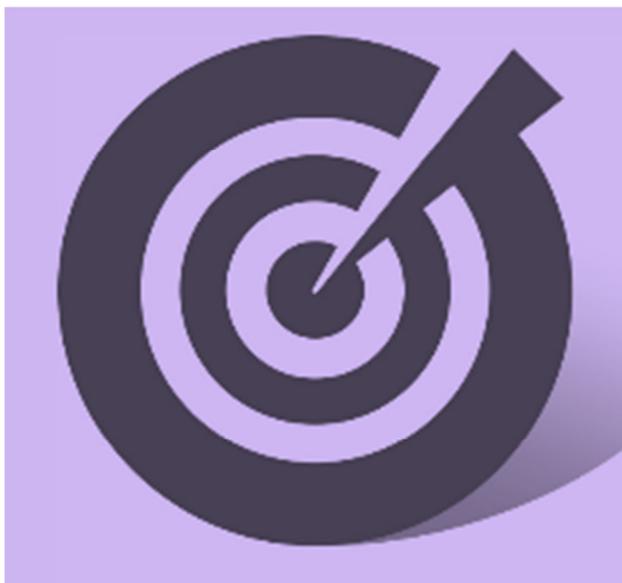


Performance and Past Research



Gender Differences in Years 6-7 literacy and numeracy Transition Outcomes

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Performance and Past Research

For a number of decades gender issues in education have been at the forefront of interest for parents, schools, education authorities and researchers. Persistent gender economic inequalities have driven investigation into the differences for girls' outcomes in school and tertiary education mathematics, science and technology. The gender focus has widened in the past decade to include educational disadvantage that boys experience. While there has been a growing perception in Australia that girls are becoming more successful in pursuing their educational goals, concern has grown that boys are experiencing comparatively poorer literacy educational outcomes and this negatively affects retention in the last years of secondary education.

This research overview is focussed on gender-based differences in literacy and numeracy achievement in school, with a particular focus on the middle years of schooling, particularly the transition from primary to secondary school. The research overview's purpose is to inform the evaluation framework, the data collection tools and the interpretation of findings for the DET project *Gender Based Differences in Year 6-7 Transition Outcomes*.

Note that the overview does not review transition literature. Instead, the project will be leveraging off the findings from prior action research for the DET project *Transition: Improved Literacy and Numeracy Outcomes (Professional Barriers 2015)*¹ where perspectives and experiences are analysed for successfully responding to the barriers to effective literacy and numeracy transition.

Research selected for review comprises empirical studies of a sufficient scale to be meaningful in a policy context and are relevant in Victoria's environment.

There are three components to the research overview:

- the patterns of students' performance related to gender
- explanations of why there are gender differences in numeracy and literacy
- strategies that are proposed to redress the gender gaps.

A synopsis of past research is below, followed by a more detailed discussion of findings and an explanation of the evaluation framework underpinning the research into classroom practices in Victorian secondary schools and their feeder primary schools.

¹ See www.education.vic.gov.au/Documents/.../transition/Toolkit_TransitionClusters.docx

Synopsis of past research

Performance and gender

Internationally and in Australia the overall pattern of gender difference is generally consistent, although findings are mostly qualified. The broader context is that Australia's overall performance has so-called flat lined and that improvements are therefore being sought across the board for both boys and girls, including in the higher bands of performance and in lower socio-economic groups

- Girls outperform boys in reading and writing – although in Victoria the difference is not large when considering mean performance
- Boys outperform girls in mathematics in some instances – the nature of the gap varies and is most apparent among high performers; but some data do not show a gap
- The gap between girls and boys in reading is greater than the between boys and girls in mathematics
- Boys' poor reading links with poor engagement in learning and the risk of leaving school early
- Girls are more likely than boys to express high anxiety about mathematics even when they achieve at the same or at a higher level than boys
- Girls are less likely to choose senior studies in mathematics even when they achieve at the same level or are better than boys.

Why is this happening

There are complex, diverse and some contested explanations

- There is consensus that differences do not arise from innate differences in abilities but from factors such as attitudes (e.g. parent and community expectations about boys' strengths), behaviours, sense of intrinsic and extrinsic value (i.e. do girls see maths as worth doing), engagement with learning and learning patterns
- However, factors other than gender and outside the immediate impact of classroom and school (e.g. socio-economic background, ethnicity, location, social expectations) may be equally or more important in explaining the gaps in performance
- *For boys and literacy* – their capacities may not be sufficiently engaged in learning and they do not consistently have opportunities for building a positive self-belief
- *For girls and numeracy* – they tend to be more afraid of mathematics as they move through school, see less intrinsic value in it and prefer other activities.

Strategies for success

The evidence base for proven education strategies is variable and as yet lacking major recommendations that are backed with a 'strong' body of evidence.

Solutions summarised by the OECD reflect those from Australian research and revolve around understanding the behavioural and attitudinal differences between boys and girls

- *For boys and literacy*– give them a greater choice and ensure enjoyment is a priority; emphasise the value of reading but also allow video games etc. and out of classroom activities
- *For girls and mathematics* – build girls self-confidence; evaluating girls' actual abilities – noting the tasks they accomplish relatively easily and those with which they struggle; use strategies that equip girls with problem solving techniques, including the time to think and rehearse solutions; build a sense of math's intrinsic and extrinsic value
- Train teachers to be aware of gender bias and how to help students look ahead and be aspirational.

Importantly, most research concludes that strategies have to be based on high quality teaching that attends to the individual learning and social needs of students through an orderly, supportive and stimulating learning environment. The focus needs to be primarily on individual need not the assumed needs of groups.

