



Education
Centre for Education
Statistics & Evaluation

How schools can improve literacy and numeracy performance and why it (still) matters

Centre for Education Statistics and Evaluation



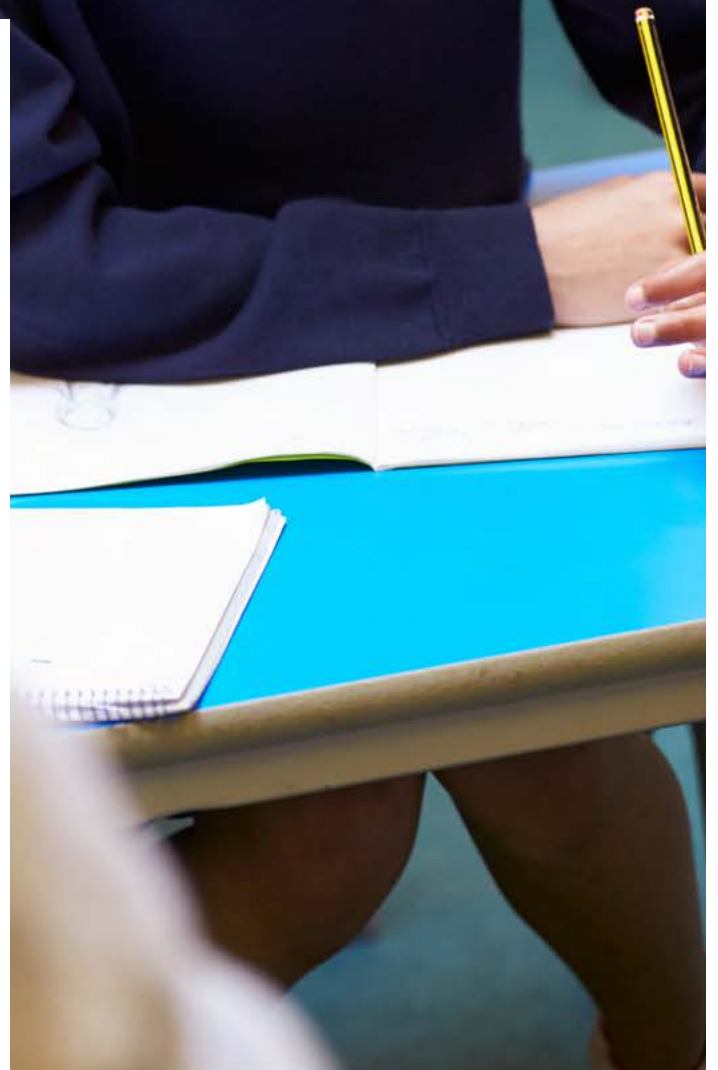


In the Australian Curriculum, literacy and numeracy are defined as the following:

... students become literate as they develop the knowledge, skills and dispositions to interpret and use language confidently for learning and communicating in and out of school and for participating effectively in society. Literacy involves students listening to, reading, viewing, speaking, writing and creating oral, print, visual and digital texts, and using and modifying language for different purposes in a range of contexts.

Literacy encompasses the knowledge and skills students need to access, understand, analyse and evaluate information, make meaning, express thoughts and emotions, present ideas and opinions, interact with others and participate in activities at school and in their lives beyond school. Success in any learning area depends on being able to use the significant, identifiable and distinctive literacy that is important for learning and representative of the content of that learning area.

... numeracy encompasses the knowledge, skills, behaviours and dispositions that students need to use mathematics in a wide range of situations. It involves students recognising and understanding the role of mathematics in the world and having the dispositions and capacities to use mathematical knowledge and skills purposefully.



Introduction

The importance of literacy and numeracy skills is well established. These skills have a significant impact both on individuals and society as a whole. They are foundational skills, providing the base on which to learn other, more complex skills. Literacy and numeracy skills underpin workforce participation, productivity and the broader economy, and can also impact on social and health outcomes. Individuals without these skills are at risk of not being able to participate in the workforce or engage fully in social and civic life.

Adolescents entering the adult world in the 21st century will read and write more than at any other time in human history. They will need advanced levels of literacy to perform their jobs, run their households, act as citizens, and conduct their personal lives (Vacca et al. 2011).

Literacy and numeracy skills have long been a focus for schooling and a variety of programs and practices have been implemented in NSW schools over the last three decades. However, in the face of data suggesting that we have reached a plateau in student achievement, and even a decline in performance in some areas, it is timely to revisit the importance of a sustained focus on literacy and numeracy skill acquisition for all students across all stages of schooling.

The teaching of literacy and numeracy is a core responsibility of schools. This paper summarises evidence-based practices to improve student literacy and numeracy outcomes at school, namely:

1. Intervene early and maintain the focus
2. Know what students can do and target teaching accordingly
3. Have clear and transparent learning goals
4. Focus on teacher professional learning that improves the teaching of literacy and numeracy

The paper also examines the research on the importance of literacy and numeracy skills to individuals and society more broadly, including employment outcomes, the economy, social inclusion, health and other variables.

Evidence-based practices to improve student literacy and numeracy outcomes

There is some debate over which particular interventions work best for improving literacy and numeracy outcomes and more high-quality research is warranted in this area. As with most matters pertaining to student learning, the quality of the teaching is key.

Research undertaken for the Commonwealth Department of Education, Science and Training in 2005 investigated the literacy teaching practices of early years teachers. The study examined the effectiveness of teachers and made findings about both the content of the instruction and the quality of the teaching. The teacher effectiveness research reinforced the crucial importance of the individual teacher in producing effective learning outcomes. It found that effective teachers have a wide repertoire of teaching practices, which they employ to suit the classroom context, their purposes and the needs of their students. Effective teachers of literacy have a strong literacy knowledge base that they make explicit to their students, in addition to creating and making use of a rich literacy environment.

The ways in which effective teachers are able to manage the many competing demands of the classroom have been likened to the skills of a juggler or to the conductor of a large orchestra. They individualise instruction in order to support and challenge students and they motivate students to participate in classroom activities, at the same time as they gain the respect of their students and skilfully structure activities and instruction (Louden et al. 2005).

How does NSW perform in literacy and numeracy?

Figure 1: NSW mean NAPLAN writing scores between 2011-2016



Source: ACARA. Note: ACARA assessed persuasive writing from 2011 to 2015, and narrative writing in 2016. 2016 results are preliminary.

Since NAPLAN testing began in 2008, NSW has ranked in the top three of all states and territories in Australia for NAPLAN numeracy in all years; and in the top three for NAPLAN reading for all years except Year 9. NSW ranks in the top two states and territories for NAPLAN spelling, and is above the Australian average for grammar and punctuation, and for persuasive writing in all years except for Year 9.

Nonetheless, NSW could be doing better. The number of students taking advanced English and advanced maths in the Higher School Certificate has fallen over the past 10 years; non-metropolitan students and Aboriginal students are still more likely to be below national minimum standards in literacy and numeracy than other cohorts; and NSW mean scores in the Programme for International Student Assessment (PISA) reading and maths are in decline. NSW NAPLAN data also shows a decline in the mean scores for writing across all year levels over the past five years.

The NSW Premier's 12 Priorities released in 2015 include a target to increase the proportion of students in the top two NAPLAN bands for literacy and numeracy by 8 per cent by 2019 and one of the State Priorities is to increase the proportion of Aboriginal and Torres Strait Islander students in the top two NAPLAN bands for reading and numeracy by 30 per cent by 2019.

