# Chapter 19
# Technology to Improve Assessments of Learning in Class, School and Nation

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**Abstract** This chapter considers the current education policy context in Australia, including the high level of technology provision and use and an increasingly national approach to curriculum, teaching and assessment. It argues that to meet the first Professional Standard—"know students and how they learn"—teachers can be strongly supported by assessments conducted through technologies. The view of assessment in this case is not one of ranking and sorting, but a growth mindset, where teachers see their role as enabling learners to demonstrate growth over time. It describes elements of a Learning Assessment System to support this growth, and how technology assists teachers by providing feedback efficiently. It includes examples of schools working with researchers, government and industry to implement assessment tools that meet their needs. Finally it argues that while teachers must take a position regarding the purpose of assessment and play a role in the developments involving technology, the scope of the task is so great that it requires collaboration locally and globally.

**Keywords** Assessment in Australia • Growth mindset • Teachers' role • Education policy • Australia • Technology provision • Approach to teaching • Assessment • Curriculum • Online assessment • Teachers • Educators • Professional standard • Educational research • Learning assessment system • Researchers • Government • Industry • Individual needs • Collaboration

For those of us who have spent many years working with teachers, learners and technology, it may seem that little progress has been made in harnessing the promised benefits of technology for learning. In past decades we understood that access to devices and infrastructure was an important factor, so governments determined that schools would have a range of hardware and software resources for teaching and learning and administrative use. Knowing too, that professional development for teachers was an important factor in introducing educational change, many programmes were offered, both face to face and online, device-focused and

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pedagogy-focused. Policy documents and curriculum statements were produced to encourage and evaluate digital learning. Many teachers used various technologies enthusiastically with their students. Yet as the 2015 Horizon Report noted, scaling up innovation remains a "wicked challenge" (Johnson, Adams Becker, Estrada, & Freeman, 2015, p. 1).

This chapter considers the current context in Australia, a long-standing federation of states and territories, which is moving towards a national approach to major aspects of education policy. It focuses on how teachers are using technology to better know their learners through assessment approaches at local and broad scales, and provides a model to support an emphasis on growth rather than rankings.

Assessment is a term not always loved by teachers. In fact I've been told by teachers "assessment was one of my least favourite subjects at university", and "everyone hates it because it's very boring". Perhaps this is because it seems to have been taken out of teachers' hands, although it is an essential part of teaching. In this chapter, I argue that assessment involves recognising and valuing what people know and can do in relation to a broader context of what is possible. This is in line with the view of Masters (2013) who says "the fundamental purpose of assessment is to establish where learners are in their learning at the time of assessment". He goes further to argue that this means that distinctions between "formative" and "summative" assessments are only related to their use, not their format. A test can be used for both formative and summative purposes, as can a music or drama performance.

The collection and aggregation of assessment data is showing us the detail teachers often suspected. When children begin school they are already likely to be spread over a wide range of achievement levels. In Australia in reading and mathematics, students commence each school year with performance levels across a range of about 5–6 years. And in spite of this evidence, educational policy and school organisation appear to assume that the vast majority of students of the same age are at similar points in their learning and development. This creates a challenge for teachers who are expected to have all their students meet certain standards. A handful of schools are attempting to organise differently, but they are in the very early stages. The examples in this chapter, several drawn from the practitioner conference "Excellence in Professional Practice" held annually in Australia (ACER, 2015), show how technology is assisting teachers to monitor and assess learners. However they also reflect the scope of the task, which goes beyond what individual teachers can achieve and is best tackled by teachers working together, often in conjunction with researchers, education departments or industry to improve student learning.

## The Australian Scene

### *Policy Context*

The "Melbourne Declaration" made by all education ministers of Australian states and territories (MCEETYA, 2008) is the current statement of goals for education in Australia. There are only two goals:

1. Australian schooling promotes equity and excellence.
2. All young Australians become successful learners, confident and creative individuals, and active and informed citizens.