1. Performance patterns and gender

1.1 Victorian Auditor General – focus on boy’s literacy and engagement with learning

The VAGO report (2015) comments that NAPLAN results show that in Victorian Government school the percentage of students assessed as being 'at or above' the minimum standard in reading and numeracy tests has improved from 2010 to 2014 for students transitioning from primary to secondary school. However, performance in writing assessments (in red below) has dropped in each year as students' transition from primary to secondary school. Specifically,

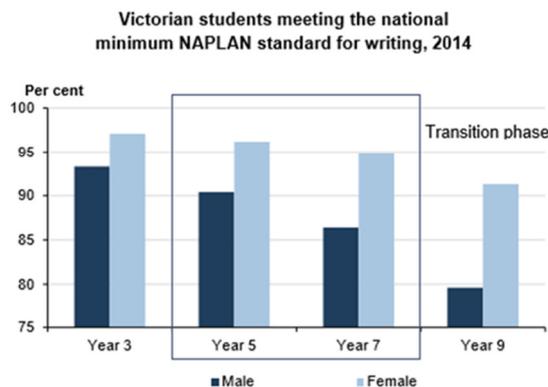
- the gaps in performance in numeracy and reading between Year 5 and Year 7 have changed little over the past five

Percentage of students meeting the national minimum NAPLAN standards

	Reading		Numeracy		Writing	
	Year 5	Year 7	Year 5	Year 7	Year 5	Year 7
2010	91	93	94	94	92	89
2011	91	94	93	94	91	87
2012	90	92	93	93	92	89
2013	95	92	93	94	92	87
2014	92	92	92	93	90	87

Source: Victorian Auditor-General's Office based on NAPLAN results for students at government schools, provided by DET.

- boys' writing performance declines at a far faster rate than their female peers as they progress through school. This is particularly notable following the transition to secondary school.



Source: Victorian Auditor-General's Office based on NAPLAN results provided by the Australian Curriculum, Assessment and Reporting Authority.

However, while there is a continuing gap between boys and girls writing in Victoria, a national comparison of Victoria's performance (all schools) shows that, at both years 5 and 7, NAPLAN scores for Victorian boys' writing (2014, 2015) are comparatively better than other jurisdictions. Of all jurisdictions Victoria has the lowest proportion of students performing at or below the national minimum standard. This should also be seen in the broader context of the general and sobering conclusion that Australia's NAPLAN performance has so-called flat lined and that improvements have been positive for Victoria 2013-2016 but slight.

The gender dimensions of suspensions from school are another factor raised by the Auditor-General.

Very few children are suspended from school during their primary years. However, immediately following the transition to secondary school the number of suspensions increases dramatically. Notably, the vast majority of secondary school suspensions are boys. Whilst the reasons for and the length of the suspensions are not indicated, VAGO suggests that this is further evidence of the need for more gender-specific education strategies. The current pattern of suspensions has remained consistent in recent years.

Data on whether students feel connected to school and are stimulated by the school's learning environment reveals significant differences in girls' and boys' attitudes. DET's Attitude to School Survey asks children in Years 5 to 12 about their experiences at school and includes assessments of how stimulated students are by their learning environment and how connected they feel to the school.

Both of these indicators decline significantly following transition into Year 7 and over the past five years the overall pattern of performance reveals that Year 7 girls' scores were significantly more positive than Year 7 boys' scores on the factors of connectedness to school and peer; student motivation; and student morale.

In summary, the key arguments from VAGO for addressing gender differences, including in the transition years stem from data about the poor attitudes and performance of boys. Specifically, VAGO was concerned:

- that boys' writing scores deteriorate faster than girls as they progress to Year 9 (Note that the writing test varies at the discretion of ACARA between narrative and persuasive writing)
- with the significant increase in suspensions from years 6 to 7 and boys' greater proportion of suspensions than girls' in Year 7 (and every year), and
- that boys have a weaker attachment to schooling and lower motivation than girls.

1.2 Gender gaps: International performance patterns

International tests are important sources of comparative data and this section draws on: OECD Program for International Student Assessment (PISA); Trends in International Mathematics and Science Study (TIMSS) and Progress in International Reading Literacy Study (PIRLS). These assessments have different emphases and results are often not fully consistent but the perspectives on gender are highly informative.

The broader context for Australia's gender performance at age 15 years is that while the OECD averages for mathematics and reading have remained stable, Australia's mean performance has declined in mathematics from 2003 to 2012 (by 20 points which is around six months) and declined in reading from 2000 to 2012 (by 16 points on average or approximately 5 months). The 2015 PISA results indicate a similar decline (Thompson et al 2016a)

In jurisdictional comparisons however Victoria's reading performance has not changed 2000 to 2015 nor has performance in mathematics changed 2003 to 2012.

On gender differences, PISA data (OECD 2015) show that across OECD countries 15 year old boys are more likely than girls to be low achievers. In PISA 2012 14 percent of boys compared with 9 percent of girls did not attain the baseline measure of proficiency in reading, mathematics. (For science, which is not being considered in this review, gender differences are only slight.)

TIMSS/PIRLS data (TIMSS 2015 and PIRLS 2011) show that female students perform at a significantly higher level in literacy in the majority of countries; in mathematics gender differences are small on average at the Year 4 level but somewhat larger in favour of boys by Year 8. (For science, gender differences are not that noticeable at Year 4 but, unlike PISA, by Year 8 are very mixed with boys performing better in a number of countries, including Australia. This has been apparent in Australia in each assessment since 1995.

Literacy differences

Internationally

- Girls outperform boys in reading in every OECD country with a consequential impact on other areas of learning – the average gap is equivalent to one year's worth of schooling.
- A closer look at boys and reading shows that a large share of the gap may stem from how much boys and girls engage in and enjoy reading – if boys enjoyed reading to the same level as girls they would gain around one year's worth of schooling.
- However, average gender differences can mask the gender gaps that are more noticeable among low and high achieving students
- In reading the gender gap is much wider among underperforming students as there are many more boys lacking basic skills than there are girls
- In PIRLS assessments students who indicated that they liked reading scored higher on the assessments than students who indicated they did not like the area. Students who felt confident in a study area also scored higher – boys like mathematics and feel more confident and girls feeling more confident in reading.