This paper draws on previous research on effective practices conducted by the Centre for Education Statistics and Evaluation (CESE), as well as literature more specifically focused on literacy and numeracy. The paper does not attempt to re-prosecute the well-understood case for the importance of high-quality, knowledgeable teachers. Nor does it focus on specific literacy and numeracy interventions or programs, or on practices for which the evidence of improvement is mixed or thin. Rather, it explores evidence-based practices at the system and school-level, which can improve the literacy and numeracy skills of students, across all stages of schooling.

1. Intervene early and maintain the focus

Quality matters early

A strong body of evidence shows that access to quality early childhood education programs makes a significant and long-term difference to children's development in many areas, including their cognitive development. Quality early childhood programs, especially in the year before school, can help children develop skills that will assist them to transition to school and gain the skills needed to succeed in later life. This is particularly important for children from disadvantaged backgrounds, as early intervention can contain the effects of disadvantage and reduce performance gaps, which emerge early (European Expert Network on Economics of Education 2012).

A number of longitudinal US studies, notably the High Scope Perry Preschool Program and the Carolina Abecedarian Project, which targeted very disadvantaged families (see Economic Policy Institute 2004; Highscope Press 2004; Campbell & Ramey 2002), found significant short and long-term improvements in outcomes for children, including improved cognitive and social development; reduced need for remedial education; higher rates of school completion and post-school education; as well as higher employment rates and reduced levels of criminal activity and welfare dependence (The Institute of Education 2004).

The UK study Effective Provision of Preschool and Primary Education (EPPE), which examined the longitudinal effects of preschool showed that pre-schooling contributed to better intellectual development, improved independence, concentration and sociability for all children (The Institute of Education 2004).

A sustained focus is important

Early intervention needs to be followed by continued high quality learning experiences to sustain effectiveness (European Expert Network on Economics of Education 2012). The first three years of school are a peak window within which children develop the literacy and numeracy skills that they will carry into upper primary and secondary school. These skills enable them to take on progressively more demanding learning tasks and successfully progress throughout school (Australian Council for Educational Research 2006). It has been noted in various research studies that children who have not acquired sufficient reading skills at the end of Year 1 almost never acquire average reading skills by the end of primary school without substantial remedial support (Torgesen & Burgess 1998; Wagner et al. 1997); similarly, Jordan et al (2007) found that number sense performance in Kindergarten accounted for 66 per cent of the variance in maths achievement in Year 1 with this effect persisting in to Year 3. As Heckman (European Expert Network on Economics of Education 2012) states, 'The longer society waits to intervene in the life cycle of a disadvantaged child, the more costly it is to remediate disadvantage'.

In NSW primary schools, an evaluation of the K-2 Literacy and Numeracy Action Plan found improved outcomes for students in K-2. On most of the measures of reading, writing and numeracy used at each grade level (Kindergarten to Year 2), and in each system/sector, the percentage of students rated by their teachers as at or above the expected end of year standard increased in 2015 (Table 1).

2. Know what students can do and target teaching accordingly

Targeted teaching can reduce achievement gaps

Targeting teaching effectively towards stronger or weaker students could be an effective strategy for improving Australia's performance in literacy and numeracy. Such an effort is necessary, given Australia's most recent PISA results. In 2012, 20 per cent of Australian 15-year-olds fell short of PISA's minimum proficient standard in maths. Only nine per cent of students failed to meet this benchmark in the world's five best-performing countries. Similarly only 15 per cent of Australia's strongest students reached the highest levels of mathematical proficiency, compared with 40 per cent of students in the best five systems (Grattan Institute 2015).

Table 1: Change in percent of students at or above Continua standards 2014-2015*

	Reading (Aspects of text)			Writing			Numeracy			No. of students		
	K	Yr 1	Yr 2	K	Yr 1	Yr 2	K	Yr 1	Yr 2	K	Yr 1	Yr 2
Per cent change between 2014-2015										2014		
Government	+6	+16	+17	+10	+17	+10	+1	+5	+4	5,635	5,771	5,716
Catholic	+8	+8	+7	-	-	-	+3	+7	+11	3,415	3,257	3,302
Independent	+16	+8	+12	-	-	-	0	+6	+5	547	648	611
Per cent of students at or above end of year standard										2015		
Government	70	72	66	64	48	34	97	91	87	9,706	5,775	5,973
Catholic	72	69	68	59	41	37	97	91	86	3,563	3,486	3,380
Independent	57	56	52	59	34	28	99	96	90	655	639	660

*Comparable writing scores are not available for 2014 in the Catholic and Independent sectors.
Source: Erebus, Evaluation of the NSW Literacy and Numeracy Action Plan 2015 Progress Report

There is also a large spread of learning achievement in Australian classrooms. In Australian schools, achievement can be spread over as many as five to eight year levels within a single class. For example, a Year 7 class may have students working at a Year 1 level, while others have mastered concepts from Year 8 (Grattan Institute 2015). The figures in NSW are similar to those for Australia as a whole (Figure 2).

One way to ensure all students achieve at their potential in literacy and numeracy is for schools to systematically implement targeted teaching. Targeted teaching refers to methods teachers use to lift the performance of students who are many years behind and also to challenge students who are already well ahead of year level expectations. Implemented school-wide, it is a means of not just delivering the year level curriculum, but extending the skills and knowledge of every student in every class regardless of their starting point. Examples of targeted teaching can include early intervention in the pre-school and early school years (see, for example, Education Endowment Foundation 2015a; 2015b), tiered intervention at later stages of schooling (see, for example, NSW Department of Education and Communities, 2012) and differentiated instruction (see, for example, Valiandes 2015).

Formative assessment helps target teaching

In order to implement targeted teaching effectively, teachers need accurate information about what students know and are ready to learn next. One way teachers can acquire this information is through the use of formative assessment which has been shown to have a significant effect on learning across the spectrum. Formative assessment is a term used for the variety of methods teachers use to monitor student learning, and to identify concepts that students are struggling to understand or skills they are having difficulty mastering; or conversely, areas in which students may require further challenge in order to keep them performing at their highest levels. In other words, it is a method of assessment for learning (Black & Wiliam 1998). Key elements of formative assessment include:

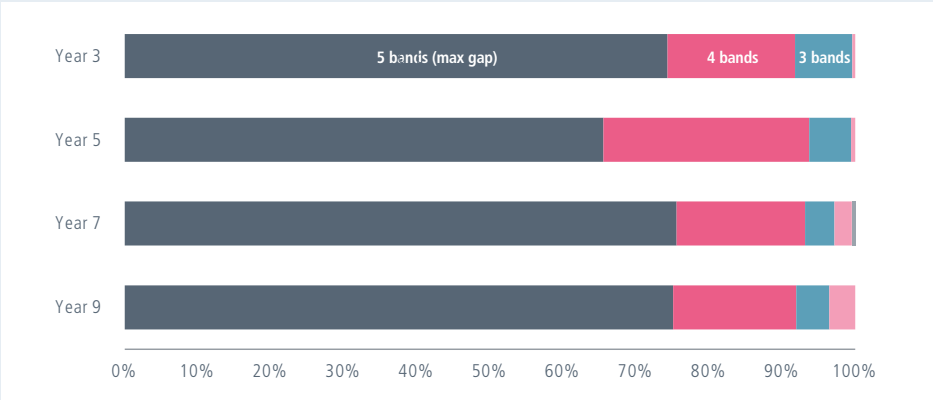
- identification of goals, outcomes and criteria for achievement
- communication between teachers and students about a student’s current knowledge and future directions
- active involvement of students in their own learning



- teachers responding to feedback by modifying teaching strategies (Karpinski & D’Agostino 2013).

