AUSTRALIAN STUDENTS IN A DIGITAL WORLD

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INTRODUCTION

This century has seen continued exponential growth in the use of digital technologies. In Australia, the proportion of students having access to a computer at home rose from about 91 per cent in 2000 to over 99 per cent in 2013, and access to the internet grew from 67 per cent in 2000 to 98 per cent in 2013 (Lokan, Greenwood & Cresswell, 2001; DeBortoli, Buckley, Underwood, O’Grady & Gebhardt; 2014). According to the 2013 report on the International Association for the Evaluation of Education Achievement’s (IEA) International Computer and Information Literacy Study (ICILS), Australia had the highest percentage of students who used computers at school at least once a week (81%), while 87 per cent reported using their home computers at least once a week (DeBortoli et al., 2014). However there was a great deal of variation in these proportions between different groups of students.

Australian students’ computer use at school was given a push along between 2008 and 2012 with the implementation of the National Partnership Agreement on the Digital Education Revolution (DER). This partnership agreement provided a total of over $2 billion in funding to the Australian states and territories to provide computers and software to all students in school years 9 to 12. The purpose of this rollout of hardware and software was to contribute to raising the overall attainment of all Australian students so that they acquire “the knowledge and skills to participate effectively in society” ((then) Department of Education, Employment and Workplace Relations (DEEWR), 2009, p2).

The emphasis on promoting teaching and learning with technologies was also evident in Australian national policies at the beginning of this century. In June 2008, a Joint Ministerial Statement issued by the then Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) and the then Ministerial Council for Vocational and Technical Education (MCVTE) agreed that

AUSTRALIA WILL have technology enriched learning environments that enable students to achieve high quality learning outcomes and productively contribute to our society and economy (MCEETYA, 2008).

This sentiment was reiterated later in the year in the Melbourne Declaration on Educational Goals for Young Australians

IN THIS digital age, young people need to be highly skilled in the use of ICT. While schools already employ these technologies in learning, there is a need to increase their effectiveness significantly over the next decade (MCEETYA, 2008).
No other national policies or strategies have been proposed since this date. There are claims that Australia is falling behind, with other countries including higher level computing activities in the curriculum at a much younger age than in Australia. Catherine Livingstone, the President of the Business Council of Australia, argued recently:

*IF THE* market for labour is global, then we are effectively dealing generations of children out of their individual ability to participate in the digital economy, never mind the consequences for our national ability to maintain and build our knowledge infrastructure (Livingstone, 2015).

This paper examines progress towards the goals of the Melbourne Declaration and presents a picture of ICT learning in Australia using information available from the International Computer and Information Literacy Study (ICILS) developed by the International Association for the Evaluation of Educational Achievement (DeBortoli et al., 2014) and the National Assessment Program - ICT Literacy (Australian Curriculum Assessment and Reporting Authority (ACARA), 2012), and considers implications for policy.
THE NATIONAL PICTURE

The most comprehensive picture of ICT Literacy in Australia comes from the National Assessment Program (NAP), which was developed in order to monitor and report on progress towards the achievement of the goals for schooling spelt out in the Melbourne Declaration, on a nationally comparable basis. Sample-based assessment surveys are conducted on a rolling triennial basis in Science Literacy at Year 6; Civics and Citizenship at Year 6 and Year 10; and ICT Literacy (NAP-ICTL) at Year 6 and Year 10.

For NAP-ICTL, ACARA adopted the MCEETYA definition of ICT Literacy as

**THE ABILITY** of individuals to use ICT appropriately to access, manage, integrate and evaluate information, develop new understandings, and communicate with others in order to participate effectively in society (MCEETYA, 2005).

The first assessment of ICT Literacy was carried out in 2005. NAP-ICTL 2011 is the third assessment cycle. It is linked to the previous two cycles but incorporates additional features resulting from new developments, including multimedia video applications, collaborative use of ICT through wikis and other applications.

A random sample of schools was chosen to participate in the NAP-ICTL, and from these schools, a random sample of up to 20 students at each designated year level was chosen to participate in the assessment. This provided a sample of 5,710 students at Year 6 and 5,313 students from Year 10.