For Australia

- PISA data show that the mean performance for literacy between girls and boys at age 15 years old represents approximately one year of schooling (Thompson et al 2013).
- On PIRLS data for Australia (Thompson and Hillman et al 2012), female students achieve at a higher level than boys in reading (around a gap of 6 months) and a higher proportion of girls achieve at an advanced level
- Australia's gender gap in reading in PISA 2012 is slightly smaller than the OECD average

Numeracy differences

Internationally

- On the whole, gender differences in mathematics are not that marked as for literacy
- Boys outperform girls in mathematics in just over half of OECD countries; but in five countries girls outperform boys and in 25 countries there is no significant difference. The gaps are narrower than for reading and the gaps are greatest among the highest achieving students.
- A closer look at girls' performance in mathematics shows that they underachieve compared with boys when asked to think mathematically and translate problems into mathematical expressions.
- In mathematics, the gender gap is negligible among underperforming students however, the gap between boys and girls increases to around a third of a year of schooling among the high performing students.

- Girls, even high achieving girls are more likely to express strong feelings of anxiety towards mathematics

For Australia

- An analysis of PISA results showed that in 2003 there was not a significant difference between boys and girls in mathematics but by 2009 Australian boys scored 10 points higher (around 4 months) than girls.
- Between PISA 2003 and PISA 2012 Australia's mathematical literacy performance declined more for girls than it did for boys. While the overall PISA mathematics score for Australia is still higher than the OECD average, the score for girls dropped so it is close to the OECD average.
- However, on 2011 TIMSS data (Thompson and Hillman et al 2012,) for Australia, in mathematics on average there was no significant gender difference at Year 4 or Year 8 but in 2015 the difference between boys and girls at Year 4 in Victoria is small but significant and the widest of all jurisdictions (Thompson et al 2016b). Performance at Year 8 remains as before with no significant difference between boys and girls.
- More boys in TIMSS reach the High and Advanced benchmarks at Year 4 in 2015; there are no differences at Year 8.
- In TIMSS, students who indicated that they liked reading and mathematics scored higher on the assessments than students who indicated they did not like the area. Students who felt confident in a study area also scored higher. The gender pattern was consistent with boys liking mathematics and feeling more confident and girls liking reading.

For both literacy and numeracy in Australia, achievement was found to be higher in a school climate where students liked their school and felt they belonged; were engaged during lessons; felt they were safe; and were almost never bullied.

An interesting observation is that overall high performance by a country in PISA does not automatically mean there is a reduced gender gap. For example, Finland has high performance overall but one of the highest gender gaps in literacy in favour of girls and no statistically significant gap in mathematics; Korea is a high performing country but the gender gap in mathematics is larger than the OECD average in favour of boys and has one of the smallest gaps in literacy. In the high performing locations of Hong Kong, Singapore and Taipei girls are on a par with boys in mathematics and in reading and underperforming girls tend to score much higher than girls elsewhere.

1.3 Girls and numeracy: Further perspective on the pattern of performance

A number of research studies have examined international and local data, including NAPLAN, to look more closely at the gaps and associated factors between boys and girls in relation to numeracy and mathematics (e.g. Buckley, 2016; Forgasz 2011; Hill 2011; Justman and Mendez 2016; Kane and Mertz 2012; Cobb-Clark and Moshion 2015; Ryan 2016).

Overall, these studies suggest Australian female students are less engaged with mathematics; more likely to be outperformed by their male peers, particularly in the high SES categories and in the top bands of performance; less likely to pursue senior studies in mathematics; and less likely to choose career pathways that involve mathematics and science. But, the accounts of performance levels and analysis of explanations (see next section) are contested among teachers and researchers (Broadley 2016).

Findings and observations include the following.

- There is a consistent pattern since 2008 of males outperforming females in the top bands of NAPLAN numeracy tests that are conducted at years 3, 5, 7, and 9. (The proportion of girls at or above the national minimum standard is higher than boys.)
- In male and female performance on each NAPLAN item there are no questions on which 10 per cent or more females than males have correct answers, but there are many questions on which 10 per cent or more males than females give the right responses.
- There is a continuing decline in students studying mathematics and science at senior secondary level and the decline for females is greater than for males
- Even for those girls where achievement levels in mathematics are the same for boys, girls do not choose senior studies in mathematics at the same rate as boys.
- There are slight gender differences in mathematics at commencement of school and at Year 3 – where boys of a higher SES outperform high SES girls – but the gender gap becomes more evident by Year 8 and beyond.

Considering PISA and NAPLAN, the achievement results for Australian students reveal that the gender gap for mathematics has gradually increased over time in favour of males. Trends in International Mathematics and Science Study (TIMSS) 2011 find however that there is no significant gender difference at either Year 4 or Year 8.

Most studies make the important point that gender alone is not the only factor associated with the observed differences in mathematics performance. Socio-economic background in particular, along with geographic location, ethnicity, Indigeneity and societal expectations are contributing factors that interact with gender and may be of greater influence in different contexts.

1.4 Boys and literacy: Further perspective on the pattern of performance

Other studies elaborate on the extent of difference between boys and girls in literacy (e.g. Alloway et al 2002; Collins, Kenway and McLeod 2000; OECD 2015; Cobb-Clark and Moshion 2015).

- Many studies in OECD countries report that girls perform better than boys on some tests of literacy. While boys and girls tend to perform relatively evenly at the top of the performance range, boys' results are more likely to be spread across the performance range and to cluster more at the bottom, while girls' scores are more likely to cluster closer to the mean.
- Australian achievement data reveal that gender differences in favour of girls in literacy achievement are greater for the expressive modes of literacy (writing and speaking) than for the receptive modes (reading, listening and viewing).
- The greatest gender difference occurs in writing and the least for viewing.
- Even at Year 3 girls in low and middle SES families have an advantage in reading over boys – the gap in one study translates to three months disadvantage for boys. But there is no gap in reading among advantaged children at this level.
- This gender difference in achievement does not widen significantly between Year 3 and Year 5 and between Year 5 and Year 7.