To be successful learners young Australians are to be creative and productive users of technology as a foundation for success in all learning areas. The Declaration identifies essential skills for twenty-first century. It describes individuals who can manage their own wellbeing, relate well to others, make informed decisions about their lives, become citizens who behave with ethical integrity, relate to and communicate across cultures, work for the common good and act with responsibility at local, regional and global levels. This document underpins the Australian Curriculum, the first national curriculum since Federation in 1901. In addition to the major disciplines, the curriculum includes seven "general capabilities": literacy; numeracy; information and communication technology capability; critical and creative thinking; personal and social capability; ethical understanding; and intercultural understanding (Australian Curriculum Assessment and Reporting Authority, 2013).

With regard to teachers, Australia has developed professional standards that commence with "know students and how they learn" and include "know the content and how to teach it", "plan for and implement effective teaching and learning" and "assess, provide feedback and report on student learning" (Australian Institute of Teaching and School Leadership, 2014). These standards outline the roles of teachers, and remind us that what students bring to the learning is the starting point for teaching and by implication, personalised learning. Yet Johnson et al. (2015) lament that the potential for personalised learning is constrained by the pressure on schools to perform on standardised assessments. Since it is unlikely that standardised tests will be discontinued readily, it is important to develop ways in which local knowledge and local assessment can provide immediate and ongoing understanding of learners, and to see standardised tests as more general information based on particular points of time. Both have value, for different purposes.

## *Technology Provision and Take Up*

Australia has a history of technology provision for education and Australians generally take up technologies with alacrity. For a population of 21 million, from 2008 to 2012 the Australian Government invested $AUD2.2 billion (£1b plus) in high speed broadband, devices for secondary students in Years 9–12, and online learning resources, through its Digital Education Revolution. Australian schools are therefore quite well resourced (DeBortoli, Buckley, Underwood, O'Grady, & Gebhardt, 2014). On average, the ratio of students to computers is three to one, compared to the international mean of 18 students per computer. An increasing number of students bring their own device to class, or have access to a class set of portable computers. Australian students are frequently using technologies outside of school. Students have reported that they most often used technology to build and expand on "what the teachers are teaching", to communicate with other students and discuss the learning

content, and to "learn other things at the same time as learning what is intended" (Moyle, 2010, p. 37). However, many of these same students reported that when in school they felt that they were stepping back in time. Moyle argues that rather than being due to the technologies available in schools, this is more a result of how the technology is used in class.

Almost all Australian Year 8 students surveyed for the International Computer and Information Literacy Study (ICILS) in 2013 had access to tutorial software, digital learning games, word processing and spreadsheet software, multimedia production tools, presentation software, communications software and graphics or drawing software (Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014). The proportions 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).

Another recent report (OECD, 2015) confirms the high level of access by Australian students. Yet in the fairly narrow measures of the Program for International Student Assessment (PISA), recent cohorts of Australia's 15-year-olds are not performing better than previous cohorts, and in fact are reaching lower scores than before. Increasingly, there is a realisation that it's not a matter of merely providing devices, but how they are used by teachers and learners. Further, it is important to consider not only actions, but also teachers' beliefs that impact on the way they incorporate technology into their teaching. Dwyer, Ringstaff and Sandholtz (1991) found that for successful change, teachers needed opportunities to reflect on their own beliefs about learning, and that given structural support, these can change whilst in the midst of reform.

## *Approaches to Learning and Assessment*

As an alternative to the hard-edged standards approach, Dweck's (2006) work on mindsets has become influential among teachers in Australia, with many accepting as a matter of principle that their role is to support students in their growth and development: "a growth mindset". Rather than starting with the assumption that individuals differ in their ability to learn (a "fixed" mindset), a growth mindset begins with a belief that most, if not all, people are capable of making learning progress if they are engaged, motivated, willing to make an effort, and provided with relevant learning opportunities. To do this, teachers not only need to know where their learners are in their learning, but also how they can target teaching to move students to further learning (Goss, Hunter, Romanes, & Parsonage, 2015). Clearly this is in contrast to a widely held view in some circles that assessment exists to rank and sort children, schools and nations. However accepting the Dweck argument can be a challenge, as it allows for no excuses.