The assessment for NAP – ICTL 2011 was computer-based and included a combination of simulated and authentic software applications, multiple choice and text response items. Each module followed a linear narrative sequence designed to reflect students’ typical ‘real world’ use of ICT. The modules included a range of school-based and out-of-school-based themes. Six of the seven modules included large tasks to be completed using purpose-built software applications. The format of the ICT Literacy assessment in 2011 was the same as in 2008 and 2005 so that the on-screen environment experienced by the student remained consistent, and so that comparisons can be made between year levels as well as between assessment cycles.

The NAP-ICTL scores are also reported in terms of proportion of students who attained the Proficient Standard at each year level. These Proficient Standards have been calculated to represent a ‘challenging but reasonable’ expectation for typical Year 6 and 10 students to have reached.

Figure 1 shows the distribution of students across the Proficiency Levels for Year 6 and Year 10 students from 2005 to 2011. Since 2005, there has been a significant increase in the proportion of Year 6 students meeting or exceeding the Proficient Standard -- from 49 per cent to 62 per cent. The small increase in the proportion of students meeting or exceeding the Proficient Standard at Year 10, however, was not significant, and nor were either of the small changes in these proportions at each year level since 2008.
At the ends of the scale, the proportion of students in both the lower and upper proficiency levels at both year levels has remained stable.

Between 2005 and 2011 there was a consistent increase in the mean score nationally for Year 6 students (Figure 2). From 2008 to 2011 the mean achievement score increased by 16 scale points and from 2005 to 2011 by 35 scale points. Both increases were statistically significant. However, the same trend was not evident for Year 10 students. The difference in the mean scale score from 2008 to 2011 was a decrease of one scale point, while the overall change from 2005 to 2011 was an increase of nine scale points. Neither of these was statistically significant.

![Figure 1](attachment:image.png) **Figure 1** Distributions across Proficiency Levels for Years 6 and 10 Students from 2005 to 2011 (ACARA, 2012)

![Figure 2](attachment:image.png) **Figure 2** ICT Literacy mean scale scores for Years 6 and 10 from 2005 to 2011
DIFFERENCES ACROSS JURISDICTIONS

The mean scores varied between jurisdictions at both year levels (Figure 3). At Year 6, students in the ACT performed at a higher level than students in any other jurisdiction other than New South Wales and Victoria. In turn, students in New South Wales and Victoria scored significantly higher mean scores than students in Western Australia, Queensland, Tasmania and the Northern Territory. Year 6 students in the Northern Territory scored at a lower level than those from all other jurisdictions other than Tasmania.

There were similar patterns at Year 10. Students in the ACT performed at a higher level than students in any other jurisdiction other than New South Wales and Victoria. Students in Victoria outperformed students in Western Australia, Tasmania and the Northern Territory. Year 10 students in the Northern Territory scored at a lower level than those from all other jurisdictions other than Tasmania.

There was significant growth in scores for Year 6 students in all jurisdictions other than Tasmania and the Northern Territory. This was largest in Queensland (45 score points), Western Australia (44 score points) and New South Wales (40 score points). New South Wales and Queensland were the only jurisdictions which showed significant growth between 2008 and 2011.

At Year 10 level there was no significant growth between either 2005 and 2011 or 2008 and 2011 in any jurisdiction.

The patterns in the mean ICTL scores reflect differences in the social and demographic characteristics of the jurisdictions as described by the Index of Community Socio-Educational Advantage (ICSEA) scores. Further investigation is needed to examine the relationships between approaches to ICT Literacy, resource allocation and teacher workforce issues, as it is possible these may be related to jurisdictional level correlations.

Figure 3  Mean NAP-ICTL scores for Year 6 and Year 10, 2011, by jurisdiction

ICSEA was created by ACARA specifically to enable meaningful comparisons of National Assessment Program. It provides a scale that numerically represents the relative magnitude of the influences of student-level factors such as parents’ occupation, school education and non-school education, and school-level factors such as a school’s geographical location and the proportion of Indigenous students for which a school caters.
DIFFERENCES ACROSS GENDER

At the national level, female students significantly outperformed male students in the NAP-ICTL assessment at both Year 6 (22 score points) and Year 10 (14 score points). At the jurisdictional level, females outperformed males in New South Wales, Victoria, Queensland and the ACT. At Year 10, Queensland, Western Australia, South Australia and the Northern Territory all recorded significant gender differences.

