

MEASURING THE IMPACT OF THE DIGITAL EDUCATION REVOLUTION ON THE ICT CAPABILITY OF THE NATIONAL TEACHING WORKFORCE

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Abstract

The last fifteen years in education policy in Australia have been marked at various points by statements of intention to improve the integration of ICT in teaching and learning practices. The last Labour Australian government through its Digital Education Revolution in Australia from 2009 expended significant funding. One of the key emphases of these policies was the development of teacher capability in the use of ICT to improve student learning. Reliable evidence on the achievement of this goal is difficult to find. This paper draws on the Staff in Australia's Schools series of surveys over the period 2006-13 to assemble an evidence base that provides some insight into the development of teacher capability as a result of the Digital Education Revolution initiatives.

Introduction

The last fifteen years have seen a number of attempts by Australian governments to maximise the benefits of information and communication technologies (ICT) in school teaching and learning practices. Policies in this domain have been implemented at the national, state and territory and sectoral – government, catholic and independent school sectors –levels. This paper examines the impact on teacher capability in ICT of the *Digital Education Revolution* (DER), a collaborative national effort by the Australian Government and states and territories, particularly through continuing professional development (CPD) and initial teacher education (ITE) levers. It is not the intention to provide a comprehensive description and assessment of DER, as this is beyond the scope of this paper. Rather, the aim is to focus on the measurement of impact and to establish baseline national data on teacher ICT capability.

National Policies on ICT in School Education

There has been strong interest from Commonwealth and State and territory governments in the last 15 years in improving ICT capability generally in primary and secondary schools. Teacher and leader capability development has generally been a major component in strategy and policy statements.

The Adelaide Declaration in 1999 included a goal on ICT capability that school students should be “be confident, creative and productive users of new technologies, particularly information and communication technologies, and understand the impact of those technologies on society” (MCEEDYA, 1999).

The Adelaide Declaration was a statement of intention that laid the ground for future policy commitments. The subsequent “Learning in an online world: school education action plan for the information economy” (Education Network Australia, 2000) action plan renewed this commitment and elaborated on how the goal was to be achieved. The priorities identified in the action plan were infrastructure, professional development and online content.

In early 2008 the Council of Australian Governments (COAG) approved the *Joint Ministerial Statement on Information and Communications Technologies in Australian Education and Training: 2008-2011* and made the following commitments:

- National collaboration across Australian education and training jurisdictions and sectors to share resources and expertise, and to leverage existing initiatives while recognising the importance of innovation and experimentation.
- National, cross jurisdictional and cross sectoral approaches through the Australian ICT in Education Committee to address the ICT enablers of technology rich learning environments (MCEEDYA, 2008).

However, the most significant commitment to improving ICT capability in schools was made by the Labour Commonwealth government through its Digital Education Revolution election policy in 2007 which was later manifested in the COAG statement: “Achieving a national vision for ICT in schools: Strategic plan to guide implementation of the Digital education revolution initiative and related initiatives” (COAG, 2008).

The four major strands of the strategic plan – leadership, infrastructure, learning resources and teacher capability - were later incorporated in a formal funding agreement between the national and state and territory jurisdictions. The *National Partnership Agreement on the Digital Education Revolution* was signed in 2009 (COAG, 2009) and included \$2.2 billion of funding for: the National Schools Computer Fund to provide computers and maintenance for Years 9-12 secondary students to a computer to student ratio of 1:1 (\$2b); broadband connections to schools (\$100m); development of online curriculum resources; collaboration with states and Deans of Education to ensure new and continuing teachers have access to training in the use of ICT ; and implementation of the four strands of the strategic plan including professional development of teachers (\$71m).

A key outcome described in the National Partnership was that “the teacher workforce will be equipped through pre-service and in-service training to effectively utilise ICT in the classroom.” For example, Teaching Teachers for the Future (TTF) was a project that was funded from the ICT Innovation Fund element of the DER in 2010 to focus on building graduate teacher capability through initial teacher education (ACDE, 2012).

Building ICT Teacher Capability Through Initial Teacher Education and Professional Development

In recent years the importance of teacher quality in improving student outcomes has gained universal acceptance as the evidence base has become more compelling (Hattie, 2003). Alongside continuing professional development, ITE has increasingly received policy attention in Australia as a means of improving the quality of teaching and therefore the learning outcomes for school students.