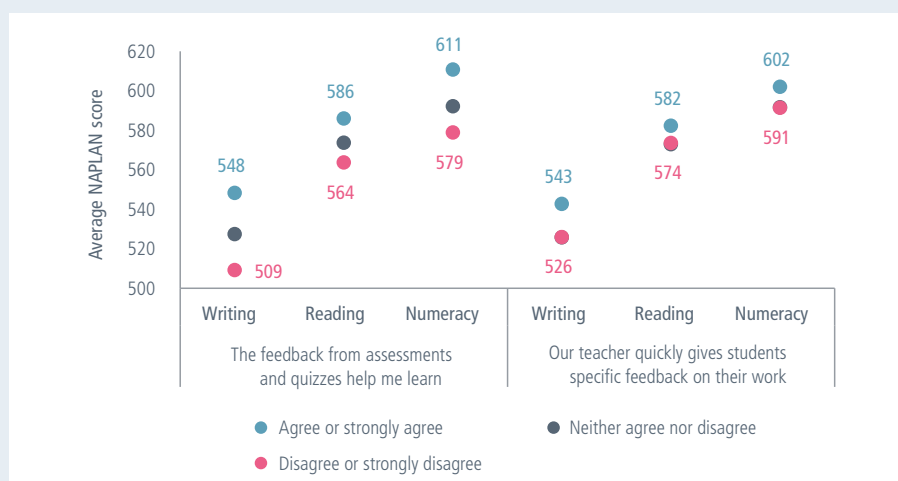
Black and Wiliam (1998) analysed over 250 studies of formative assessment, and found significant learning gains with effect sizes between 0.4 and 0.7. These gains can be seen both across student learning in general, and also specifically in regard to literacy and numeracy. For example, in a study looking at student writing in Years 1 to 8, Graham et al. (2015) found that feedback to students about their writing from adults, peers, self, and computers statistically enhanced writing quality, yielding average weighted effect sizes of 0.87, 0.58, 0.62 and 0.38 respectively. In another study, Fontana and Fernandes (1994) examined Portuguese maths students aged 8 to 14 who had been taught by their teachers to self-evaluate as a means of formative assessment, against a group of students who had not. The results of the students who had been taught self-assessment techniques improved by an average of 15 marks – almost twice as big an improvement as the control group, whose marks improved by an average of 7.8 marks¹.

Figure 2: Gaps in NAPLAN Reading performance between lowest and highest performing students in the school, 2012



Source: Centre for Education Statistics and Evaluation, analysis of 2012 NAPLAN data

Figure 3: Difference in NAPLAN scores for Year 9 NSW students responding to questions about formative assessment



Note: where the blue dot is not visible, 'neither agree nor disagree' and 'disagree or strongly disagree' are the same value.
Source: Centre for Education Statistics and Evaluation, analysis of 2014 NAPLAN and TTFM data

The New South Wales *Tell Them From Me*² student survey data also shows the positive relationship between the use of formative assessment and NAPLAN scores (Figure 3).

3. Have clear and transparent learning goals

High-growth schools set clear learning goals

Research shows that having clear and transparent learning goals at both the school and classroom level leads to improvements in learning achievement. At the school level, a whole school approach can be important to promoting clear and transparent learning goals. In the study of high value-add schools in NSW (Centre for Education Statistics and Evaluation 2015a), setting whole school goals and strategies for change was found to be one of the six effective practices in high growth schools. Research shows that in order to impact student outcomes:

- the school's vision must be translated into concrete goals
- these goals must focus on teaching and learning
- the goals must be shared
- the goals must embody high expectations but focus on a small number of core priorities to avoid innovation overload (Centre for Education Statistics and Evaluation 2015b).

An effective whole school approach can be useful in the case of literacy and numeracy, particularly at the high school level, where the focus can often move away from literacy and numeracy as a core goal.

Learning continua or progressions support explicit teaching

Critical to the success of a whole school approach for literacy and numeracy are well-articulated and clear learning continua or progressions. Learning is not a series of discrete events, but rather a trajectory that involves developing skills and understandings that build upon each other. Learning progressions, or 'standards' refer to 'a carefully sequenced set of building blocks that students must master en route to a more distant curricular aim' (Popham 2007).

Learning progressions ensure that students are learning age-appropriate material (knowledge and skills that are neither too advanced nor too basic), and that teachers are sequencing learning effectively and avoiding the inadvertent repetition of material that was taught in earlier grades (Glossary of Education Reform 2013).

Learning progressions or continua support explicit teaching by enabling teachers to accurately determine students' current learning achievement. Presenting learning as a continuum can assist educators to understand what is to be learned, and support both instructional planning and formative assessment (Council of Chief State School Officers 2008). For example, a study of primary and junior secondary school teachers in Hawaii and their use of learning progressions in literacy or numeracy found that when teachers used learning progressions to set expectations for, and assess student work, they gained a clearer understanding of what 'within grade-level progress' could look like and gained confidence in using assessment techniques and tools to monitor student progress (National Center on Educational Outcomes 2012).

Learning continua or progressions also need to be clearly aligned and mapped to existing curriculum or syllabuses in order to achieve the best outcomes for students (Fortus and Krajcik 2011). As Margel et al. (2008) and Merrit et al. (2008) state: 'Learning progressions, by specifying how ideas develop over time, can provide curriculum designers with the tools to purposefully build upon and link students' current understandings to form richer and more connected ideas over time' (cited in Bernholt et al. 2012).

Explicit teaching improves student learning

At the classroom level, Hattie (2009) rates teacher clarity – the teacher's ability to communicate the intentions of the lessons and what success means for those intentions – as one of the top 20 influences, as measured by effect size, on student learning and achievement. Learning intentions can be defined as: what it is teachers want students to learn in terms of the skills, knowledge, attitudes and values within any particular unit or lesson.

² *Tell Them From Me* is a student engagement survey offered by the NSW Department of Education to NSW public schools annually.

Learning intentions can be clarified through learning progressions or continua (as described above). Learning intentions should be clear and provide guidance to the teacher about what to teach; help learners be aware of what they should learn from the lessons; and form the basis for assessing what the students have learnt and what teachers have taught well to each student (Hattie 2009).

One way in which clear and transparent goals can be set is through the use of explicit teaching. Explicit teaching practices involve teachers clearly showing students what to do and how to do it, rather than having students discover or construct this information for themselves. Explicit teaching can also be referred to as direct³ or explicit instruction.

The teacher decides the learning intentions and success criteria, makes them transparent to students, demonstrates them by modelling, evaluates if they understand what they have been told by checking for understanding, and retelling them what they have been told by tying it all together with closure (Hattie 2009).

Evidence shows that students who experience explicit teaching practices perform better than students who do not (Figure 4). In fact, the average effect size for explicit teaching according to Hattie (2009) is 0.59, which indicates above average benefits to student outcomes⁴.

Research conducted by the Centre for Education Statistics and Evaluation (2015a) into high value-add schools shows the effectiveness of explicit teaching strategies on outcomes: teachers in high value-add schools were more likely to report using effective teaching strategies such as setting clear learning goals compared with teachers in schools that did not show high-growth over time.