At both year levels, a larger proportion of female students than male students achieved the Proficient Standard (Figure 4).

Female students were significantly more confident than male students about their basic ICT skills, but male students were significantly and far more substantially confident of their advanced ICT skills.

DIFFERENCES BY SOCIOECONOMIC BACKGROUND

For the first time in 2011, parental education and occupation data were collected from the participating schools. There were large amounts of missing data on these variables (around 20% on each), meaning that results should be interpreted with some caution, however they are quite consistent with those found in other analyses of similar data (see for example PISA national reports). While the sizes of the differences vary, the effect of socioeconomic background is substantial.

For example, students whose parents were senior managers or professionals (highest occupational group) had scores that were 83 score points higher at Year 6 and 64 score points higher at Year 10 than students whose parents were unskilled labourers, office, sales and service staff (lowest occupational group). At both year levels, around half of the students with parents in the lowest occupation group attained the Proficient Standard (50% in Year 6 and 57% in Year 10) whereas more than three-quarters of students with parents in the highest occupational group reached the Proficient Standard (79% in Year 6 and 78% in Year 10).

There were similar findings for parental education (Figure 5). More than three-quarters of students with parents who had a Bachelors degree or higher attained the Proficient Standard, compared to fewer than half of the students with parents in the lowest educational group: Year 9 or below.
Figure 4  Proportion of students at Year 6 and Year 10 achieving Proficient Standard, by gender

Figure 5  Percentage of students achieving the Proficient Standard, Year 6 and Year 10, by parental education
THE INTERNATIONAL PICTURE

Australia also participates in the IEA’s ICILS. As part of the ICILS 2013 survey, Grade 8 students in the 21 participating ICILS countries completed a questionnaire concerning their use of information and communication technology (ICT) at home and at school, their experience of using ICT, and their access to ICT resources. Students answered this computer-based questionnaire after completing the ICILS assessment of computer and information literacy (CIL).

The definition used for the international assessment of Computer and Information Literacy (CIL) was ‘an individual’s ability to use computers to investigate, create and communicate in order to participate effectively at home, at school, in the workplace and in society’ (Fraillon, Schulz & Ainley, 2013, p. 17). So the ICILS assessment of CIL consisted of similar tasks to those found in the NAP-ICTL assessment, and in fact the two assessments are linked and have been equated, providing further valuable information about Australian students in an international context. The sampling methodology for ICILS was identical to that for the NAP-ICTL – a random sample of schools was selected and a random sample of up to 20 Year 8 students selected to participate in the study.

WHERE DOES AUSTRALIA STAND COMPARED TO OTHER COUNTRIES?

Outperformed only by the Czech Republic, with Poland, Republic of Korea and Norway achieving at the same level, Australian students acquitted themselves well in the ICILS international assessment (Figure 6). In terms of proficiency levels, Australia was one of the countries with the highest proportion of students achieving the Advanced proficiency level. At the same time, however, around five per cent of students failed to achieve the minimum proficient level and a further 15 per cent just achieved at Proficiency Level 1 (Figure 7).

WHERE DO THE JURISDICTIONS STAND INTERNATIONALLY?

ICILS was able to identify some stark differences between jurisdictions in computer and information literacy. Victoria, the ACT and New South Wales scored significantly higher than the Northern Territory, Tasmania and Queensland (Figure 8). In each of the three latter jurisdictions around 30 per cent of students were at or below the base proficiency level.

DIFFERENCES ACROSS GENDER

In this assessment, as in the NAP-ICTL, female students outperformed male students. This was apparent in every jurisdiction other than the ACT and NT. Female students were performing particularly well in NSW and Victoria, where seven per cent achieved the Advanced proficiency level, and male students performed particularly poorly in Queensland, Tasmania and the Northern Territory, in which more than one-third (36%, 34% and 34% respectively) were performing at or below Proficiency Level 1.
Figure 6  Mean CIL scores, ICILS 2013

Figure 7  Percentage of students across the CIL proficiency levels (DeBortoli et al., 2014)

Figure 8  Difference between jurisdiction mean ICIL scores and Australian mean
DIFFERENCES BY SOCIOECONOMIC BACKGROUND

ICILS also gathered data about parental education, occupation and the number of books in the home, all items that are typically used to construct a composite measure of socioeconomic background, along with other measures of home resources.