Designing educational experiences that take advantage of the potential of digital technologies hinges on the professional skills, knowledge and confidence of teachers. The strong relationship between ITE and quality teaching has been reflected in policy statements that seek to improve teaching and learning by harnessing ICT. Some key policies are briefly described below.

A key strategy in creating a quality teaching workforce is improving the quality of graduates from initial teacher education courses. Mourshed, Chijioke, and Barber (2010) found that school systems that aspire to improve from good to great focus on raising the quality of teachers and principals who enter the system. For initial teacher education this means raising the quality of those entering initial teacher education and improving the quality of ITE courses.

As an example of potential impact of new graduates, Victorian universities produce approximately 4,500 teaching graduates annually and require up to 25,000 practicum placements (based on the 3 x 3 weeks model) in Victorian schools (not including early childhood placements). The Department of Education and Early Childhood Development (DEECD) employs approximately 2000-2500 new graduates each year, or approximately 5% of the total DEECD teacher workforce. This represents a major opportunity for improving the quality of the overall workforce over a period of time. It is expected that, through the application of the *Accreditation of initial teacher education programs in Australia: Standards and Procedures* (Australian Institute for Teaching and School Leadership (AITSL), 2010) pre-service teacher education programs will prepare graduates with the skills needed to be effective in the teaching and learning of young people and articulate clear standards for graduate capabilities and how they will be achieved, including in priority areas such as literacy and numeracy, languages, special needs and ICT. If these expectations were realised, and graduates were supported with structured induction and mentoring support at the point of employment, there is the potential for substantial increases in teacher capability in these areas through the direct influence of graduates and knowledge transfer to existing teachers.

Research Evidence on Effectiveness of Initial Teacher Education

There is evidence that graduates are not being prepared to be effective teachers. Numerous reports over the past 30 years have documented a range of concerns about the nature and quality of teacher education.

In Victoria, the *Parliamentary Inquiry into the Suitability of Pre Service Teacher Training Courses* (Education and Training Committee, 2005), concluded that pre service teachers should spend more time in schools to help them become more familiar with classrooms.

Ure and Gough (2009), in their study of practicum partnerships for the Australian Learning & Teaching Council, noted that supervising teachers are not normally trained to supervise pre-service teachers (PSTs) and that they typically undertake the role in conjunction with many other teaching duties. Ure and Gough identified four models of teacher professional learning: Partnership and collaborative learning; Reflective learning; Clinically applied; and Pedagogical content focused.

Top of the Class: report on the inquiry into teacher education (House of Representatives Standing Committee on Education and Vocational Training (2007) noted that surveys of principals and recent graduates consistently pointed to the following as issues of concern:

- Aspects of the school-based professional experience components of courses
- The weakness of the link between *theory* and *practice*
- The perceived lack of relevance of some of the theoretical components of courses
- The capacity of beginning teachers to deal adequately with classroom management issues, to perform assessment and reporting tasks and to communicate with parents

The 2007 national survey of schoolteachers and leaders, *Staff in Australia's Schools* (SiAS) (McKenzie, Kos, Walker, & Hong, 2008) reported that more than half of early career teachers felt that their pre-service training was of limited help in several important aspects of teaching. In addition, 25 to 56 per cent of primary school principals and 26 to 77 per cent of secondary school principals thought that graduates were well prepared or very well prepared in important aspects of teaching.

The *Staff in Australia's Schools* survey (McKenzie, Rowley, Weldon, & Murphy, 2011) found that in 2010:

- A majority of both primary and secondary early-career teachers found their pre-service training helpful or very helpful in preparing them in relation to only eight out of 15 specified teaching skills.
- A majority of principals considered that recent teacher graduates were only well prepared or very well prepared in four (primary) and five (secondary) areas out of ten specified areas.

The 2008 *Teaching and Learning International* (TALIS) (Freeman, O'Malley, & Eveleigh, 2010) survey showed that 36 per cent of Australian teachers worked in schools where the school principal believed that a lack of pedagogical preparation hindered instruction in their schools. This view is

shared by teachers who also tend to believe that schools are more effective than universities in preparing them for careers in teaching.