Adams and Engelmann (1996) found that explicit instruction has even higher effect sizes for literacy and numeracy in particular, with an effect size of 0.69 for reading, 1.11 for maths and 1.33 for spelling. Evidence also shows that the most effective strategies for improving writing include strategy instruction which involves explicitly and systematically teaching students strategies for planning, revising and/or editing text (Graham & Perin 2007), sentence combining (Hillocks 1987) and summarisation (Graham & Perin 2007).

4. Focus on teacher professional learning that improves the teaching of literacy and numeracy

Quality professional learning improves teaching quality

High-quality teaching is, according to Hattie, the greatest in-school influence on student engagement and outcomes. At least 20 to 30 per cent of the variance in student achievement stems from teacher effects. The average teacher is associated with an impact on standardised tests each year of somewhere between 0.2 and 0.4, expressed as effect sizes. But some teachers support even higher gains in their students' achievement, with yearly gains of 0.5 to 0.6, and do so repeatedly over years (Hattie & Yates 2014). Effective professional learning can help ensure that all teachers are delivering at their highest levels and improve student outcomes in literacy and numeracy.

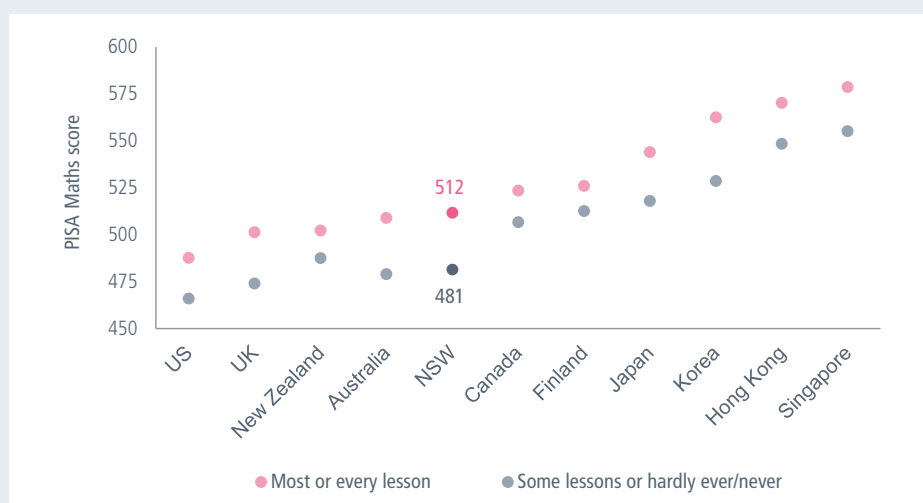
A report compiled by the United States Institute of Education Studies (Institute of Education Sciences 2007) examined the overall impact of professional development on elementary school teachers across a number of evaluation studies and found an average and consistent effect size of 0.54 in relation to improving student outcomes. Significant gains in student outcomes have also been seen in studies looking at the impact of professional learning on maths outcomes (e.g. Scher & O'Reilly 2009; Council of Chief State School Officers 2009) and literacy outcomes (e.g. New Zealand Ministry of Education 2010; New Zealand Ministry of Education 2007) at both the primary school and secondary school level.

The evidence base suggests that professional learning is most successful if it:

- deepens teachers' content knowledge and knowledge about how students learn that content
- is supported by the wider school community and seen as part of achieving whole school goals
- is linked to clear and relevant goals that are related to student outcomes (Centre for Education Statistics and Evaluation 2014).

A meta-analysis commissioned by the Ministry of Education in New Zealand analysed 97 studies of professional learning that led to improved outcomes in literacy, numeracy and science.

Figure 4: Difference in PISA scores for students reporting different frequencies of 'the teacher tells us what we have to learn'



Source: Centre for Education Statistics and Evaluation, analysis of 2012 PISA data

³ Note that this in this context, direct instruction refers to Hattie's (2013) use of the term, not the product named 'Direct Instruction'.

⁴ Hattie (2009) identifies an effect size of 0.40 or higher in education as being the threshold over which above-average beneficial effects on student outcomes are seen.



It found that, for students of the participating teachers, deepening pedagogical content and assessment knowledge, grounding learning in practice (i.e. taking into account the local classroom context), and engaging existing theories of practice (i.e. existing practices within the school) were the most effective professional learning programs (New Zealand Ministry of Education 2008). This study also showed that all of the professional learning programs that led to improved student outcomes in maths and literacy included communication of clear goals related to student outcomes during the professional development sessions (New Zealand Ministry of Education 2008).

Experts in the classroom provide instructional leadership to the whole school

The importance of a whole-school approach to teacher professional learning is highlighted by a 2008 meta-analysis which showed that when school leaders promote and participate in teacher professional development, the activity produces an effect size on student outcomes of 0.84 (Robinson et al. 2008). Other crucial elements of effective professional learning are teaching experts working in classrooms with teachers, and teachers learning from each other by sharing experiences and expertise (PTR Consulting 2012). The general consensus in the evidence base is that professional learning should be primarily school-based and school-managed and that schools need to become learning communities in which professional learning is part of the teachers' everyday work (PTR Consulting 2012).

The appointment of Instructional Leaders has been an effective strategy in NSW schools under the K-2 Action Plan, and has accelerated the pace of change in the targeted schools. An evaluation by Erebus found that 'the particular model of Instructional Leadership adopted is of less importance than the skills and experience of the people involved, the level of competence and confidence they have in their respective roles, their willingness to embrace change, and the relationships they develop' (Erebus 2016).

Teaching writing has far-reaching benefit

One area for professional learning that has been shown to lead to improvements in both literacy and numeracy at a whole-school level is the use of writing as a means of learning. The 'write-to-learn' concept recognises writing as a tool for learning and a means to promote content learning across all disciplines and year levels (Sedita 2013). In numeracy, explicit teaching of writing supports development of students' foundational skills, procedural fluency, and conceptual understanding. The formal teaching of writing should not be confined to English classes alone as a function of learning to write. The approach to the teaching of writing should be school-wide, with each discipline teaching and assessing the requirements of writing that are specific to that discipline, as a means of writing to learn. Bangert-Drowns et al. (2004) conducted a meta-analysis of the impact of 48 writing-to-learn strategies on academic achievement in a school setting. The findings suggested that writing-to-learn typically produced small, positive effects⁵ on school achievement. Graham and Perin (2007), in a meta-analysis of writing interventions, also note a small positive effect size for 'writing for content area learning'. They state that although the impact of writing activity on content learning is small, it is consistent enough to predict enhancement in learning as a result of writing-to-learn activities. They found writing-to-learn was equally effective for all content areas (social studies, maths, and science) and all grades (4-12) studied.

The US National Writing Project began in 1974 in the Graduate School of Education at the University of California, Berkeley (National Writing Project 2016) and continues to deliver robust research about the importance of writing. The Project has a substantial evidence base for the importance of explicit teaching of writing, showing significant gains in writing and overall literacy for students of teachers who have good knowledge about the teaching of writing, including theory and research, the analysis of practice, and the experience of writing. A major focus of the project is equipping teachers at every level with the tools to identify and teach to the full spectrum of writing development across year levels and subject areas.

Writing is essential to communication, learning, and citizenship. It is the currency of the new workplace and global economy. Writing helps us convey ideas, solve problems, and understand our changing world. Writing is a bridge to the future (National Writing Project 2016).