Dweck's argument is supported by research in neuroscience that shows that most learning builds on existing learning, and that learning can be lifelong. Bruno della Chiesa, the instigator of the OECD project that led to the publication *Understanding*

*the brain*: *The birth of a learning science* (OECD, 2007), suggests that educators need to keep two crucial ideas in mind: brain plasticity and the recognition of sensitive periods in human development (Australian Council for Educational Research, 2013). Plasticity refers to the discovery that 90 % of the neuronal connections (the synapses) are not developed at birth, but develop through life. Connections in our brains are activated as we recognise and link to previous learning, making it very important for teachers to continue to know their learners by conducting regular formal or informal diagnostic assessment activities.

In his theoretical model that can apply to all domains, Masters portrays the processes required for a connected approach, in a Learning Assessment System (Masters, 2013, p. 33). The purpose of the assessment system is to inform teaching and learning, and the five elements are:

- An empirically based learning domain
- Domain-appropriate assessment methods
- Task rubrics for recording observations
- Evidence-based conclusions
- Feedback

The first step in assessment is to specify the learning domain to be assessed. But Masters goes further to argue that the specification and description of the domain must be based on empirical work and firmly grounded in research into the nature of learning within the domain, which can be a specific discipline area, like history; or narrow fields within the disciplines; or one of the general capabilities or competencies that cross disciplines. The intention is to describe learning progress within a domain, rather than only listing learning outcomes.

The second step acknowledges that the assessment methods must be designed to provide useful information about where learners are in their learning within the domain. Different assessment methods are valid for different kinds of learning. Third, task rubrics for recording observations must be specific to the task, hierarchical and qualitatively defined. This means that rubrics are not generic, but must relate to a specific assessment task. Hierarchical rubrics are criteria or marking guides that contain several levels, each higher level including the description of those below. They are most useful when the characteristics or qualitative differences of each level are clear to the learners and assessors. Fourth, evidence-based conclusions should be drawn with reference to an explicit, empirically based understanding of learning progress within the domain. Deep knowledge involves professional training, experience and research. Finally feedback can be given and received.

Teachers in Australia are influenced extensively by the work of Hattie (2009, 2015), particularly on feedback. In his meta-analysis of research into factors affecting student learning, feedback was shown to have a significant effect size of 0.73. Most everyday feedback comes from teachers, in the form of a smile, a rebuke, a grade, a verbal or written comment. It can be immediate or delayed, depending often on the format. However recent work on intelligent tutoring systems and computer adaptive testing is providing instant feedback to students. A most important form of feedback is from students to teachers, which Hattie (2009) calls “Know thy impact”,

and this is where technology can be very helpful. Students generate digital data on a daily basis in their online interactions through learning management systems and use of devices. These data are the basis of work in educational data mining and learning analytics. For teachers, quantitative data collected through student activities and assessments can be presented in visualisation software to make individual performances and patterns visible, providing the information teachers need to plan the next steps for learning. There are numerous tools on the market, both subject specific and general.

A project undertaken in Australia's Science of Learning Research Centre is researching how to optimise feedback in interactive learning environments. Specifically, the project is exploring what kinds of feedback work best for learners of differing ability. The study uses behavioural and neural research methods such as observation, computer log data, eye tracking, biometric data and electroencephalogram (EEG) to examine the neural responses to feedback when students are using intelligent learning environments. Clearly the findings of these projects will assist teachers, but are beyond what most can undertake themselves.

