating ICT in teaching was the time required to develop and implement activities. Another factor mentioned was a lack of digital learning resources in schools and student access to ICT tools out of school. Infrastructure was seen as an obstacle to ICT use by only about one quarter of Australian teachers and a similar number cited their own knowledge of using ICT in pedagogy. These patterns were similar for science and mathematics teachers. School principals also indicated that a lack of time for teachers to use ICT was an obstacle to incorporating it in teaching. However, principals also indicated that the ICT skills of teachers were an issue as was a lack of digital resources and tools for them to use.

Correlates of ICT use in teaching

The results of regression analyses of the use of ICT indicated that the use of ICT is more likely when teachers have a higher level of competence (or confidence) in ICT, when teachers have participated to a greater extent in ICT-related professional development, and when there are fewer contextual obstacles (such as poor infrastructure, lack of digital learning resources, access to ICT out of school, lack of access to ICT tools, and knowledge of what tools would be most useful). There was no evidence in these analyses that the level of IT support within schools was associated with the use of ICT in teaching. The importance of teacher confidence and competence for the effective implementation of ICT in schools has been reported in other studies (Jones, 2004).

Differences between science and mathematics classrooms in the use of ICT

SITES M2 involved a series of 174 case studies from 28 countries of innovative pedagogical practices that used ICT (Kozma and McGhee, 2003). One of the features of those studies was that a disproportionate number came from the sciences or languages with a smaller group from the social sciences and creative arts. The present survey reports that in Australia the teaching of Year 8 science is more likely to make use of ICT than the teaching of Year 8 mathematics. Differences in percentage of ICT-using mathematics teachers and science teachers were also found in other education systems (Law et al, 2008) and in other reviews (Jones, 2004). In SITES the samples of mathematics teachers and science teachers were taken from the same schools and so the differences could reflect curriculum differences at system level in these areas or differences in the nature of the disciplines. One inference to be drawn from this is that the subject (or discipline) context is an important aspect of the uptake of ICT in teaching. It may be that some subjects lend themselves more readily to the pedagogical use of ICT or that there are stronger traditions of innovation in some subjects than others.

Education System Strategies for the Use of ICT in Teaching and Learning

Comparative international studies such as SITES can provide a context for national perspectives on educational issues such as the use of ICT in teaching. When data from SITES in Australia are compared with data from other countries they suggest that ICT has been relatively widely adopted (at least in science and mathematics in secondary schools), that there is a relatively strong provision of computers in schools and that teachers are more confident in their ICT capability than their peers in other countries. This suggests that the *digital revolution* will be building on underlying strengths in Australian schools.

The data also suggest that the implementation of ICT in teaching would be enhanced by building the capacities of teachers (through an expansion of professional development) as well as removing contextual obstacles by improving the resources available to students and teachers. Three of the four top priorities nominated by school principals for enhancing the use of ICT in their schools involved teachers: improving the ability of teachers to make good pedagogical use of ICT, improving the technical skills of teachers and increasing the number of teachers using ICT for teaching/learning purposes.

Three Hypotheses

Three main hypotheses for this module of SITES were outlined in Chapter 2. These were:

1. The extent of use of ICT for pedagogical purposes in mathematics and science will be related to the level and nature of ICT resources available.
2. The use of ICT in teaching and learning will depend on the expertise or competence of teachers in ICT.
3. The pedagogical use of ICT will depend on the support available to teachers.

The results confirm the first two of these hypotheses but not the third. The use of ICT for teaching and learning in Year 8 mathematics and science was related to the level of ICT resources available and to the expertise of teachers in ICT. However, within Australia it did not appear that the use of ICT depended on the support available to teachers. This result was not expected and deserves further investigation in relation to the circumstances in which support may be important. For example, it may be that there is an interaction so that support is more important where teacher expertise is lower. In addition it could be that the provision of IT support facilitates more effective use of ICT in teaching and learning even if it is not associated with more extensive use of ICT.

REFERENCES

Anderson, R. & Ainley, J. (2009, in press). Technology and learning: Access in schools around the world. In B. McGaw, E. Baker, and P. Peterson *International Encyclopedia of Education*, 3rd Edition. Amsterdam: Elsevier.

Balanskat, A., Blamire, R., & Kefala, S. (2006) A Review of Studies of ICT Impact on Schools in Europe. European Schoolnet, European Commission: Brussels. (insight.eun.org)

Committee for the Review of Teaching and Teacher Education (2003). *Australia's Teachers: Australia's Future – Advancing Innovation, Science, Technology and Mathematics. Main Report.* Canberra: Department of Education, Science and Training.

Downes, T., Fluck, A., Gibbons, P., Leonard, R., Matthews, C., Oliver, R., Vickers, M., & Williams, M. (2001). *Making better connections: Models of teacher professional development for the integration of information and communication technology into classroom practice*. Canberra: Department of Education Science and Training

Jones, A. (2004). *A review of the research literature on barriers to the uptake of ICT by teachers*. Coventry: BECTA.

Kozma, R. (2003). ICT and educational change: A global phenomenon. In R. Kozma (Ed.), *Technology, innovation, and education change: A global perspective: A report of the Second Information Technology in Education Study (SITES) Module 2.* Eugene, OR: International Society for Technology in Education.

Kozma, R., & McGhee, R. (2003) ICT and innovative classroom practices. In R. Kozma (Ed.), *Technology, innovation, and education change: A global perspective: A report of the Second Information Technology in Education Study (SITES) Module 2.* Eugene, OR: International Society for Technology in Education.

Law, N., Pelgrum, W., & Plomp, T. (2008). *Pedagogy and ICT Use in Schools Around the World: Findings from the IEA SITES 2006 Study*. Hong Kong: Comparative Education Research Centre, University of Hong Kong.

Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) (1999). *National Goals for Schooling in the Twenty First Century*. Curriculum Corporation: Melbourne. www.curriculum.edu.au/mceetya/adeldec.htm.

Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) (2000) *Learning in an Online World: the School Education Action Plan for the Information Economy*. Adelaide: Education Network Australia, Retrieved 7 April 2007 from http://www.edna.edu.au/edna/webdav/site/myjahiasite/shared/00_learning_onlineworld.pdf

Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) (2005) *Contemporary Learning: Learning in an On-line World*. Carlton, VIC: Curriculum Corporation. Retrieved 7 April 2007 from http://www.mceetya.edu.au/verve/_resources/Contemp_Learning_Final.pdf.

Organisation for Economic Cooperation and Development (OECD) (2006). *Are Students Ready for a Technology-Rich World: What PISA Studies Tell Us*. Paris: OECD.

Pelgrum, H. & Anderson, R. (1999). *ICT and the Emerging Paradigm for Lifelong Learning. A Worldwide Educational Assessment of Infrastructure, Goals and Practices.* Amsterdam: International Association for the Evaluation of Educational Achievement.

Plomp, T., Anderson, R., Law, N., & Quale, A. (2009). *Cross-National Information and Communication Technology: Policies and Practices in Education*. Charlotte, North Carolina: Information Age Publishing.

Thomson, S. & de Bortoli, L. (2007). *PISA 2003 Australia: ICT Use and Familiarity at School and Home*. (ACER Research Monograph No 62). Melbourne: ACER.

Thomson, S. & Fleming, N. (2004). *Summing it up: Mathematics achievement in Australian secondary schools in TIMSS 2002*. (TIMSS Monograph No. 6). Melbourne: Australian Council for Educational Research.