Effective teachers use data

Another way to improve literacy and numeracy through teacher professional development is to ensure that teachers possess the technical expertise to make the best use of data and the evidence base. Research shows that effective teachers use data and other evidence to constantly assess how well students are progressing in response to their lessons (Timperley & Parr 2009). For example, a study by Timperley in 2009 showed that a professional development program for teachers that focused on the interpretation and use of assessment information resulted in student achievement gains accelerating at twice the expected rate. For all schools that focused on writing, the average effect size was 1.20; and for reading, 0.92. Gains were found to be greatest for the lowest-performing 20 per cent of students: effect sizes were 2.25 in writing and 1.90 in reading for these students.

⁵ While the effect sizes for writing-to-learn were small by Hattie's definitions, it is worth noting Slavin's (2016) argument that small effect sizes can still be well worth considering, depending on the study that generated them and the nature of the intervention.

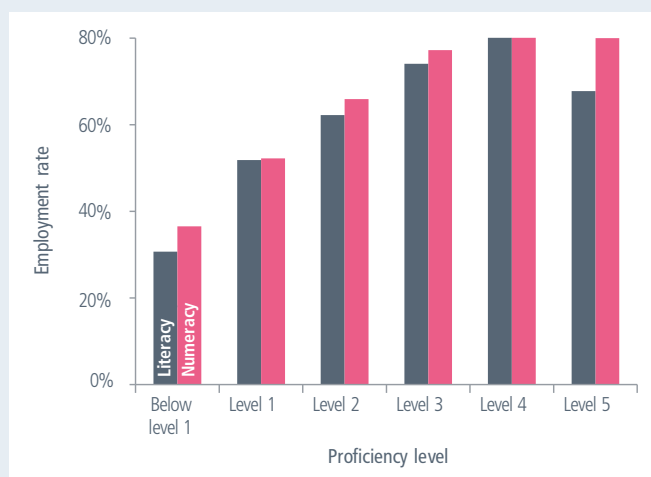
Another study focussed on NSW, showed that teachers who received training on the effective use of data as part of the National Partnership on Literacy and Numeracy reported a greater understanding of data analysis tools and techniques, leading to changes in their classroom practice. Eighty-one per cent of survey respondents said that this training had led to more effective classroom teaching of literacy and numeracy (Erebus International 2011).

The importance of literacy and numeracy to individuals and society

It is essential that students gain a fundamental understanding of basic literacy and numeracy skills at school. If they do not, individuals are at risk of not being able to participate fully in society, and society as a whole is at risk of poorer outcomes. Literacy and numeracy skills underpin workforce participation, productivity and the broader economy, and can also impact on social and health outcomes. As the National Foundation Skills Strategy for Adults (Department of Industry 2013) states, 'people with higher language, literacy and numeracy skills are more likely to be employed, participate in their community, experience better health and engage in further training' (p. 2). Graham and Perin (2007) similarly say that literacy is a 'basic requirement for participation in civil life and in the global economy' and that the ability to read, comprehend and write is 'tantamount to a survival skill'. Improved literacy and numeracy skills also have a generational flow-on effect with research showing that parents transfer improved literacy and numeracy skills to their children (Skills Australia 2010; National Research and Development Centre for Adult Literacy and Numeracy 2006).

The following section looks at the effect that improved literacy and numeracy skills have on employment outcomes, the economy, social outcomes, health outcomes and involvement in crime. While the research draws links between literacy and numeracy skills and various outcomes, it is important to note that the causal relationship is complex and it can sometimes be difficult to isolate the impact of literacy and numeracy skills from other factors, such as socioeconomic status and cultural background.

Figure 5: Association with literacy and numeracy and employment, Australia



Source: Centre for Education Statistics and Evaluation, analysis of 2012 PIAAC data

Employment outcomes

Foundation skills, such as literacy and numeracy, are essential for preparing and applying for work, and are also increasingly in demand by employers (OECD 2015). As the OECD Skills Outlook report 2015 states, 'Young people who leave school before they achieve a sufficient level of proficiency in literacy and numeracy find it difficult to enter the labour market' (p. 33).

Results from the Program for the International Assessment of Adult Competencies (PIAAC) 2012 Survey of Adult Skills⁶ suggest there is a positive relationship between literacy and numeracy and employment outcomes. In Australia, approximately 82 per cent of respondents who scored at Level 4/5 in reading literacy were employed, compared with only 56 per cent of those scoring at or below Level 1 (OECD 2013a) (Figure 5). Further, a median earner with Level 4/5 reading literacy proficiency earns approximately USD12 more per hour than a median earner with Level 1 proficiency (OECD 2013a).

The demand for literacy and numeracy skills in the workplace has also increased with the emergence of the knowledge economy⁷ and the increasing role of information and communication technologies (ICT) (National Centre for Vocational Education Research 2007; Department of Industry 2013). As The National Foundation Skills Strategy for Adults (Department of Industry 2013) states: 'the trend away from low-skilled to knowledge-based work has increased the need for workers with stronger LLN [language, literacy and numeracy] skills' (2013 p. 7). The strategy also notes that ongoing technological developments have enhanced the need for continual skill development.

Economic impact

There is increasing recognition that in modern societies, a country's educational levels are a predictor of its potential for economic growth (OECD 2009; Skills Australia 2010). For example, Coulombe et al. (2004, cited by Skills Australia⁸ 2010) in a study that used 1960-1995 data from 14 OECD countries, found a one per cent higher national literacy score is associated with 2.5 per cent higher labour productivity and thus an associated increase in GDP per capita.

Literacy and numeracy skills are particularly important for productivity as they provide the foundation to develop other skills:

The basic skills acquired in early childhood and school years, particularly literacy and numeracy, are the necessary foundation for developing higher order skills that contribute to a more productive workforce (Treasury 2010, cited by Productivity Commission 2014).

In Australia, industry groups have consistently expressed concern about poor foundation skills across the workforce and resulting costs to industry (Department of Industry 2013). For example, in a survey conducted by the Australian Industry Group (2010) of employers from 338 companies, 75 per cent of respondents reported that their business was affected by low levels of literacy and numeracy. The most commonly cited issues were poor completion of workplace documents, having to re-do tasks and the waste of materials due to incorrect calculations or misinterpreted instructions. This issue has also been seen internationally.

⁶ PIAAC assesses the proficiency of adults from age 16 onwards in literacy, numeracy and problem solving in technology-rich environments. The survey assesses an individual's proficiency in literacy, numeracy and problem solving in technology-rich environments. The most recent survey was conducted in Australia from October 2011 to March 2012, with a total of 7,430 Australians aged 16-65 taking part.

⁷ A knowledge-based economy relies primarily on the use of ideas rather than physical abilities and on the application of technology rather than routine or unskilled labour.

⁸ Now part of the Australian Government Department of Industry.

The US National Commission on Writing notes that the majority of both public and private employers say that writing proficiency has become critical in the workplace and that it directly affects hiring and promotion decisions (cited in Graham & Perin 2007).

Social outcomes

Literacy and numeracy skills are vital for creating and maintaining an inclusive, equal society (Adams 2009). Poor literacy and numeracy skills can limit a person's ability to perform a range of every-day activities, such as using a computer, reading recipes or timetables or communicating via email or text message (World Literacy Foundation 2015; Department for Business, Innovation and Skills 2012). These skills can also affect an individual's ability to access government services and information, particularly as many of these services move online (OECD 2015). This, in turn, can prevent a person from fully participating in their community (Adams 2009).

The Survey of Adult Skills (PIAAC) 2012 collected information on social outcomes including the level of trust in others; political efficacy or the sense of influence on the political process; and participation in volunteering activities. Across the participating countries, reading literacy proficiency was found to have a positive relationship with all of these outcomes, even when the effects of education, socio-economic background, age, gender and immigrant background had been taken into account (OECD 2013b).

