
USING ASSESSMENT DATA: DOES GENDER MAKE A DIFFERENCE?



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Since 2000 gender differences in mathematics achievement in Australia have reappeared. In this paper we report on the achievement outcomes of girls and boys in a longitudinal study of reform in low economic school communities. Analysis of student data to inform teaching was one element of student centred approaches implemented by teachers. Teachers targeted students' next point of learning and more girls than boys participated in mathematics intervention programs. Growth in achievement was greater for boys than for girls in the primary years, and so the achievement gap that favours males widened. It is concluded that student centred approaches need to be gender inclusive.

Introduction

For the past decade, researchers have observed the re-emergence of gender inequality in mathematics achievement, participation and affect in Australia at all levels of schooling (Vale, 2010; Vale & Bartholomew, 2008). These outcomes represent a reversal of a trend toward gender equality in achievement and participation observed during the 1990s (Forgasz, Leder, & Vale, 2000) and can be attributed a lack of focus on gender equity in educational policy in general and on the educational needs of boys in particular (Vale, 2010). The focus of the current federal government education policy on equity and socio-economic equity in particular (MCEETYA, 2008) has provided an opportunity to refocus the attention of education systems and teachers on equity issues in education. Australian government initiatives for school reform include programs designed to build capacity of educational leadership and teachers; promote whole school approaches, the use of data, and student centred teaching; develop intervention programs for students; and support the engagement of parents and community (DEEWR, 2009).

In this paper we examine gender issues in low socio-economic (SE) school communities using data gathered during a longitudinal study of teacher practice and student achievement in schools that participated in a school reform project jointly funded by the Victorian government (DEECD, 2009) and the federal government, under its *Smarter Schools Pilot* program (DEEWR, 2009).

Background

Various feminist theories have informed the struggle for gender equity in mathematics education through policy initiatives, curriculum development, and pedagogical approaches since the 1980s (Vale, 2010; Vale & Bartholomew, 2008). It is generally agreed that equitable practice is responsive to students' learning needs, intellectually challenging, and inclusive (Anthony & Walshaw, 2007; Jorgensen, Grootenboer, & Sullivan, 2010). Such practice, it is argued, is student centred.

The capacity to respond to students' learning needs depends on teachers knowing their students well. Analysis of students' work samples and formative assessment practices, also known as assessment for learning, has been driving reform of mathematics teaching in Australia since 2000 as a result of research projects such as *The Early Years Numeracy Project* (Clarke, et al., 2001) and *Scaffolding Numeracy in the Middle Years Project* (Siemon, Izard, Breed & Virgona, 2006) conducted in Victoria. By analysing students' mathematical reasoning teachers are able to target their teaching to address students' misconceptions or challenge them within their "zone of proximal development" (Vygotsky, 1978).

Critical theory supports transformative pedagogies that go beyond addressing student learning needs which, from the school improvement policy context, are often perceived from a deficit perspective. Transformative pedagogies connect with students' cultures, involve reciprocal learning and develop respect (Atweh, 2009). Boaler (2008) believes that transformational practice also involves equitable relations in diverse classrooms with students "acting" equitably and "treating each other with respect and considering different viewpoints fairly" (p. 168). These approaches shift student centredness from a constructivist perspective to a social-constructivist perspective where teachers also design tasks for students organised in mixed achievement-level groups and classes.

Findings from international assessment studies (TIMSS and PISA), Australian national benchmarking, and particular research studies for the period 1995 to 2007 are reported and summarised by Vale (2010). Studies of affect consistently report gender differences favouring males at all year levels and this has remained unchanged since the 1980s. Since 2000 males typically out perform females in the early years of schooling (for example, Horne, 2004) as 9-year-olds in TIMSS and 15-year olds in PISA. Higher proportions of females achieved the national benchmark in Years 3, 5, and 7 however the proportion of females performing below expected benchmark increases with year level. Studies by Forgasz (2006) and Leder and Forgasz (2010) show that female participation in senior secondary mathematics is falling in the subjects required for continued study of mathematics beyond schooling and that males are more highly represented among the top performers at all levels of schooling. Studies also reveal that gender differences in mathematics achievement are mediated by other equity factors such as individual and school socio-economic level, indigenous status, language background other than English, and degree of remoteness (Thomson, De Bortolli, Nicholas, Hillman, & Buckley, 2010).

For some years accountability has been driving educational policy and interventions in Australia and internationally. All schools in Victoria are required to develop annual strategic plans that aim to improve the proportion of students achieving the national achievement benchmarks. To date, gender equity is not given prominence in current

government policy, and therefore schools are not called upon to develop targets and strategies for gender equity.

Australian government initiatives, as indicated above, are now providing resources and small amounts of funding for low SE and indigenous school communities to support reform. The suite of reforms that these schools and their leaders and teachers are expected to adopt include the use of assessment data to inform school planning and classroom teaching, student centred approaches to teaching, and appropriate intervention programs. In this study we report briefly on the way in which schools and teachers who participated in one of the Literacy and Numeracy Pilot programs (DEEWR, 2009) implemented these strategies, and the achievement outcomes for girls and boys from low SE school communities.