The National Standards Frameworks Role in Improving Teacher Capability

Australia's approach to lifting the capability of teachers has in recent years been based on the identification of national professional standards for teachers and national standards for the accreditation of initial teacher education programs. Australian state governments responded to the findings of such inquiries by implementing their own versions of teacher professional standards and accreditation of ITE programs. A truly national approach to this task was not realised until the establishment of the Australian Institute of Teaching and School Leadership (AITSL) in 2010. AITSL has led the work to implement these standards through a range of processes in the teacher and leader lifecycle including ITE, continuing professional learning and performance and development.

The *Australian Professional Standards for Teachers* comprise seven standards that outline what teachers should know and be able to do. They are grouped into three domains of teaching: Professional Knowledge, Professional Practice and Professional Engagement. Within each standard, focus areas provide further illustration of teaching knowledge, practice and professional engagement. These are then separated into Descriptors at four professional career stages: Graduate, Proficient, Highly Accomplished and Lead. They provide a framework that makes clear the knowledge, practice and professional engagement required across teachers' careers:

The Standards are a public statement of what constitutes teacher quality. The Standards define the work of teachers and make explicit the elements of high-quality, effective teaching in 21st-century schools, which result in improved educational outcomes for students (AITSL, 2014).

A recent evaluation of the APST has provided evidence that, since their introduction in 2010, the standards have been embedded in much of the work of teacher educators, teacher education students, principals and teachers.

Relationship Between Initial Teacher Education and ICT

The national effort to improve teacher quality coincided with the implementation of the Digital Education Revolution that provided the opportunity for ICT capability to be built into the national frameworks for improving teacher quality. The use of ICT is embedded in a number of focus areas in the Professional Practice and Professional Engagement domains. Additionally, AITSL, through the *Teaching Teachers for the Future* (TTF) project, has produced detailed statements at the Graduate level for 31 of 37 focus areas and 10 Graduate ICT illustrations of practice to assist with the interpretation of the standards.

The Teaching Teachers for the Future project consisted of three components:

- Component 1, led by AITSL contributed: validated ICT Statements for the Graduate career stage of the National Professional Standards for

Graduate Teachers; Annotated Illustrations of Practice to assist with the interpretation of Standards; and e-Evidence user guides to assist teacher education students.

- Component 2, led by Education Services Australia (ESA) contributed: a national audit of resources and twelve digital resource packages that demonstrate effective use of ICTE in the four first phase subjects of the Australian Curriculum. The digital resources have been created following the Technological Pedagogical and Content Knowledge (TPACK) learning framework (Mishra & Koehler, 2006).
- Component 3, led by the Australian Council of Deans of Education (ACDE), contributed: the development and distribution of an Institutional Guide for institutions participating in the TTF project. The Guide included a work plan and position statements for TTF Program Coordinators and ICT Pedagogy Officers (ICTPO) to assist institutions in their recruitment process. Using the TPACK model, each ICTPO completed a mapping of ICT with current curriculum and pedagogy practices on at least one subject area from the first phase of the Australian Curriculum. This involved a review of course description documents, learning outcomes, course materials and assessment items.

According to the mid-program review of the DER, conducted near the end of 2011 when the 1:1 computer-to-student ratio had been achieved, many stakeholders commented on the need for initial teacher preparation to focus on systematically integrating ICT into teaching and learning rather than as a ‘bolt on’ to existing practice (dandolopartners, 2012).

The Teaching Teachers for the Future project aimed to embed ICT capabilities in the National Professional Standards for Graduate Teachers. The TTF Project facilitated and promoted institution-led research and evaluation projects, research networks, and collaboration. This has increased national and international visibility and dissemination of the effective use of ICT. In addition, case studies on institutions demonstrated increased ICTE capacities of teacher education institutions (ACDE, 2012).

Measuring the Impact of ICT Policies on Teacher Capability

This section of the paper focuses on available data, at the national level, which supports measures of the ICT capability of teachers generally. Its primary focus is not on the capability of teachers who specialise in the teaching of computing or information technology subject areas¹ at either the primary or secondary levels although of course these teachers are included in the overall data and the capability of this sub-group can be regarded as one indicator of the impact of policies. This is consistent with the TPACK approach, which seeks to describe and explain the integration of technological, pedagogical and content knowledge in the practice of teachers across the school curriculum. It is also consistent with the new national curriculum in Australia that includes ICT as a “general capability.” General capabilities encompass knowledge, skills, behaviours and dispositions that, together with curriculum content in each learning area and the cross-curriculum priorities, are designed to assist students to live and work successfully in the twenty-first century. General