Student performance in CIL increased as level of parental occupation status and level of parental education increased. On a socioeconomic index that combined parents’ occupation, education and number of books in the home, the differences in achievement were substantial, with a mean of 81 score points separating the two groups. Figure 9 shows the stark differences between the high and low socioeconomic groups by comparing the proportion of students achieving the ICILS proficiency levels.

Of those in the highest quartile of socioeconomic background, just eight per cent were achieving at Level 1 or below, compared to 42 per cent of students in the lowest socioeconomic quartile. At the other end of the achievement distribution, 15 per cent of students in the lowest socioeconomic quartile compared to 54 per cent of those in the highest socioeconomic quartile were achieving at Proficiency Level 3 or 4.

Interestingly, while socioeconomic background had a relationship with basic ICT skills, in that students from the highest socioeconomic quartile were significantly more confident of their skills than students from the lowest socioeconomic quartile, there was no such relationship with confidence in advanced ICT skills.

LINKING THE NATIONAL AND INTERNATIONAL PICTURES

The ICILS assessment in Australia was designed to be able to explore the links between it and the NAP-ICTL. Some items from the NAP were added to the ICILS assessment so that common-item equating could be carried out, with the broad aim of better understanding the CIL skills of Australian students by enabling comparisons between year levels within Australia. This exercise was successful and the growth curve shown in Figure 10.
Figure 9  Percentage of students across the CIL proficiency scale, by socioeconomic background (DeBortoli et al., 2014)

Figure 10  Scores for NAP-ICTL and ICILS
ICT RESOURCES IN SCHOOLS

Australian schools are rich in ICT resources, according to the ICILS report (DeBortoli et al., 2014). In Australia, on average, every three students have access to one computer, compared to the international mean of 18 per computer. This varied a little by jurisdiction, with 1:1 ratios in the Northern Territory and Queensland, up to 4:1 in New South Wales.

In many secondary schools these computers were located in a laboratory or in the library, but an increasing number of students are bringing their own computers to class, or have a class set of computers that are moved between classrooms. Only in Norway were there similar numbers reported. Almost all students attended schools which had internet-related resources available: computer-based information resources, interactive digital learning resources, access to the World Wide Web, and mail accounts for teachers and students.

This report indicates there is a wide range of software resources available in Australian schools. Almost all Year 8 students have access to tutorial software; digital learning games; word processing and spreadsheet software; multimedia production tools; presentation software; communications software and graphics or drawing software. The proportion of students with access to data-logging and monitoring tools (85%) and simulation and modelling software (85%) were much higher in Australia than in any other country, and substantially higher than the international means (54% and 41% respectively).

OBSTACLES FOR ICT TEACHING AND LEARNING

So what obstacles hinder ICT teaching and learning? Across all ICILS countries the most problematic obstacles are related to skills and resources. According to the Australian ICT coordinators surveyed, 75 per cent of Year 8 students attend schools in which the biggest problem reported was lack of ICT skills among teachers. More than two-thirds (67%) of Year 8 students attend schools in which there is insufficient time for teachers to prepare lessons, while around half attend schools in which there is perceived to be a lack of effective professional learning resources for teachers or a lack of incentives for teachers to incorporate ICT use in their teaching.

ICT RESOURCES AND SOCIOECONOMIC BACKGROUND

As with the data on student access to resources, these proportions are also averages, and examining the data by socioeconomic background sheds a little more light on the story. To achieve this, the socioeconomic index for each student was aggregated to obtain an average for the school, and this divided into quartiles. While further work should be done to confirm these findings, they provide a starting point.

Some of the issues identified by ICT coordinators were more of an issue in schools with low socioeconomic backgrounds than high. These are shown in Table 1.
For Australian teachers too, the major factors inhibiting their use of ICT in their teaching were those to do with time and training.
Fifty-four per cent of Year 8 teachers surveyed, reported that there is not sufficient time to prepare lessons that incorporate ICT, and 48 per cent report that there is not sufficient provision for them to develop expertise in ICT. More than a third (37%) also say there is not sufficient technical support to maintain ICT resources, and the same percentage argue that there are issues with limited or slow internet connectivity. Almost one in three (28%) say that the computer equipment in their school is out of date.