Again, socio-economic status has an impact on the differences in literacy achievement between boys and girls as the differences in achievement are greater among students from low socioeconomic backgrounds than among students from other socioeconomic groups.

2. Explanations of gender differences

The findings from the literature about why there are gender differences in learning are complex and diverse. Most studies arrive at the conclusion that the inconsistencies in the patterns of achievement between boys and girls across different contexts make it unlikely that one unified theory will ever provide a compelling explanation of the overall relationship between gender and achievement (Cobb-Clark and Moshion 2015).

The OECD (2015) concluded from their analysis of PISA 2012 that the evidence is clear that gender disparities in performance do not stem from innate differences in aptitude but rather from students' attitudes to learning, their behaviours for learning, how they spend their leisure time and the confidence they have in their abilities as students.

Explanations of gender differences span a range of disciplines, reflecting the wide interest in the community as well as academia in understanding gender inequity and building strategies that combat gender inequities. Theories draw on psychology, neuroscience,² sociology, cultural theory and education (Buckley 2016). There are also analyses of the nature of gender differences that use econometric modelling of the data from achievement tests and surveys of contextual characteristics. While perspectives from these disciplines are important, the main category that this overview draws from is educational research – which in turn frequently draws on econometric modelling, developmental psychology and social theory and cultural studies when seeking explanations of 'unobserved factors' or the like that explain gender gaps.

The findings summarised below are grouped into three broad categories:

- *Attitudes and behaviours*: findings of similarities and differences in boys' and girls' attitudes and behaviours with respect to literacy and numeracy;
- *Intrinsic and extrinsic value*: findings about gender differences in recognising the inherent value and enjoyment to be gained from literacy and numeracy and the value for later life and employment; and
- *Engagement in learning*: findings about gender differences in engagement with learning.

(All findings are for Australian students, except where otherwise indicated.)

2.1 Attitudes and behaviours

A substantial body of work concludes that gender differences in performance relate closely to differences in attitudes and behaviours for boys and girls in relation to literacy and numeracy. (Alloway et al 2002; Justman and Mendez 2016; McPhan et al 2006; Munns et al 2006; OECD 2012; Watt 2004; Watt 2006; Watt et al 2012; Yeung and Curwood 2015;

² Neuroscience is influential in the analysis of gender differences and some teaching texts refer to different male and female brain functioning as the starting point for pedagogy. Buckley (2016) reviews the evidence and advises of the ethical implications of a simplistic interpretation of differences between male and female brain functioning and the need instead to understand the multiplicity of influencing factors including evidence around brain plasticity and the potential for change through training.

Fredericks and Eccles 2002; OECD 2015; Ryan 2016; and Cobb-Clark and Moschion 2015). There is broad consistency in these findings.

Literacy

The main explanations of boys and girls different attitudes to literacy include the following.

- Girls in large part start out more advanced and score higher on Year 3 reading tests because they are more ready for school and have better developed literacy skills from early childhood education experiences
- Boys underperformance at Year 3 is linked to the fact that they have fewer of the attributes and experiences associated with reading achievement
- Throughout the age range girls are more likely to enjoy reading and read more complex fiction and non-fiction
- Boys are less likely to enjoy and value reading and are more likely to read within a restricted range (e.g. comics)
- Boys tend not to see themselves as confident readers
- Boys tend to enjoy digital reading material and this may encourage a more positive attitude to reading and writing (this is a recent line of enquiry so these conclusions are somewhat tentative)
- Teenagers whose parents read to them when they started primary school tend to read better than their peers whose parents did not read to them (but this finding is challenged by other studies that show no overall significant differences in parental support for reading between boys and girls)

In general, much of boys' literacy performance is seen as related to the conditions at home and out of school. Parents of lower and middle range SES tend to see boys as having lower self-esteem, higher emotional and behavioural problems and greater competitiveness which can contribute to boys' underperformance.

Numeracy

The main explanations for boys' and girls' different attitudes to mathematics are that:

- girls tend to rate their own ability in mathematics as lower than boys as early as the first year of primary school – even when their performance is equal
- small differences in attitudes between boys and girls at Year 4 open up to a large gap by Year 8 where the girls become more cautious and less confident and differences are apparent across the distribution of social background, levels of achievement, demographic characteristics and gender of teachers
- girls tend to base their judgement of their ability (even when it is high) on objective indicators (e.g. high marks) whereas boys attribute their confidence (even when low performing) to more subjective stimuli (e.g. teacher encouragement)
- girls' view of whether they are talented or not declines through secondary school, while boys maintain consistently higher perceptions of their talent than girls throughout Years 7-11.

One study using the Australian data from 2011 Trends in International Mathematics and Science Study (TIMSS) (Ryan 2016) identified that girls in single sex arrangements generally like mathematics and are as confident about their ability as are boys in single sex schools.

A large scale longitudinal Victorian study (Justman and Mendez 2016) found that student choice or 'gender streaming' into mathematics, technology and science subjects at the

senior levels is not driven by prior achievement in mathematics but by other factors- such as social norms or school practices.

Overall, it appears that development trajectories over secondary school retain the broad pattern that is apparent at Year 7, which suggests that the point of divergence for boys' and girls' perceptions of their capability to perform well in both mathematics and English commences at an earlier age.

2.2 Perception of value

The extent that boys and girls see intrinsic value and long term utility of their studies is an important factor in explaining gender differences in performance according to conclusions from large scale research – noting that these findings need to take account of the complex interplay between various cultural, socio-economic and institutional factors in gender differences (Watt 2004; Eccles and Wigfield 2000; Watson et al 2010; Rapoport and Thibout 2016).