capabilities are addressed through the learning areas and identified wherever they are developed or applied in content descriptions (ACARA, 2011). There is not strong agreement in the literature about what constitutes effective measures of teacher capability or teacher quality. Research on readily measurable characteristics of teachers such as qualifications, teaching experience and indicators of academic ability or subject-matter knowledge, generally indicates that there is a positive relationship between these characteristics and school student performance, albeit to a lesser extent than may be expected. Other research suggests that there are important relations between different indicators of teacher competence and student achievement, including teacher education, experience, measured knowledge and skills, and continuing professional development. The conclusion of the landmark OECD report *Teachers Matter* concludes that although there is a lack of definitive evidence linking teacher credentials such as qualifications and experience to student results, and alternative indicators of teacher quality should be taken into account, these characteristics provide fundamental information on the quality of teaching workforces (OECD, 2005).

Following the *Teachers Matter* findings, the indicators of ICT teacher capability employed in this paper fall into the following categories:

- Proportions of teachers with tertiary education study in ICT – both content and pedagogy
- Continuing professional development undertaken –content & pedagogy
- Experience in teaching ICT or using ICT to teach other content areas
- Perceptions of teachers about their ICT capability – as expressed through perceived PD needs
- Perceptions of early career teachers about how well prepared they were by initial teacher education courses in using ICT in teaching/learning
- Assessment by principals of how well prepared recent graduates were in using ICT in teaching and learning

Perceptions of teachers about their ICT capability and their preparation through ITE are important indicators of self-efficacy in the face of changing knowledge and skills demands made on them. In the context of education, teacher self-efficacy is considered a powerful influence on teachers' overall effectiveness with students (Pendergast, Garvis, & Keogh, 2011).

Sources of Data

Data are drawn from the Australian report of the OECD *Teaching and Learning International Survey 2008* (TALIS) and the *Staff in Australia's Schools* (SiAS) surveys undertaken in 2007, 2010 and 2013. Data is presented in chronological order to enable any longitudinality in to emerge (Tables 1-3).

TALIS was conducted in 24 OECD and OECD-partner countries in 2007 and 2008, though internationally comparable results were reported for only 23 countries due to requisite publication sampling standards. The report provides detailed analyses of teachers' self-reported practices, activities, beliefs and attitudes; teacher appraisal systems; impacts of school policies on teaching and learning environment; and pathways to effective school leadership.

The Staff in Australia’s School survey (Australian Council for Educational Research (ACER), 2008, 2011 and 2014) provides a detailed picture of the Australian teacher workforce and information to assist in future planning of the workforce. The 2013 survey provides comparative and updated data following on from the previous SiAS surveys conducted in 2006-07 and 2010. The survey was open to the sampled schools and teachers May - August 2013.

The third cycle of SiAS included a number of new and revised questions to reflect emerging teacher workforce issues and the introduction of the Australian Professional Standards for Teachers in 2011. The survey was structured around four populations: Primary Teachers; Secondary Teachers; Primary Leaders; and Secondary Leaders. *Leaders* were defined as Principals, Deputy/Vice Principals, and their equivalents in the different school systems. It was a two-stage sample design: schools were sampled first, and then all eligible teachers in the schools that agreed to take part were invited to complete the survey. The design meant that all eligible teachers in Australia had an approximately equal probability of selection.

Assembling the Available Data

As can be seen in the following tables, the available data is often not directly comparable. However, it provides a base of indicators on the development of teacher ICT capability over time, particularly for early career teachers (ECT).

Staff in Australia’s Schools Survey 2007

Table 1

Staff in Australia’s Schools Survey 2007

Indicator	Primary	Secondary
University studies-content and methodology	-	<ul style="list-style-type: none"> • 24% and 40% of teachers teaching IT at years 7/8-10 and 11-12 had completed three or more years of tertiary studies in the subject • 11% of total secondary teachers report some tertiary study in Computing • 6% have studied teaching methodology in Computing
CPD undertaken	<ul style="list-style-type: none"> • 12% indicated that they had undertaken professional development in the subject area in last 12 months • 26% of those who did CPD in a subject area other than their specialisms² focused on Computing³ 	<ul style="list-style-type: none"> • 19% of those who did CPD in a subject area other than their specialities focused on Computing⁴
Perceived needs CPD	-	-
Experience	<ul style="list-style-type: none"> • 10 % reported currently teaching in the specialist area of computing • 7% have more than five years’ experience teaching computing 	-
Perceptions	-	-

of ECT		
Perceptions of principals	-	-

Teaching and Learning International Survey 2008

Continuing professional development needs:

- 97% of Australian teachers reported taking part in a structured professional development activity during the 18 months preceding the survey. Whilst this demonstrates an extremely high participation rate, a considerable amount of this time was compulsory, with almost half of the average nine days being mandated.
- 55% of Australian teachers expressed that they wanted to participate in more professional development activities than in the previous 18 months
- 18% of Australian teachers at lower secondary level indicated a ‘high level of need’ for CPD in the area of ICT teaching skills compared with the TALIS average of 25%.
- On most of the areas of need for CPD surveyed in TALIS, Australian teachers reported lower levels of need than the OECD country average and a lower overall index of development need.
- “ICT teaching skills” and “teaching special learning needs students” were the only two categories of eleven for which more than 10% of Australian teachers recorded a high level of need.
- 62% of Australian teachers who indicated that they wanted more professional development cited ‘conflict with work schedule’ as the reason for non-participation. In excess of 40% reported that ‘lack of a suitable program’ mitigated against participation and approximately 30% reported ‘expense’ (33%) or ‘lack of employer support’ (27%) as a reason for non-participation.

Staff in Australia’s Schools Survey 2010.

Table 2

Staff in Australia’s Schools survey 2010

Indicator	Primary	Secondary
University studies	<ul style="list-style-type: none"> • 34% and 19% had completed some tertiary study in computing and information technology respectively • 22% and 12% had completed methodology studies⁵ 	<ul style="list-style-type: none"> • 34% of teachers teaching IT at years 7/8-10 and 47% of years 11-12 had at least one semester of studies at third year or higher • 42% and 52% respectively had methodology studies in IT • 17% of total secondary teachers report some tertiary Computing study • 8% of total secondary teachers have methodology in Computing
CPD undertaken	<ul style="list-style-type: none"> • 6.3% had undertaken CPD in the last 12 months⁶ 	-
CPD – perceived	-	-

needs		
Experience	<ul style="list-style-type: none"> 6.1 % currently teaching in specialist area of computing 	-
ECT Perceptions	-	-
Perceptions of principals	-	-

Staff in Australia’s Schools Survey 2013

Table 3

Staff in Australia’s Schools survey 2013

Indicator	Primary	Secondary
University studies	<ul style="list-style-type: none"> 33% and 27% had completed some tertiary studies in computing or IT respectively 21% and 18% respectively had undertaken methodology studies in computing and IT 	<ul style="list-style-type: none"> 16% and 13% respectively 8% and 7% respectively 42% of teachers teaching IT at years 7/8-10 and 58% at years 11-12 had at least one semester at third year or higher of tertiary education 61% (years 7/8) and 82% (years 11-12) had completed at least first year tertiary studies in IT 46% and 62% respectively had methodology studies
CPD undertaken	<ul style="list-style-type: none"> 57% had undertaken organised or self-directed professional development activities 25% had undertaken studies as part of a professional qualification 67% had undertaken some form of professional development in ICT in the preceding 12 months 17.3% (computing) and 17.9% (IT) had undertaken professional development in the subject in the last 12 months. 19.4% (computing) and 15.9% (IT) had undertaken tertiary study or professional development in the area but had not taught the subject as a specialist 	<ul style="list-style-type: none"> 62% (years 7/8-10) and 83% (years 11-12) had undertaken CPD in IT in the past 12 months 7.1% and 7.1% of total secondary teachers had undertaken professional development in computing and IT respectively in the past 12 months 65% of total secondary teachers had undertaken organised or self-directed professional development activities 29% of total secondary teachers had undertaken studies as part of a professional qualification 74% of total secondary teachers had undertaken some form of professional development in ICT in the preceding 12 months
CPD – perceived needs	<ul style="list-style-type: none"> 38% of Early Career Teachers indicated that they needed more professional learning in making 	<ul style="list-style-type: none"> 32% of ECT indicated that they needed more professional learning in making effective