The link between higher reading literacy and these social outcomes is stronger in Australia than in most OECD countries according to the PIAAC survey (Figure 6). Results for Australia indicate:

- those scoring at or below Level 1 in literacy were more than three times as likely as those with a high level of literacy to report that they do not participate in volunteer activities
- those scoring at or below Level 1 in literacy were almost three times more likely to report low levels of trust in others
- those scoring at or below Level 1 in literacy were about two and a half times more likely to report low levels of political efficacy (OECD 2013b).

Similar results were reported in a paper by the National Endowment for the Arts (2007) in the United States. Using data from the 2002 Survey of Public Participation in the Arts and

the National Assessment of Adult Literacy (2003), the report analysed the relationship between reading literacy skill level and civic participation, such as volunteering and engagement with current affairs. Results showed 35 per cent of those at a proficient reading literacy level accessed information from the newspapers 'a lot', compared with 20 per cent of those at the below basic level. The authors also found voting activity increased in relation to reading literacy level, with 84 per cent of those with proficient reading level voting compared with 62 per cent at basic and 53 per cent of those at below basic levels.

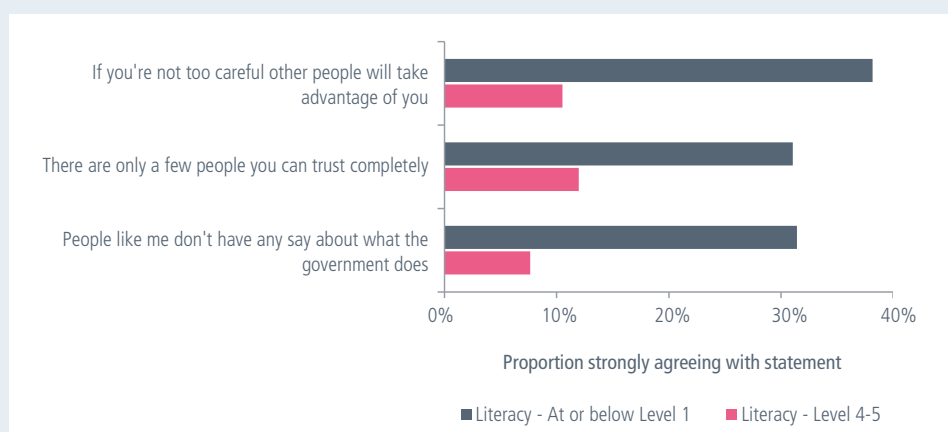
Health outcomes

According to the literature, educational attainment can impact on an individual's health in a number of ways. For example, education can influence employment prospects and income, which can in turn affect the options available to individuals to improve or maintain their health (i.e. money available for dental care). Education can also play a role in influencing behaviour, including reducing health risks such as tobacco smoking and alcohol consumption (Australian Bureau of Statistics 2009). Numeracy skills, in particular, can affect an individual's ability to understand risk-benefit information, such as deciding between treatment options or assessing the needs for different tests (i.e. frequency of mammography screening) (Peters et al. 2007).

Results from the Survey of Adult Skills (PIAAC) 2012 indicate a link between higher reading literacy and numeracy skills and better health (Figure 7). For example, those scoring at or below Level 1 in literacy were more than two times as likely as those with a high level of reading literacy to report that they are in fair or poor health. This trend was apparent even when examining individual age groups.

A report by the Department for Business, Innovation and Skills (2012a) in the United Kingdom reached similar conclusions. The report used data from the British Cohort Study, which included self-rated health at age 34 and 38, and then compared this to results from a reading literacy and numeracy assessment undertaken when the participants were aged 34. The analysis found that poor adult numeracy skills are associated with deteriorating self-rated health between ages 34 and 38 for men and women. They also found that adults with lower reading literacy and numeracy skills were consistently more likely to report that their health status limited their daily activities.

Figure 6: Association between reading literacy and trust and political efficacy



Source: Centre for Education Statistics and Evaluation, analysis of 2012 PIAAC data.

Involvement in crime

Research evidence suggests there is a relationship between education, skills and criminal activity, although most of the research in this area focusses on educational attainment rather than literacy and numeracy skills specifically. It can also be particularly difficult to isolate the effect of literacy and numeracy skills from other factors, such as gender, socioeconomic background, culture and age, when it comes to crime (National Centre for Vocational Education Research 2006).

A study published by the Basic Skills Agency (2002) used data drawn from two groups of British adults born in 1958 (National Child Development Study) and 1970 (British Cohort Study) to explore the association between basic skills and self-reported police contact and offending. The data was collected through a self-completion questionnaire in 1999 and 2000, when the adults were aged 42 and 30 years old respectively. Results were analysed against the literacy and numeracy skills of participants who had been assessed at an earlier time. It was found that, after controlling for factors such as social disadvantage and low educational attainment, poor reading literacy or numeracy skills were associated with an increased risk of being stopped and questioned or arrested by the police on a repeated basis.

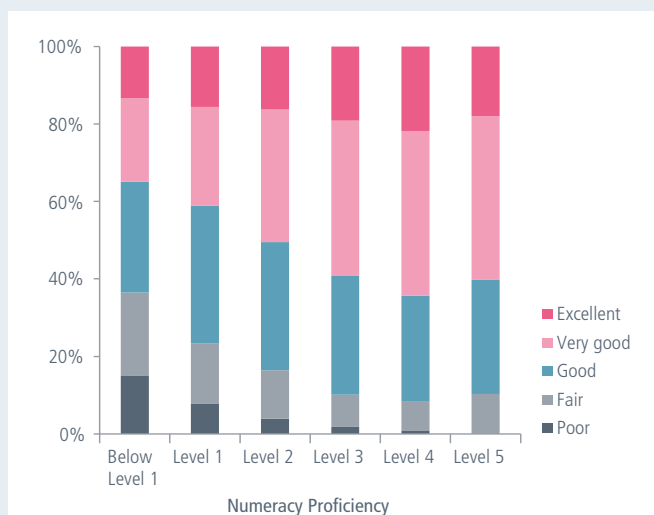
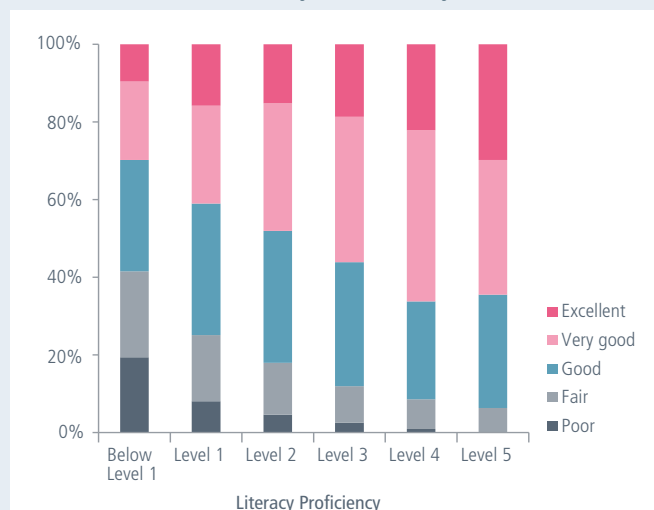
The NSW Young People on Community Orders – Health Survey 2003-2006 also found young offenders perform well below

average in all forms of educational achievement (Attorney General & Justice 2012). The sample comprised 683 males and 119 females, with a mean age of 16 years and 6 months. Many participants scored in the borderline or below average ranges on both the cognitive and academic tests. The reading skills of 21 per cent and the arithmetic skills of 64 per cent of young offenders were equivalent to those expected of people with intellectual disabilities (Figure 8). The results suggest that, compared to other adolescents, many young people on community orders have difficulty comprehending, communicating and problem solving using language or numbers.