Numeracy

- Intrinsic value (I like doing this) for mathematics was characterised by a consistent gender difference favouring boys.
- Australian adolescent girls (in PISA) appear to perceive significantly lower levels of intrinsic value for mathematics and consistently responded more negatively to prompts referring to intrinsic value and motivation.
- For all students, intrinsic value declined through junior secondary and plateaued in senior years.
- Mathematics utility (do I need it?) however, was not seen differently by boys or girls (possibly in response to the extensive communication on the need for mathematics) but their perception of usefulness did decline through secondary school.
- An international pattern is that girls choose educational pathways leading to careers with lesser status and reward and that girls value their achievement differently to boys when choosing their study pathways.

Literacy

- Girls saw significantly greater intrinsic value and utility for English than boys throughout secondary schooling
- However, for both boys and girls the perception of the intrinsic value of English declined over secondary Years 7-11, showed some recovery in the later years but did not come back to the initial Year 7 levels.

2.3 Engagement with learning

Numerous studies have examined the extent to which the dynamics of teaching and learning in classrooms and schools and the practices of teachers can explain gender learning differences in general and specifically the differences in literacy and numeracy performance. Engagement is an ambiguous term and researchers have different emphases – a student's psychological investment in their own learning, their participation in learning and their sense of belonging and relationship to the teacher (AITSL 2013). Overall researchers typically used 'engagement' to describe students' motivated involvement with all or a part of schooling particularly in relation to motivational beliefs (Buckley 2016; Trent and Slade 2001; Munns et al 2006; Martin 2002; Alloway et al 2002; Creswell et al 2002).

For mathematics

Key findings for mathematics include that:

- girls are less engaged with mathematics and more fearful of the subject
- girls perceive mathematics to be more difficult than do boys through most of secondary school, although they have more or less similar perceptions of difficulty in Year 7 and at the end of Year 11
- gender differences in confidence extend beyond self-efficacy (e.g. confidence that I can solve a problem) to more general competence beliefs (e.g. I am generally good at this), with girls tending to perceive their general ability levels more negatively than boys
- the choice to study higher level mathematics is significantly influenced by the level of engagement and success in junior mathematics classrooms and the associated perceptions of ability by boys and girls.

For literacy

Key findings for literacy include that:

- a lack of engagement for many boys has come about because literacy has become synonymous with schooling and literacy is something that many of them are not good at and see little merit in
- boys consistently report poor engagement with schooling, perhaps due to their inability to have meaningful input into their learning, and this has led to school not being relevant for them
- boys are engaged by tasks emphasising visual, logical and analytical approaches, but these are not in general adequately catered for by existing curricula and pedagogies.
- boys' disengagement from their schooling is placing them at risk of becoming behaviour problems. The early years are seen to be particularly risky for those boys who do not find positive and engaging experiences in their schooling.

3. Effective strategies

The school factors impacting on girls' and boys' literacy and numeracy performance are typically characterised as multi-faceted and complex.

It is no surprise then that the strength of the evidence base for recommended or proven education strategies is variable. A major meta-analysis in the US of strategies for improving girls' engagement and performance in mathematics concluded that empirically tested strategies are only moderate to weak in the strength of their evidence with no evidence available of strongly recommended strategies (Halpern et al 2007). Similarly, a major Australian study of strategies for boys and literacy concluded that efforts have often been piecemeal (House of Representatives 2002) and that a multilayered repertoire of practice is required in order to work through the complexity of the problem (Alloway et al 2002).

The evidence consistently refers to the role of family and the wider social context in shaping attitudes and behaviours to school and learning. However, the focus of practical strategies to address gender gaps are directed more to school or classroom level changes and how teachers should take a student's background into account than on tackling cultural factors directly. Parent and community relations are a component of the NSW strategy for boys and girls with the advice more in terms of building parent and school collaboration than in guiding specific parent-related strategies (NSW 2008).

As it currently stands, the core recommended strategies for addressing gender differences in mathematics and literacy mostly focus on what is generally seen as high quality teaching that attends to the individual learning and social needs of students through an orderly, supportive and stimulating learning environment. As one English researcher stated

As the project progressed the issue for teachers became less about gender than about how to be most effective in teaching literacy. Teacher practice therefore became central – rather than unpacking the details of difference (Maynard 2002).

The summary of strategies below for addressing gender gaps combines well researched and endorsed strategies for high quality teaching with more specific advice for meeting the needs of students to acquire adequate and higher levels of literacy and numeracy. The summary is structured by the following factors: insights into attitudes and behaviour; the sense of value in succeeding in English and mathematics; and learning engagement in school and in English and mathematics. The strategies mostly address the combination of these factors however where some strategies have a specific intent this is indicated.

3.1 Attitudes and behaviours

For girls and mathematics

The gap in outcomes could be tackled by the following (Buckley 2016; Halpern et al 2007; Watt et al 2012).

- Programs that provide more opportunities for struggling female students to practice their mathematical skills and develop 'maths literacy'
- Initiatives that challenge negative gender stereotypes, beliefs about fixed ability and feelings of anxiety
- Teachers explicitly teaching students that academic abilities are expandable and improvable as this is likely to enhance girls' beliefs about their abilities
- Providing more objective indicators of high-achieving girls' abilities, so that they base their talent perceptions on non-affective and non-subjective information
- Supporting girls to be more aware of contextual pressures and assisting them to develop ego-protective strategies.

For boys and literacy

The gap in outcomes could be tackled by the following (Alloway et al 2002; House of Representatives 2002; Carroll and Benman 2015).

- Acknowledging and exploring the different social and cultural backgrounds that boys bring to literacy classrooms through examining the ways that understandings about masculinity may influence boys' behaviour and learning in literacy
- Providing regular opportunities for boys to experience success and to develop a positive self-belief
- Expanding boys' views of success to include outcomes such as 'personal bests' and improvement
- Engaging boy's interest in acquiring literacy skills by engaging them in gaming practices and social engagement mechanisms – games require strong levels of literacy to succeed and require use of narrative, perseverance and logical thinking.