	<p>effective use of ICT</p> <ul style="list-style-type: none"> • 50% of experienced teachers (more than 5 years teaching experience) indicates they need more professional learning in making effective use of ICT 	<p>use of ICT</p> <ul style="list-style-type: none"> • 48% of experienced teachers indicated that they needed more professional learning in making effective use of ICT
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Table 3 (Continued)

Staff in Australia's Schools survey 2013

Indicator	Primary	Secondary
Perceptions of ECT	<ul style="list-style-type: none"> 52% of primary ECT indicated that ITE had been very helpful or helpful in preparing them for making effective use of ICT 	<ul style="list-style-type: none"> 56% of secondary ECT indicated that ITE had been very helpful or helpful in preparing them for making effective use of ICT
Perceptions of principals	<ul style="list-style-type: none"> 70% of primary principals thought that recent graduates were very well prepared or well prepared by ITE in making effective use of ICT 	<ul style="list-style-type: none"> 76% of secondary principals thought that recent graduates were very well prepared or well prepared by ITE in making effective use of ICT

Comments on Data Quality

A number of observations need to be made about the analysis and interpretation of the above data. Firstly, the DER focused on provision of computers in Years 9-12 of secondary school and therefore would be expected to have a more marked impact on teachers in those levels. However, given that most secondary teachers teach at both senior and lower levels of secondary school, the effect of DER would most likely be manifested across all the secondary teacher population, validating whole workforce indicators from the surveys. Any effect on primary school teachers would be indirect only as they were not exposed to student devices and other resources directly, although they may have participated in CPD if they worked in P-12 schools which took a whole-school approach to CPD.

Secondly, the gaps in data across the five indicators are substantial, particularly for 2007 and 2009. This reduces the utility of the data both from an absolute perspective and a longitudinal perspective with the latter in particular, mitigating against a before-and-after type analysis of the DER. Nevertheless there is some scope for longitudinal analysis in relation to university studies and CPD undertaken. Longitudinal analysis of the impact of DER on aspects of teacher and student engagement and use of ICT is available at a single state level in the New South Wales evaluation of the DER 2010-13 (Howard & Mozejko, 2013).

Thirdly, survey questions changed over time, making comparison across surveys even more difficult. For example, the definition of what constitutes first-year university level content studies. Terminologies also evolved as exemplified in the fact that the term "ICT" was introduced into the questions in 2013 and was not used at all in the 2007 survey and only got a mention in 2010 in the brief discussion of the TALIS 2008 data.

Fourthly, data on Computing, IT and ICT specialist teachers is included in the comparisons even though the aim of DER was to embed ICT capability across the school curriculum because DER is likely to have stimulated greater interest in these specialities among prospective and current teachers.

Fifthly, the impact of DER on perceptions of early career teachers (ECT) would not be expected to be as pronounced as it may have been had the DER been introduced earlier as the ECT category refers to teachers with up to five years' experience in 2013 whereas implementation began in 2009. In any case it may be difficult to separate the effect of DER from other social and family effects on this group. That is, there are generational issues at play as younger teachers have grown up with ICT and would tend to be more receptive to the uptake of new methods than older teachers (dandolopartners, 2012). Nevertheless, the data provides an insight not previously been available.

Finally, the TALIS 2008 data provides a measure of CPD need in ICT capability, which was not available in the 2007 and 2010 SiAS and therefore provides some basis for comparison with the SiAS 2013 data.

Discussion

The mid-program evaluation of DER reported in 2012 (dandolopartners, 2012) found that it had the following impacts:

- Teaching practice was evolving and helping to create effective learning environments.
- The importance of teacher competency in the effective use of ICT was better understood.
- Collaboration was occurring between teachers and schools through professional networks and forums.
- Deans of Education were now more committed to ICT curriculum for initial teacher education.

In relation to the Teacher Capability strand the evaluation found that DER delivered real benefits, while acknowledging that more needed to be done if the teaching profession is to capitalise on the potential value of technology. The report observes that this is not surprising given the generational issues at play, and the complexity associated with integrating new tools and techniques across all Australian schools. Additionally, with the continually changing nature of the technology landscape, continued and regular teacher professional development in this area would be an integral part of the profession.

Two of the four main findings from the DER-NSW evaluation in 2013 (Howard & Mozejko, 2013), which compared teacher practices from 2010 to 2013, were:

- Teachers' positive beliefs about ICT and frequency of use have positively increased.
- Teachers are reporting increases in student-centred practices, as a result of laptop use.