Table 2 provides the proportion of teachers in high and low socioeconomic background schools who agree or strongly agree that the following are obstacles to ICT teaching and learning in their schools.

Table 1  Issues affecting ICT teaching and learning in Australian schools, by socioeconomic background of schools

<table>
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<tr>
<th>Issue</th>
<th>Percentage of students in Low SES schools</th>
<th>Percentage of students in High SES schools</th>
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<tbody>
<tr>
<td>Lack of ICT skills amongst teachers</td>
<td>79</td>
<td>63</td>
</tr>
<tr>
<td>Insufficient time for teachers to prepare for lessons</td>
<td>79</td>
<td>70</td>
</tr>
<tr>
<td>Lack of effective professional learning resources for teachers</td>
<td>53</td>
<td>37</td>
</tr>
<tr>
<td>Lack of incentives for teachers to integrate ICT sue in their teaching</td>
<td>55</td>
<td>34</td>
</tr>
<tr>
<td>Insufficient Internet bandwidth or speed</td>
<td>46</td>
<td>39</td>
</tr>
<tr>
<td>Lack of qualified technical personnel to support the use of ICT</td>
<td>43</td>
<td>26</td>
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Table 2  Teachers perspectives on issues with ICT teaching and learning in Australian schools, by socioeconomic background of schools

<table>
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<th>Issue</th>
<th>Percentage of students in Low SES schools</th>
<th>Percentage of students in High SES schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is not sufficient time to prepare lessons that incorporate ICT</td>
<td>53</td>
<td>49</td>
</tr>
<tr>
<td>There is not sufficient provision for me to develop expertise in ICT</td>
<td>48</td>
<td>37</td>
</tr>
<tr>
<td>My school has limited connectivity (e.g. slow or unstable speed) to the Internet</td>
<td>41</td>
<td>26</td>
</tr>
<tr>
<td>There is not sufficient technical support to maintain ICT resources</td>
<td>40</td>
<td>23</td>
</tr>
<tr>
<td>My school does not have sufficient ICT equipment (e.g. computers)</td>
<td>40</td>
<td>16</td>
</tr>
<tr>
<td>The computer equipment in our school is out-of-date</td>
<td>37</td>
<td>16</td>
</tr>
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STUDENTS, MOTIVATION AND ENGAGEMENT WITH ICT

The level of familiarity of students with computers and the internet is dependent on their exposure and level of use – both at home and at school. Almost all Australian students have access to computers in the home, and almost all have at least some access to computers at school. Overall, 60 per cent of Year 6 students and 82 per cent of Year 10 students are frequent computer users (ie. use a computer at least once a day in the home or school). Correspondingly, 27 per cent of Year 6 students and 51 per cent of Year 10 students reported that they are frequent computer users at school.

Four activities dominated students’ reports of use of computers for school-related purposes, both internationally and within Australia. These activities were preparing reports or essays (70% of Australian students), preparing presentations (68%), completing worksheets or exercises (64%), and working with other students from your own school (56%). The proportion of Australian students reporting these activities, however, was still in excess of the proportion reported internationally.

ICT USE OUTSIDE OF SCHOOL
Half of the Year 8 Australian students surveyed in ICILS reported having used a computer for seven or more years, however this varied by socioeconomic background, with 42 per cent of students from the lowest socioeconomic quartile compared to 57 per cent of students in the highest socioeconomic quartile having had this length of experience.

In the ICILS survey students were asked how often they participated in certain activities relating to communication and exchange of information. Eighty per cent of Australian students reported that they used social networking at least once a week – this was higher than the ICILS mean but substantially lower than in other countries such as Norway, Poland and the Slovak Republic, for example. Female students were more likely to use this method of communication than male students, although proportions for both groups were high.

Students were also asked about the use of computers for recreation – 80 per cent listed listening to music and 65 per cent watching downloaded or streamed video at least once a week as their primary use for recreation. Surprisingly these means were significantly lower than the mean across all ICILS countries. There were no gender differences in these uses of computers.
STUDENT MOTIVATION

A key focus of the ICILS questionnaire was to investigate students’ motivation towards ICT learning. Confidence, in the form of self-efficacy, enjoyment and interest are key to motivation.