3.2 Perception of value

For girls and mathematics

The gap in outcomes could be tackled by the following (Buckley 2016; Halpern et al 2007).

- Adopting strategies that increase students' interest, enjoyment and perceptions of their competence in mathematics
- Promoting the value of mathematics for future educational and career aspirations
- Explicitly teaching students that academic abilities are expandable and improvable.

For boys and literacy

The gap in outcomes could be tackled by (Alloway et al 2002):

- ensuring all boys gain mastery of content through the provision of explicit teaching, and clarification of student understanding

3.3 Engagement with learning

The OECD (2015) identified a range of factors that link what happens in the classroom to the gender gaps in achievement for mathematics and literacy.

For girls and mathematics

For mathematics, a series of actions were identified as strongly linked with achievement in most countries. They included actions such as the teacher asking questions that make students reflect on the problem; the teacher giving extended time to think through complex problems; and questions are posed in different contexts. These actions were linked with better performance in mathematics in general and with greater improvements in girls' achievements compared to boys in a number of countries (e.g. Germany and Poland).

Teachers' practices to stimulate improved enjoyment and performance in reading included actions such as asking students the meaning of a text; asking questions that challenge; encouraging students to express an opinion and helping them relate reading to their own lives. These practices were linked with improved performance in literacy in forty two countries with girls benefitting as well as boys.

Other studies (Halpern et al 2007) provide advice for program content as well as classroom practices. For girls and numeracy the gap in outcomes could be tackled by:

- providing opportunities for girls to engage in spatial skills training by teaching students to mentally image and draw spatial displays in response to mathematics and science problems and requiring students to answer mathematics problems using both verbal responses and spatial displays
- providing girls with prescriptive, informational feedback regarding their performance - focusing on strategies, effort, and the process of learning. (Such feedback enhances girls' beliefs about their abilities, typically improves persistence, and improves performance on tasks.)

The question of the effects of single sex classes or schools for girls so as to improve outcomes has been extensively debated and research continues to show possible positive effects but when socio-economic issues are taken into account the differences vanish.

On the positive side, a NSW study (Centre for Education Statistics and Evaluation 2014) of factors in value adding to a student's performance identified some positive effects of single

sex-schooling for girls in NSW government system with the effect more noticeable at the senior level of secondary school. As previously mentioned, a study using the Australian data from 2011 TIMSS (Ryan 2016) identified that girls in single sex arrangements generally like mathematics and are as confident about their ability as are boys in single sex schools.

On the other hand, while OECD analysis of 2006 PISA data did find significant differences between the performances of students in Australian single-sex and co-ed schools, they also found that the gains made by single-sex schools were all but wiped out after socio-economic factors were taken into account.

Similarly, large scale studies in the United States (Halpern et al 2007, Pahlke 2014) found that any advantages for girls from single sex classes are trivial and, in many cases, non-existent. They argue that where girls in single-sex schools perform well it is because the schools are good schools in their own right, not that it is because they are single-sex.

For boys and literacy

For boys and literacy the gap in outcomes could be tackled by a range of teaching techniques (Alloway et al 2002; Lingard 2002; Martin 2002; Munns et al 2006; Trent and Slade 2001; Woolcott Research 2001; Yeung and Curwood 2015).

- Making pedagogy in schools more intellectually demanding and more connected to the boys' lives and the world beyond the classroom; and genuinely listening to boys' opinions and concerns
- Emphasising the relevance of learning and its connection to the outside world
- Modelling the behaviours expected of boys, such as fairness and respect
- Personalising tasks so that challenges match boys' capacities such as incorporating practical or 'hands-on' activities into lessons
- Providing regular opportunities for boys to experience success and to develop a positive self- belief
- Expanding boys' views of success to include outcomes such as personal bests and improvement
- Providing active and purposeful engagement strategies in classrooms
- expanding boys' repertoire for understanding self, relating to others, engaging with cultures
- providing more hands on- self-directed activities involving personal choice
- Establishing different agency and power in classrooms
- Providing boys with greater access to materials from different sites and modes – multi-modal texts

Group based solutions versus highly effective teaching for all

Strategies for girls and mathematics and boys and literacy can be interpreted as 'group-based' solutions or they can be part of wider suite effective practices to meet a range of needs (Masters 2016). Numerous studies have identified a positive effect for a target group from strategies designed for specific gender needs but also acknowledge that others benefit. Highly effective teaching practices (e.g. personalised instruction, providing feedback, time for reflection, encouraging effort, catering to different interests) tend to work for all regardless of the group.

4. Mapping the research findings to the Evaluation Framework

The overview of research findings indicates that gender differences in learning outcomes between boys and girls in mathematics and English relate closely to:

- differences in attitudes and behaviours
- the value placed on the learning mathematics and reading
- differences in engagement in learning and beliefs about ability

For this project the centrepiece of the Evaluation Framework for analysing gender differences in mathematics and English is a *Transition Years Feedback Questionnaire* (TYFQ) This is an instrument to collect feedback about students' and teachers' perceptions of experiences in the individual classroom. (Students and teachers surveyed in this research will be in schools in the middle band for NAPLAN and where gender gaps are narrow or wide. Roundtables with teachers on their practices will also be held.)

The empirical evidence underpinning the questionnaire design is drawn from research into student motivation and engagement; self-regulated learning; achievement goal theory; interest; thinking and learning, constructivism, authentic pedagogy, teacher professional learning, teacher-student relationships; classroom effects on learning; and school leadership influences on teaching and learning.

The 7 scales chosen for this research focus on those attitudes and practices that most relate to the *classroom factors* identified in the literature as being significant for strengthening, or through their absence, inhibiting girls' outcomes in mathematics and boys' outcomes in English.