The two major findings in regard to teacher capability from the two reports are that:

- Teaching practice involving the use of ICT has been enhanced by the DER, particularly on the emphasis of personalisation of teaching and learning

- Teachers' self-efficacy regarding the use of ICT in teaching and learning has increased as a result of the DER.

In addition, the report claimed that awareness of the importance of teacher knowledge and skills in the use of ICT has increased.

The following discussion will assess the extent to which the above claims in relation to teacher capability are supported by SiAS data and identify any other themes suggested by the data.

Continuing Professional Development

There was an apparent increase in the amount of CPD undertaken by secondary teachers in ICT between 2007 and 2013, although the data needs careful interpretation given the different questions that elicited the data. In 2007, of those who reported having undertaken CPD in a subject area other than their speciality (16% of total secondary teachers), 19% did the CPD in Computing, the highest subject area reported. However this represented a mere 3% of total secondary teachers; whereas, in 2013, 74% reported having undertaken some form of CPD in ICT in the preceding 12 months. Even if one takes account of the narrowness of the question in 2007, this is a huge difference in activity, suggesting that the DER both stimulated demand and provided additional opportunities for teachers to participate in such CPD.

Perceived Continuing Professional Development Needs

A comparison of *TALIS 2008* with *SiAS 2013* data suggests that demand for CPD in ICT increased markedly in the intervening years from 18% of lower secondary teachers expressing a high level of need in 2008 to 32% of ECT and 48% of experienced secondary teachers expressing a need for more professional learning opportunities in 2013. It is likely that the intense focus of the DER on ICT in schools generated demand for CPD in this area as teachers experienced the reality of increased learning resources within the school and in the hands of their students and increased expectations about using these resources from school communities and central offices.⁸

University Studies

There was growth in the proportion of secondary teachers with some content studies in ICT at tertiary level from 11% in 2007 to 17% in 2010 (computing) and 16% (computing) and 13% (IT) in 2013.⁹ Studies in computing methodology also increased slightly from 6% in 2007 to 8% in 2010 and 8% (computing) and 7% (IT) in 2013. In addition the qualifications of specialist ICT teachers who were currently teaching the subjects at secondary level increased significantly between 2007 and 2013 in both content and methodology.

It is difficult to link these changes to the DER, given that the patterns were established between 2007 and 2010 before the DER would have had a major impact. Data indicates that the demand for computer/IT university courses decreased substantially since 2000. Despite the general decline in IT enrolments the proportion of IT service teaching (to undergraduate students enrolled in non-IT fields of education) at the undergraduate level remained stable between 2002 and 2010. Undergraduate students in Management and

Commerce, Engineering, Natural and Physical Sciences, and Society and Culture received almost all of the IT service teaching. This suggests that potential secondary teachers continued to study IT units as part of their undergraduate studies which might explain the increase. It is more likely that secondary ITE students were more likely to undertake IT subjects as part of their undergraduate degrees (Australian Government Office of the Chief Scientist, 2012). Other possible factors are that IT was still regarded as a relatively hard to staff area in secondary schools during 2000-2005 as the popularity of the IT subject at secondary level grew, and the global financial crisis may have increased the attractiveness of a teaching career for IT graduates.

Perceptions of Impact of Initial Teacher Education by Early Career Teachers

Both ECT and principals agreed that ITE made a positive contribution to graduates' ICT capability with 56% of ECT indicating that ITE was very helpful or helpful in preparing them for using ICT effectively and 76% of secondary principals agreeing that recent graduates were very well prepared or well prepared in using ICT. The rating by principals was the highest of the 23 focus areas being measured¹⁰ while the rating by ECT was near the median for the 23 focus areas.¹¹ The difference between principal and ECT ratings may well be due to generational factors, as discussed earlier, where principals are comparing the ICT skills of recent graduates with those of more experienced teachers. Given that the rating of ECT is relatively low, it may be that DER actions at the ITE level, including the Teaching Teachers for The Future initiative, had not had time to take effect. In addition, the ECT responses could have been diluted by those ECT who had graduated prior to or in the very early phases of the DER. Either way; the response indicates that there is considerable room for improving the preparation of graduates in this area.