## *New Technologies and New Literacies*

The growing use of new technologies is requiring new ICT capabilities, including new skills in reading, communicating, online searching, and problem solving for a world in which employment opportunities are increasingly based on new knowledge and skills. The term "new literacies" can encompass visual literacy, critical literacy, scientific literacy and multiliteracies (Brown, Lockyer, Caputi, & Tognolini, 2010; Hartnell-Young, 2007). Assessments of aspects beyond the common areas of literacy and numeracy include assessments of ICT skill itself (Fraillon et al., 2014) and constructs where ICT is an integral part, such as digital reading (OECD, 2011) and problem solving (De Bortoli & Macaskill, 2014; Griffin & Care, 2015).

In line with the goals for learning, ICT Literacy—accessing, managing, integrating and evaluating information, developing new understandings, and communicating—is measured in Australia's National Assessment Program (NAP). Sample surveys are conducted on a rolling triennial basis at Year 6 and Year 10. The most recent figures show that the skills of Year 6 students are increasing, while at Year 10 the level of skills is relatively stable (Thomson, 2015). At the national level, female students significantly outperformed male students in the NAP-ICTL assessment at both Year 6 and Year 10.

There are calls for assessment reform and renaissance, with some authors suggesting that current assessment methods need to be replaced, and that technology will play a larger role in the future (Hill & Barber, 2014; Masters, 2013). As new literacies or general capabilities develop throughout the years of school, assessment processes must be capable of monitoring students' long-term development. We will need to underpin assessment with knowledge of what long-term improvements in these skills, attributes and understandings look like—that is, by learning "metrics" for monitoring

progress over time. How are teachers to respond? Clearly not individually, and possibly not even as teachers alone. More and more, teachers are collaborating with researchers to engage in systematic inquiry around issues of professional practice. In a project designed to assess "multiliteracy", researchers developed and tested a conceptual model in conjunction with practitioners, using an online assessment (Brown et al., 2010; Buckley-Walker, Tognolini, Lockyer, & Brown, 2015).

Australia has been involved in the leadership of the Assessment and Teaching of 21st Century Skills (ATS21C) project and researchers at the University of Melbourne have developed a range of assessments to identify collaborative problem solving (between two human learners, rather than placing a learner with a computer agent as the collaborator). The trial tasks relate to curriculum domains such as mathematics and physics as well as general capabilities. Based on the principle that each learner has different information that must be combined to solve the problem, the data logs created as the two learners share their information provide measures of cognitive and social skills on a continuum of growth (Care, Griffin, Scoular, Awwal, & Zoanetti, 2015).

Even if assessments are presented in the form of tests, the range of possibilities is much broader than the typical multiple choice format. Tests now incorporate dynamic texts, such as video, animation or audio. As well as using a mouse to click on an option, or typing words or numbers, students can record responses orally, or drag and drop an object from one place to another, or click on a hot spot. This can lead to greater engagement and can enhance validity by isolating the skills being assessed, which are often mediated by, for example, students' reading levels or writing skills. For reasons such as these, a large-scale project in the Department of Education and Training in New South Wales, Australia (Sim, 2015) provides online multimedia interactive assessment items in science for a diagnostic test at several year levels, mapped against an assessment framework aligned with national and state curriculum. Work has started to expand the project to English, mathematics and history.

Interactive learning environments, such as simulations, can be used simultaneously for teaching and assessing, and are often used in science (Timms & Lodge, 2015). They can represent phenomena that would be hard to observe in a classroom, and allow students to safely use virtual equipment to conduct experiments. But a major benefit is their capacity to monitor students' decision making and other interactions with the system. Assessment can be embedded in the tasks and evaluated immediately within the system, giving feedback to the learners as well as to the teachers. Research shows that reliable judgements about learning can be made using these tools, but Timms and Lodge caution that due to the time and effort required, they should only be used for assessment that is difficult to undertake in other ways.