The seven scales are as follows:

- *Value of Work* scale: Work (i.e. mathematics and English) is seen to be important, meaningful and worth doing.
- *Collaborative Skills* scale: Through practice in collaborative learning, students develop a range of associated skills.
- *Learning Values* scale: Students understand that the values emphasized in their class are depth of understanding and effortful learning for all students.
- *Positive Attitude* scale: The teacher encourages student self-confidence, perseverance and efficacy.
- *Feedback* scale: Feedback is frequent, prompt, individual and formative.
- *Teacher Knowledge and Engagement* scale: Students see the teacher as knowledgeable about content and process, as well as being someone who enjoys teaching the students in the class and the subject being taught.
- *Work Interest* scale: Work (i.e. mathematics and English) is experienced as interesting and absorbing rather than monotonous and boring.

Other questions have been designed to identify the *school level culture and factors* and *gender specific* subject practices, teacher beliefs and practices at the *transition point* that address other aspects of the evidence explaining gender based differences.

These have been derived from the OECD indices for mathematics and literacy classroom practices (OECD 2015: 144-5) and from the DET project *Transition: Improved Literacy and Numeracy Outcomes (Professional Barriers) 2015*.

4.1 Linking evidence with data gathering instruments

The evidence of gender inequalities in literacy and numeracy and the data collection for this project are aligned as follows.

- *Differences in attitudes and behaviours – girls enjoy reading more than boys and boys are less confident readers, girls find maths boring*

- classroom and teaching practices related to these factors will be measured by the Work Interest and Attitudes and Relationships scale
- *Gender differences relate to the intrinsic value placed on the learning mathematics and reading*
 - classroom and teaching practices related to this factor will be measured by the Value of Work scale
- *Differences in engagement in learning and beliefs about ability - e.g. reluctant performers tend to believe ability is fixed and do not see the connect between ability and effort in learning*
 - classroom and teaching practices related to this factor will be measured by the Feedback and Learning Values scale

4.2 Identification of the prevalence of strategies to address the gender gaps

The questionnaire will examine the use of a range of strategies

- *Explicitly teaching students that academic abilities are expandable*
 - Feedback and Learning Values address this
- *Exposing girls to female role models who have achieved in maths*
 - School factor and culture questions address this
- *Giving prescriptive, informational feedback is important*
 - Feedback and Learning Values address this
- *Providing boys with classrooms that are designed to promote an active, hands-on, purposeful and democratic learning environment*
 - Collaboration and Work Interest address this
- *Constructing a classroom environment where boys' knowledge and skills are valued and respected*
 - Attitudes and Relationships address this
- *Supportive teacher-student relationships*
 - Attitudes and Relationships / Teacher Knowledge & Engagement address this.

References

- Australian Institute for Teaching and School Leadership (AITSL) 2013, *Engagement in Australian Schools*, AITSL, Melbourne
- Alloway, N., Freebody, P., Gilbert, P., and Muspratt, S. (2002) *Boys literacy, and schooling: expanding the repertoire of practice*, Commonwealth Department of Education, Science and Training, Canberra
- Broadley, K., (2016) *Mathematics and gender: International trends and explanations*, Alliance of Girls Schools Australasia
- Buckley, S. (2016) *Gender and sex differences in student participation, achievement and engagement in mathematics*, Research Developments, ACER. Melbourne ACER
<https://rd.acer.edu.au/article/closing-the-gender-gap-in-maths>
- Centre for Education Statistics and Evaluation, (2014) Value added models for NSW government schools Technical Paper, Centre for Education Statistics and Evaluation, NSW Office of Education, Sydney
- Carroll, J. and Benman, V. (2015) Leveraging boys engagement with gaming for improving literacy, *Australian Journal for Middle Years Schooling*, Vol 15, Issue 1, pp 4-17
- Cobb-Clark D., and Moschion, J. (2015) 'Gender Gaps in Early Educational Achievement', Working Paper No. 23/15, Melbourne Institute Working Paper Series, Faculty of Business and Economic, University of Melbourne
https://www.melbourneinstitute.com/downloads/working_paper_series/wp2015n23.pdf
- Cresswell, J., Rowe, K. and Withers, G. (2002) *Boys in School and Society*, Australian Council for Educational Research, Melbourne
http://research.acer.edu.au/cgi/viewcontent.cgi?article=1000&context=boys_edu
- Eccles, J., and Wigfield, A. (1995) 'In the mind of the actor: The structure of adolescents' achievement task values and expectancy-related beliefs', *Personality and Social Psychology Bulletin*, 21, 215 – 225
- Forgasz, (2011) Gender and NAPLAN numeracy results, newsletter November 20 2011, Monash University
<http://monash.edu/news/show/gender-and-naplan-numeracy-results>
- Halpern, D. (Chair) (2007) *Encouraging Girls in Math and Science, IES Practice Guide*, NCER U.S. Department of Education
- Hill, J., (2011) *Gender Differences in NAPLAN Mathematics Performance*, Mathematics: Traditions and New Practices, Australian Association of mathematics Teachers
https://www.merga.net.au/documents/RP_HILL_MERGA34-AAMT.pdf
- House of Representatives Standing Committee on Education and Training (2002) *Boys: getting it right*, Commonwealth of Australia, Canberra
- Justman, M., and Méndez, S. (2016) *Gendered Selection of STEM Subjects for Matriculation*, Melbourne Institute Working Paper no 10/16, Melbourne.
http://melbourneinstitute.com/downloads/working_paper_series/wp2016n10.pdf
- Kane, J., and Mertz, J. (2002) Debunking Myths about Gender and Mathematics Performance, *Notices of the American Mathematical Society*, Vol 59, No 1
- Lingard, B., Martino, W., Mills, M., and Bahr, M. (2002) *Addressing the Educational Needs of Boys*, Report to Department of Education, Science and Training, Canberra
- McPhan, G., Morony, W., Pegg, J., Cooksey, R., and Lynch, T. (2006) *Maths, Why Not? Final Report*, Department of Education, Employment and Workplace Relations (DEEWR)