Australian students were most confident performing basic ICT tasks: searching for and finding information they needed on the internet; searching for files on a computer; creating or editing documents and text; and uploading text, images and videos to an online profile. These students were least confident performing more advanced ICT tasks: creating a computer program or macro; creating a database; building and editing a web page; and setting up a computer network. This level of confidence may be quite realistic: in one of the more difficult items on the CIL scale, reported in the international ICILS report (Fraillon, Ainley, Schulz, Friedman & Gebhardt, 2014), only 19 per cent of Australian students (compared to, for example, 28% of students in Lithuania) were able to identify that a mismatch between a purported sender and their email address may suggest that the email is suspicious.

On the scale developed to capture students’ interest and enjoyment using computers, Australian students had scores that were significantly lower than the ICILS international mean, indicating lower levels of interest and enjoyment than on average across ICILS countries. This is because the score for female students was substantially lower than the international mean, and lower again than the international mean for females, while the scores for males was the same as the international mean for males.

The NAP-ICTL report confirms these findings. At Year 6, males had significantly higher levels of interest and enjoyment in ICT than females, and the gap widened in Year 10. For both males and females, the level of interest and enjoyment declined between Year 6 and Year 10. There were no gender differences in self-efficacy at either Year level.

Despite their obvious aptitude, female students in Australia reported significantly lower levels of interest and enjoyment in using computers than male students.
WHERE TO FROM HERE?

Is Australia on track to realise the aims of almost a decade ago, to ensure that ‘young people need to be highly skilled in the use of ICT’? Certainly it seems from the national assessment data that the skill level of students in Year 6 has increased, with more reaching the proficient standard in 2011 than 2005; however there should be some concerns that there has been no positive change in the average scores of Year 10 students in any jurisdiction in Australia. Also of concern is the stable percentage of young people achieving only at the lowest proficiency levels in both year levels and the few, particularly at Year 10, that are reaching the highest proficiency level.

In terms of what we know from the international data, Australia seems to be doing quite well in computer and information literacy, however it must be noted that as yet comparisons are being made with a very limited number of countries only. Also, there is some indication from the ICILS data that whilst our students are performing well on basic ICT Literacy tasks, they are not performing as well, nor do they have confidence in their ability to perform higher level ICT tasks. Our education system could well be creating basically proficient ICT users but very few technicians, innovators or developers.

As part of Goal 1 of the Melbourne Declaration, Ministers agreed that they would work to “ensure that socioeconomic disadvantage ceases to be a significant determinant of educational outcomes” (MCEETYA, 2008, p. 7), and further into the Declaration, that “Australian governments must support all young Australians to achieve not only equality of opportunity but also more equitable outcomes” (p 16).

However, data from both the NAP-ICTL and ICILS show that socioeconomic disadvantage does play a substantial part in outcomes in this area. The proportion of students achieving the Proficient Standard in the NAP-ICTL is significantly lower for students from a low socioeconomic background and there are a substantially higher proportion of students from a low socioeconomic background at the lower proficiency levels in ICILS.

The Australian Council of Learned Academies (Marginson, Tytler, Freeman & Roberts, 2013) recommended that Australia needs to grow its pool in the area of Science, Technology, Engineering and Mathematics (STEM), and expanding this talent pool requires increasing the proportion of young women as well as low socioeconomic students, resources that are at the moment underutilised. The Year 10 students in particular that are assessed as part of NAP-ICTL are at a crucial stage in their education – ready to make decisions about the subjects they choose to study in senior secondary school and into what careers they may go. A strong influence on their decision making will be what they are confident and interested in. Indications from these reports are that for many, and in particular for female students, ICT courses at either level will not be the choice, despite the fact that females are achieving at least at the same level as male students.
Livingstone (2015) argued that for Australia to succeed in a digital age, we should be starting the digital education of our students in the beginning years of primary school, introducing skills such as computational thinking, problem solving and computer coding. This is a giant leap from where Australia is now, and will require determined policy and a great deal of teacher professional development.
REFERENCES


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