Conclusion

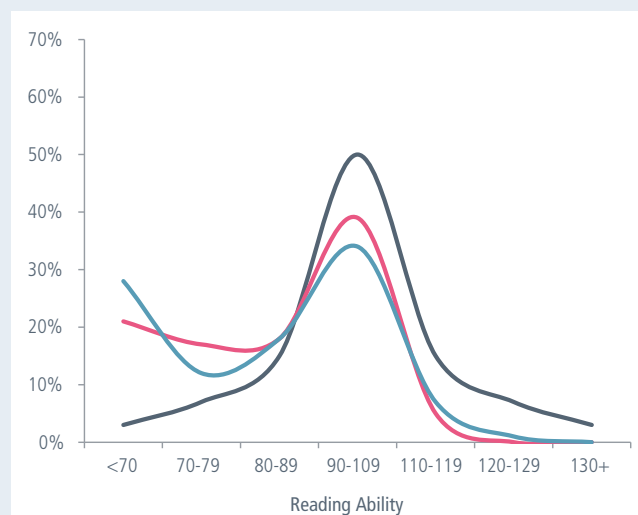
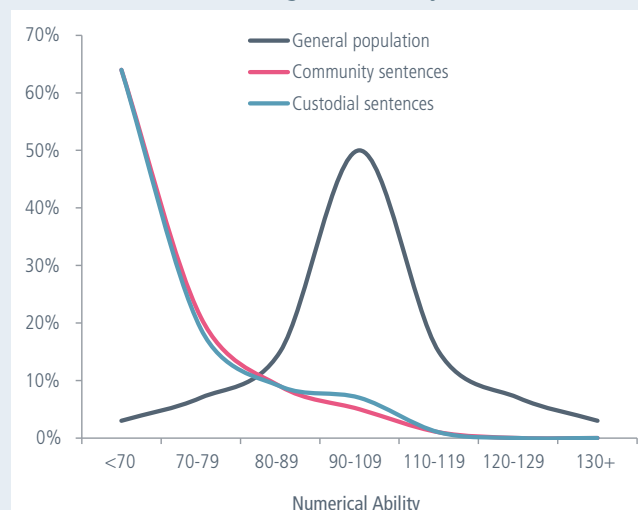
The teaching of literacy and numeracy is a core responsibility of schools. There are a number of evidence-based practices schools can employ to improve literacy and numeracy outcomes for students. These include knowing what students can do and targeting teaching accordingly; having clear and transparent learning goals at both the school and classroom level; and focusing on teacher professional learning that improves the teaching of literacy and numeracy. Effective literacy and numeracy skills are important for both individuals and the population as a whole to meet the demands of modern workplaces, increase productivity, undertake day-to-day tasks and engage meaningfully with the community.

Figure 7: Self-reported health status by proficiency in literacy and numeracy



Source: Centre for Education Statistics and Evaluation analysis of 2012 PIAAC data

Figure 8: Performance of young people on tests of reading and numeracy




Source: Attorney General & Justice 2012, Youth on Track: Projected Volumes and Needs

References

- Adams, D 2009, *A Social Inclusion Strategy for Tasmania*.
- Adams, G and Englemann, S 1996, *Research of direct instruction: 25 years beyond DISTAR*, Educational Achievement Systems, Seattle.
- Attorney General & Justice 2012, *Youth on Track: Projected Volumes and Needs*.
- Australian Bureau of Statistics 2009, *Health literacy*, viewed 1 December 2015, <<http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Main+Features20June+2009>>
- Australian Council for Educational Research 2006, *Growth in literacy and numeracy in the first three years of school*, report prepared by M Meiers, S Khoo, K Rowe, A Stephanou, P Anderson and K Nolan.
- Australian Industry Group 2010, *National Workforce Literacy Project*.
- Bangert-Drowns, R, Hurley, M and Wilkinson, B 2004, 'The effects of school-based writing-to-learn interventions on academic achievement: A meta-analysis', *Review of Educational Research*, vol. 74, no. 1.
- Bernhold, S, Neumann, K and Nentwig, P, 2012, *Making it tangible: Learning outcomes in science education*, Waxmann.
- Black, P and Wiliam, D 1998, *Inside the black box: Raising standards through classroom assessment*.
- Campbell F and Ramey C 2002, 'Early Childhood Education: Young Adult Outcomes from the Abecedarian Project', *Applied Developmental Science*, vol. 6, no. 1, pp. 42-57.
- Centre for Education Statistics and Evaluation 2014, *The elements of effective professional development*.
- Centre for Education Statistics and Evaluation 2015a, *Six effective practices in high growth schools*, learning curve.
- Centre for Education Statistics and Evaluation 2015b, *Effective leadership*, learning curve.
- Council of Chief State School Officers 2008, *Learning Progressions: Supporting Instruction and Formative Assessment*, prepared by M Heritage.
- Council of Chief State School Officers 2009, *Effects of teacher professional development on gains in student achievement: How meta analysis provides scientific evidence useful to education leaders*, report prepared by R Blank and N de las Alas.
- Department for Business, Innovation & Skills 2012, *The 2011 Skills for Life Survey: A Survey of Literacy, Numeracy and ICT Levels in England*, research paper.
- Department for Business, Innovation & Skills 2012a, *The Contribution of Basic Skills to Health Related Outcomes During Adulthood: Evidence from the BCS70*, research paper.
- Department of Industry 2013, *National Foundation Skills Strategy for Adults*.
- Economic Policy Institute 2004, *Exceptional Returns: Economic, Fiscal and Social Benefits for Investment in Early Childhood Development*, report prepared by R Lynch.
- Education Endowment Foundation 2015a, *Early literacy approaches*, viewed 9 February 2016, <<https://educationendowmentfoundation.org.uk/toolkit/early-years/early-literacy-approaches/>>
- Education Endowment Foundation 2015b, *Early numeracy approaches*, viewed 9 February 2016, <<https://educationendowmentfoundation.org.uk/toolkit/early-years/early-numeracy-approaches/>>
- Erebus 2016, *Evaluation of the NSW Literacy and Numeracy Action Plan: 2015 Progress Report*.
- Erebus International 2011, *Evaluation of the take-up and sustainability of new literacy and numeracy practices in NSW schools*, final report of phase 1, report prepared by T Wyatt and R Carbines.
- European Expert Network on Economics of Education 2012, *The Case for Investing in Disadvantaged Young Children*, policy brief, report prepared by J Heckman.
- Fontana, D and Fernandes, M 1994, 'Improvements in mathematics performance as a consequence of self-assessment in Portuguese primary school students', *British Journal of Educational Psychology*, vol. 64, no. 3
- Fortus, D and Krajcik, J 2011, 'Curriculum coherence and learning progressions', in Fraser, B, Tobin, K, and McRobbie, C (eds) *Second International Handbook of Science Education*, Springer, Netherlands.
- Glossary of Education Reform 2013, *Learning Progression*, viewed 23 May 2016, <<http://edglossary.org/learning-progression/>>
- Graham, S, Herbert, S and Harris, K 2015, 'Formative assessment and writing: A meta-analysis', *Elementary School Journal*, vol. 115, no. 4.
- Graham, S and Perin, D 2007 *Writing next: Effective strategies to improve writing of adolescents in middle and high schools – A report to Carnegie Corporation of New York*, Alliance for Excellent Education, Washington DC.
- Grattan Institute 2015, *Targeted teaching: How better use of data can improve student learning*, report prepared by P Goss and J Hunter.
- Hattie, J 2009, *Visible Learning: A synthesis of over 800 meta-analysis relating to achievement*, Routledge, London and New York.
- Hattie, J and Yates, G 2014, *Visible learning and the science of how we learn*, Routledge, London and New York.
- Highscope Press 2004, *The High Scope Perry Preschool Study through age 40: Summary, conclusions and frequently asked questions*, report prepared by L Schweinhart, J Montie, Z Xiang, W Barnett, C Belfield and M Nores.
- Hillocks, G 1987, Synthesis of research on teaching writing. *Educational Leadership*, vol. 44, no. 8.
- Institute of Education Sciences 2009, *Assisting students struggling with struggling with mathematics: response to intervention for elementary and middle schools*, report prepared by R Gersten, S Beckmann, B Clarke, A Foegen, L Marsh, J Star and B Witzel.
- Jordan, N, Kaplan, D, Locunlak, M and Ramineni, C 2007, 'Predicting first grade math achievement from developmental number sense trajectories', *Learning Disabilities Research and Practice*, vol. 22, no. 1, pp. 36-46.
- Karpinski, A and D'Agostino, J 2013, 'The role of formative assessment in student achievement', in Hattie, J and Anderman, E (eds), *International Guide to Student Achievement*, Routledge, New York and London.