- Maynard, T. (2002) *Boys and literacy: Exploring the issues*, Routledge Flamer, London
- Martin, A. (2002) *Improving the educational outcomes of boys*, A report to the ACT Department of Education, Youth and Family Services, Canberra
http://www.det.act.gov.au/data/assets/pdf_file/0005/17798/Ed_Outcomes_Boys.pdf
- Masters, G. (2016) *Achievement gaps: The continuing challenge*, Teacher Magazine, ACER, Melbourne.
<http://www.teachermagazine.com.au/geoffmasters/article/achievement-gaps-the-continuing-challenge>
- Munns, G., Arthur, L., Downes, Gregson, R., Power, A., Sawyer, W., Singh, M., Thistleton-Martin, J., and Steele F. (2006) *Motivation and engagement of boys: Evidence based teaching practices*, A report to the Australian Government Department of Education, Science and training, Canberra
- Department of Education and Training (2008) *Leading the way in school and classroom practice: Boys and Girls Education Strategy Support Document*, NSW Government
<http://www.dec.nsw.gov.au/detresources/Boys' and Girls' Education strategy kaklDQSPeo.pdf>
- OECD (2009) *Equally prepared for life: How 15 year old boys and girls perform in school*, OECD Publishing
<https://books.google.com.au/books?isbn=9264064079>
- OECD (2012) *Closing the gender gap: Act now*, OECD Publishing
- OECD (2014) *Are boys and girls equally prepared for life?*, PISA in Focus, 37
<http://www.oecd.org/pisa/pisaproducts/PIF-2014-gender-international-version.pdf>
- OECD (2015) *The ABC of gender equality in education: Aptitude, behaviour, confidence*, PISA OECD publishing, <http://dx.doi.org/10.1787/9789264229945-en>
- Pahlke, E., Hyde, J., S., and Allison, C. (2014) "The Effects of Single-Sex Compared with Coeducational Schooling on Students' Performance and Attitudes: A Meta-Analysis," *Psychological Bulletin*, online Feb. 3, 2014.
- Rapoport, B., and Thibout, C. (2016) 'Why Do Boys and Girls Make Different Educational Choices? The Influence of Expected Earnings and Test Scores', Working Paper No. 1/16, *Melbourne Institute Working Paper Series*, Faculty of Business and Economic, University of Melbourne
https://www.melbourneinstitute.com/downloads/working_paper_series/wp2016n01.pdf
- Ryan, C. (2016) 'The Attitudes of Boys and Girls towards Science and Mathematics as They Progress through School in Australia' Working Paper No. 24/16, *Melbourne Institute Working Paper Series*, Faculty of Business and Economic, University of Melbourne
https://www.melbourneinstitute.com/downloads/working_paper_series/wp2016n24.pdf
- The Telethon Kids Institute (2014) *Gender differences in the AEDC and into the school years, Research Snapshot*
<https://www.aedc.gov.au/>
- The PISA 2012 assessment of students' mathematical, scientific and reading literacy
- Thomson, S., De Bortoli, L., and Buckley, S. (2013) *PISA 2012: How Australia measures up: The PISA 2012 assessment of students' mathematical, scientific and reading literacy*, Australian Council for Educational Research (ACER) Melbourne
- Thomson, S., Hillman, K., Wernert, N., Schmid, M., Buckley, S., and Munene, A. (2012) *Highlights from TIMSS & PIRLS 2011 from Australia's perspective*. Australian Council for Educational Research (ACER) Melbourne:

Thomson, S., De Bortoli, L., and Underwood, C. (2016a) *PISA 2015: A first look at Australia's results*, Australian Council for Educational Research (ACER) Melbourne.

Thomson, S., K., Wernert, N., O'Grady, E., and Rodrigues, S. (2016b) *TIMSS 2015: A first look at Australia's results*, Australian Council for Educational Research (ACER) Melbourne.

Trends in International Mathematics and Science study, (TIMSS), and Progress in International Reading Literacy Study (PIRLS) (2011), International Association for the Evaluation of Educational Achievement.

Trent, F. & Slade, M. (2001) *Declining Rates of Achievement and Retention: The Perceptions of Adolescent Males*, a submission to the Parliamentary Enquiry on the Education of Boys, Department of Education, Training and Youth Affairs, Canberra
http://www.dest.gov.au/archive/highered/eippubs/eip01_6/01_6.pdf

Victorian Auditor General's Office (VAGO) (2015) *Performance Audit: Education Transitions*, Victoria
<http://www.audit.vic.gov.au/publications/20150318-Education-transitions/20150318-Education-transitions.pdf>

Watson, A., Kehler, M., & Martino, W. (2010) 'The problem of boys' literacy underachievement: Raising some questions', *Journal of Adolescent and Adult Literacy*, 53(5), 356-361
<http://dx.doi.org/10.1598/JAAL.53.5.1>

Watt, H. (2006) *What Makes high-School Girls Think they are Talented (or not Talented) at Maths? A Qualitative Examination of Intra- and Extra-Personal Influences and Performance Bases*, Thesis, University of Sydney

Watt, H. (2004) 'Development of Adolescents' Self-Perceptions, Values, and Task Perceptions According to Gender and Domain in 7th- through 11th-Grade Australian Students', *Child Development*, September/October, Volume 75, Number 5, Pages 1556–1574

Watt, H., Shapka, J., Morris, Z., Durik, A., Keating, D., & Eccles, J. (2012) Gendered motivational processes affecting high school mathematics participation, educational aspirations, and career plans: A comparison of samples from Australia, Canada, and the United States, *Developmental Psychology*, Volume 48, Number 6, 1594

Woolcott Research Pty Ltd (2001) *Young Australians reading: from keen to reluctant readers*, prepared for the Australian Centre for Youth Literature and the Audience and Market Development Division of the Australia Council.

Yeung, D., and Curwood, J. (2015) Boys' literacy development: Navigating the intersection of popular culture, new literacies, and high-stakes assessments' [online], *English in Australia*, Volume 50, Number 2, 21-29