Comparison With Primary Teachers

In regards to university studies, 2010 figures show that primary teachers are more likely to have studied content and methodology in computing and IT subjects than secondary teachers. This is likely to be the case because primary teachers are expected to teach across the primary school curriculum and ITE courses are structured accordingly.¹² Nevertheless the data indicates that there was some growth in the proportion of primary teachers with content and methodology studies in IT, while computing was more or less unchanged. The available data is not clear enough to allow a judgment about this growth relative to that of secondary teachers.¹³

In relation to CPD undertaken, the 2013 data indicates that the participation of primary teachers was of the same order but less than that of secondary teachers. Similarly the figures for CPD needs and perceptions of ECT and principals about the effectiveness of ITE were of the same order. These figures tend to throw some doubt on the extent of the impact of the DER on the development of teacher capability directly as a result of the DER.

Conclusion

This paper has attempted to assess the impact of the DER on teacher capability using existing data from national scale surveys that gathered data on a large range of aspects of teachers' careers and practice. There is evidence of impact particularly in relation to participation in, and perceived needs for, continuing professional development, enhanced qualifications of secondary teachers currently teaching specialist ICT subjects and preparation in ICT use by initial teacher education programs. Overall, the data tends to confirm the conclusions of the national and New South Wales reviews of the DER, although not conclusively. A comparison between the primary teacher and secondary teacher workforce did not produce the difference in capability that may have been expected given that the DER focused on secondary schools. The reasons for this could be the subject of future analyses.

Clearly one shortcoming in the above analysis is that the data collection was not tailored for the purpose of measuring the impact of DER and therefore had only limited application to the task. However, notwithstanding the fact that there was not consistent data available from the SiAS surveys and the difficulties in comparing some of the data, this paper has identified measures and baseline data that could inform future surveys and analyses in ICT capability of teachers. There is also scope for more detailed examination of measures of teacher capability that are more strongly related to learning outcomes of school students.

Notes

1. Subjects may be described differently at different levels of schooling, such as Years 7-10 and Years 11-12 of secondary education, and across states and territories. The national school curriculum, currently being implemented, will increase national consistency. The terms "computing" and "information technology" have currency across Australia generally, but may encompass variations such as Informatics and Software Development at senior levels. In this paper the term ICT refers to technologies that are employed by teachers across the curriculum, while computing and information technology refers to subject specialities, as seems to be intended in the SiAS surveys. However this may create legacy issues as definitions have evolved over time.
2. As for professional development: 20% of primary teachers and 16% of secondary teachers engaged in professional learning over the past 12 months that involved developing their capacity to teach in a different curriculum area from their regular teaching.
3. Only English (33%) and Mathematics (28%) were higher than computing. These proportions represent about 5-6% of all primary teachers.
4. Computing was the highest followed by Technology (16%), English (15%) and SOSE (15%). These proportions represent about 3% of all secondary teachers.
5. There was a change in wording from 2007 from "all the schooling areas in which they had studied at tertiary level" to "having completed at least one semester of studies at that year level". It was felt that the focus of the 2007 question on "the highest year level completed" might

- have led to an under-estimation of the extent of teachers' tertiary studies. This may account for some of the differences in results.
6. Care is needed in interpreting such changes due to slight differences in the question wording between the two surveys.
 7. The proportion of teachers currently teaching the subjects is a proportion of the primary teacher sample. However it includes only those teachers who said they are not currently generalists: those who indicated that they are both generalist and specialist teachers are not included in the figures. This is likely to explain the reduction in numbers from 2007 and 2010.
 8. There was some evidence from the program review of the DER that parents valued the digital education capabilities of schools and considered them when making enrolment or re-enrolment decisions (dandolopartners, 2012).
 9. Data for IT were not collected in 2007 and 2010.
 10. The second highest focus area was "Subject content knowledge" at 62%.
 11. "Developing and teaching a unit of work" (76%), "meeting my professional and ethical responsibilities as a teacher" (74%) and "learning how to evaluate and improve my own teaching" (72%) all scored significantly higher among early career teachers.
 12. AITSL (2011), Accreditation of Initial Teacher Education Programs in Australia: Standards and Procedures, p14. The standards describe the minimum content and methodology requirements for primary teachers.
 13. It is not clear the extent to which the measurement of the IT subject area among the general teaching population, in addition to computing, in the 2013 survey represented a real increase in university studies in ICT for both primary and secondary teachers or whether this was extant but not measured by previous surveys.

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