- Louden, W, Rohl, M, Barratt Pugh, C, Brown, C, Cairney, T, Elderfield, J, House, H, Meiers, M, Rivalland, J and Rowe, K 2005, *In teachers' hands: Effective literacy teaching practices in the early years of schooling*, Edith Cowan University, Mount Lawley.
- National Centre for Vocational Education Research 2006, *Social and economic benefits of improved adult literacy: Towards a better understanding*, report prepared by R Hartley and J Horne.
- National Centre for Vocational Education Research 2007, *Thinking beyond numbers: Learning numeracy for the future workplace*, report prepared by B Marr and J Hagston.
- National Center on Educational Outcomes 2012, *Learning Progressions in K–8 Classrooms: How Progress Maps Can Influence Classroom Practice and Perceptions and Help Teachers Make More Informed Instructional Decisions in Support of Struggling Learners*, synthesis report 87, report prepared by K Hess.
- National Endowment for the Arts 2007, *To Read or Not to Read*, research report.
- National Research and Development Centre for Adult Literacy and Numeracy 2006, *New light on literacy and numeracy, summary report*, prepared by J Bynner and S Parsons.
- National Writing Project 2016, *About National Writing Project*, viewed 21 July 2016, <<http://www.nwp.org/cs/public/print/doc/about.csp>>
- New Zealand Ministry of Education 2007, *Evaluation of the Literacy Professional Development Project*, report prepared by S McDowall, M Cameron, and R Dingle.
- New Zealand Ministry of Education 2008, *Teacher professional learning and development: Best evidence synthesis on professional learning and development*, report prepared by H Timperley, A Wilson and H Barrar.
- New Zealand Ministry of Education 2010, *Making a difference to student achievement in literacy: Final research report on the Literacy Professional Development Project*, report prepared by H Timperley, J Parr, K Meissel and P O'Connell.
- NSW Department of Education and Communities 2012, *Early Action for Success: Implementing the NSW Literacy and Numeracy Action Plan*.
- Organisation for Economic Cooperation and Development 2013a, *Australia Country Note*.
- Organisation for Economic Cooperation and Development 2013b, *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*.
- Organisation for Economic Cooperation and Development 2015, *Adults, Computers and Problem Solving: What's the Problem?*.
- Peters, E, Hibbard, J, Slovic, P and Dieckmann, N 2007, 'Numeracy Skill and the Communication, Comprehension, and Use of Risk-Benefit Information', *Health Affairs*, vol. 26, no. 3, pp. 741-748.
- Popham, J 2007, 'All about accountability/The lowdown on learning progressions', *Educational Leadership*, vol. 64, no.7, pp. 83-84.
- Productivity Commission 2014, *Literacy and Numeracy Skills and Labour Market Outcomes in Australia*, staff working paper, prepared by A Shomos and M Forbes.
- PTR Consulting 2012, *Linking effective professional learning with effective teaching practice*, prepared by P Cole.
- Robinson, V, Lloyd, C and Rowe, K 2008, 'The impact of leadership on student outcomes: An analysis of the differential effects of leadership types', *Educational Administration Quarterly*, vol. 663.
- Scher, L and O'Reilly, F 2009, 'Professional development for K-12 math and science teachers: What do we really know?', *Journal of Research on Educational Effectiveness*, vol. 2, no. 222.
- Sedita, J 2013, 'Learning to write and writing to learn', in M, Hougen, *Fundamentals of literacy instruction and assessment: 6-1*, Brookes, Baltimore.
- Skills Australia 2010, *Australian Workforce Futures*, a National Workforce Development Strategy.
- Slavin, R 2016, *Robert E. Slavin blog in the Huffington Post*, viewed 6 June 2016, <<http://www.huffingtonpost.com/robert-e-slavin>>
- The Institute of Education 2004, *The Effective Provision of Pre-School Education (EPPE) Project Final Report*, report prepared by K Sylva, E Melhuish, P Sammons, I Siraj-Blatchford and B Taggart.
- The Basic Skills Agency 2002, *Findings from a study of adults born in 1958 and 1970*, prepared by S Parsons.
- Timperley, H 2009, 'Using assessment data for improving teaching practice', *Paper presented at the Australian Council for Educational Research Conference*, 16-18 August, Perth.
- Timperley, H and Parr, J 2009, 'Chain of Influence from policy to practice in the New Zealand literacy strategy', *Research Papers in Education*, vol. 24, no.2, pp. 135-154.
- Torgesen, J and Burgess, S 1998, 'Consistency of reading-related phonological processes throughout early childhood: Evidence from longitudinal-correlational and instructional studies', in JL Metsala & LC Ehri (eds), *Word recognition in beginning literacy*, Earlbaum, New Jersey, pp. 161-188.
- Vacca, R, Vacca, J, Mraz, M 2011, *Content Area Reading: Literacy and Learning Across the Curriculum*, 10th edn, Pearson.
- Valiandes, S 2015, 'Evaluating the impact of differentiated instruction on literacy and reading in mixed ability classrooms: Quality and equity dimensions of education effectiveness', *Studies in Educational Evaluation*, vol. 45.
- Wagner R, Torgesen J, Rashotte C, Hecht S, Barker T, Burgess S, Donahue J and Garon, T 1997, 'Changing relations between phonological processing abilities and word-level reading as children develop from beginning to skilled readers: A 5-year longitudinal study', *Developmental Psychology*, vol. 33, no. 3, pp. 468-479.
- World Literacy Foundation 2015, *The Economic & Social Cost of Illiteracy*, final report.

Centre for Education Statistics and Evaluation
GPO Box 33
Sydney NSW 2001
Australia

 02 9561 1211

 cese@det.nsw.edu.au

 www.cese.nsw.gov.au

© NSW Department of Education
August 2016



Education
Centre for Education
Statistics & Evaluation