## *The Roles of Teachers*

Teachers recognise that they are at some times learners too, engaged in co-constructing knowledge with their students. While much of the large-scale development work described above will not be undertaken by teachers, they should be

aware of and contribute to means of assessment that can assist their teaching. Moyle (2010) suggests that technologies provide an opportunity to rethink the way educators work. While Johnson et al. (2015) consider rethinking the roles of teachers as a difficult challenge, the author has found in empirical research that teachers were shaping their roles (e.g. Hartnell-Young, 2003, 2009) in light of access to technologies. One major role of teachers is ongoing monitoring and assessing, although the term assessment may not always be used to describe it. But the main focus for this role is to find out: What does this child know? What can she do? What should we do now to stretch the learning, even beyond what we are imagining? And when an activity or intervention has been planned and tried out, How well has it worked? Is there evidence of progress? While it is not possible to tackle this alone, it is important for teachers to understand what is possible, and what is occurring in the technology arena. To do this they need to work together, constructing knowledge with their students, with other teachers, with researchers and other interested parties.

A "rolling summit" on assessment reform and innovation, under the auspices of Australian Council for Educational Research (ACER) over recent years, listened to teachers and shared with them some of the trends in assessment, particularly in using technologies. One teacher said "technology has yet to really flower as a mode of assessment" and others felt it was used mainly for learning tasks, rather than assessment. Those who did use technology reported they could set a wider variety of tasks, often authentic or "real life". Teachers reported developing their own systems to use spreadsheets to record, collate and analyse assessment data, pinpointing areas of concern to inform their teaching of individuals or groups of students. They used tablets and cameras for coaching purposes and to record obvious progress for self, peer and teacher assessment. They established class community sites, and platforms and quizzes where teachers could give timely feedback. Some used adaptive testing and on demand assessments provided by education departments. Others provided continuous reporting to parents through a learning management system or through digital portfolios.

At a secondary school in New South Wales, teachers formed an assessment and reporting team representing each learning area and used a range of assessment tools to enable students to show their growth (Endicott & Gavin, 2015). After a successful implementation of the new approach to assessment in Years 7 and 8, it has spread to Year 9 and 10. One primary school in Melbourne, Victoria decided to improve mathematics learning and teaching, assessment and reporting through the creative use of technology. A whole-school approach to evidence-driven assessment was developed, using readily available software, while also working with industry to develop customised products (Sheedy, Cananzi, & O'Shea, 2015). The resulting personalised approach to goal setting and feedback is said to have increased student agency. Another primary school determined to lift the scores of students in the upper and lower quartiles of achievement on standardised tests in reading comprehension (Blakey, Darvell, & Holmes-Smith, 2015). As well as implementing professional development and specific teaching strategies for reading, the school worked with the University of Melbourne and a small software company to identify where students were placed on a reading continuum, and used progressive achievement tests to

gauge each student's Zone of Proximal Development (Vygotsky, 1962). After 3 years, students were showing growth on internal and external measures.

Some schools work closely with their education systems. With the introduction of the Australian Curriculum, many schools in Western Australia looked for a systematic way to collect student data. A not-for-profit association worked with the Department of Education to investigate teachers' needs and develop solutions. Over one hundred primary schools in Western Australia now use a Maths Tracker Monitoring Tool that includes teacher judgement data and covers the range from Kindergarten to Year 10. The tool creates data pictures of individual students as well as groups (Wright & Julian, 2015).

These examples show teachers taking the initiative to use technology tools to better know their learners as well as to realise efficiencies by working together and aggregating data.

## Conclusion

With the attention given to curriculum and pedagogy in recent years, it is certainly time to turn our attention to the third part of the trinity: assessment. The approach to addressing assessment issues should include elements of top down support (from governments and large companies, for example) and bottom up action (by schools and teachers). Technology can assist teachers and learners to better know what progress they are making, individually and en masse. But teachers' beliefs need to be acknowledged as they are essential to successful reform. If we are to scale up innovation, involving teachers in the process, teachers must be clear about what they want to achieve with assessment tools, and take this opportunity to collaborate in projects as described in this chapter, share their experience and become involved in decisions that are made.

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