The study

The 76 government schools in this study belong to four networks of primary and secondary schools located in metropolitan Melbourne and regional Victoria. The Department of Education and Early Childhood Development (DEECD) selected these networks of schools for participation in the Victorian Pilot because of the low SE of the school communities and the general underperformance of these networks, overall and individual schools, when compared with other networks in Victoria. Some schools in these networks also have high proportions of Koori students, students who are new arrivals in Australia, refugees, or students meeting the criteria for learners of English as a second language (ESL).

The study used a mixed methods design incorporating quantitative assessment of student mathematics outcomes and collaborative practitioner research methods (Cherednichenko, Davies, Kruger, & O'Rourke, 2001). Principals, numeracy leaders, numeracy coaches, regional network leaders, and other regional project staff from all schools in the Pilot were invited to respond to three open-ended questions (personal accounts). Other qualitative methods including observations of meetings and classrooms and analysis of documents were used for in-depth case studies of nine schools. Schools also completed a questionnaire about the numeracy intervention program(s) implemented at their school and provided student identification numbers of the students who participated in these intervention programs.

Student mathematics achievement data were collected using online assessment tools provided to schools by the DEECD. Data were collected four times at six-monthly intervals during the study: March and September, 2009, and March and September, 2010. The *Mathematics Online Interview* (MOI) adapted from the *Early Years Numeracy Interview* (Clarke et al., 2001) was used to gather assessment data for students in years P–2 and results are reported in “growth points.” The *On Demand Adaptive Test for Number* (VCAA, 2009) was used for students in Years 3–10. This test is designed to assign items to the student based on their relative success with a beginning set of items at a level indicated by the classroom teacher. Results are recorded to one decimal place using the *Victorian Essential Learning Standard* (VELS) score (VCAA). Individual student results for each assessment period were paired. Growth in student achievement for each six-month period (March 2009 to September 2009, September 2009 to March 2010, and March 2010 to September 2010) was calculated. Analysis of variance was used to compare achievement and growth by gender.

Findings

Using student data, student centred approaches and interventions

At last year's MERGA conference we reported on the student centred approaches implemented by teachers in the pilot study (Vale, Weaven, Davies, & Hooley, 2010). We showed that the schools and teachers adopted a constructivist interpretation of student centred approaches since they focussed on the children's "point of need" to differentiate teaching and learning. These approaches were typically more evident in the practices of primary teachers than secondary teachers in the pilot. Teachers used a range of data to identify children's learning needs. These included analysis of student responses to MOI, the *Number Fluency Interview* (Montgomery & Waters, n.d.), and NAPLAN test items, along with samples of students' class work. School Numeracy Leaders and Numeracy Coaches supported analysis of these data, often taking responsibility for compiling results and responses in formats that made interpretation of data for individual students and classes of students easier for teachers. Analysis of these data enabled teachers to identify students at various levels of risk of under-achievement, and hence target students for particular intervention programs implemented at schools. Intervention programs included both in class and withdrawal programs. Some were individual; others were for small groups of students. The data analysis practices and intervention programs are presented in more detail elsewhere (Vale, Davies, Hooley, Weaven, Davidson, & Loton, 2011).

Gender differences in the early years (P-2)

Mean scores and growth in achievement for place value and addition and subtraction for female and male students for March 2010 to September 2010 is recorded in Table 1. Male achievement is significantly greater than female achievement for both place value and additive thinking ($F=19.411$, $p<0.05$ and $F=4.361$, $p<0.05$ respectively). While growth in achievement is greater than the equivalent ENRP benchmark for six months (0.56 for place value and 0.82 for addition and subtraction (Clarke et al., 2010), the effect of the Pilot has been to widen the achievement gap between males and females. The gap widens from 0.09GPs to 0.15GPs for place value and 0.05GPs to 0.1GPs for addition and subtraction from March to September 2010. While these changes appear to be small they are statistically significant ($F=5.454$, $p<0.05$ and $F=4.260$, $p<0.05$ respectively). The gaps in achievement are illustrated in Figure 1.

Table 1. Achievement and growth in place value and addition and subtraction for students in Years P-2 (MOI growth points), March 2010 – September, 2010.

Domain	Month	Females (N=2664)		Males (N=2937)		Mean difference
		Mean	SE	Mean	SE	
Place Value	March	0.984	0.021	1.075	0.020	-0.091
	Sept	1.675	0.023	1.823	0.022	-0.148*
	Mean growth	0.691		0.748		-0.057*
		Females (N=2652)		Males (N=2930)		Mean difference
		Mean	SE	Mean	SE	
Addition & Subtraction	March	1.423	0.028	1.468	0.027	-0.045
	Sept	2.316	0.030	2.426	0.028	-0.110*
	Mean growth	0.893		0.958		-0.065*

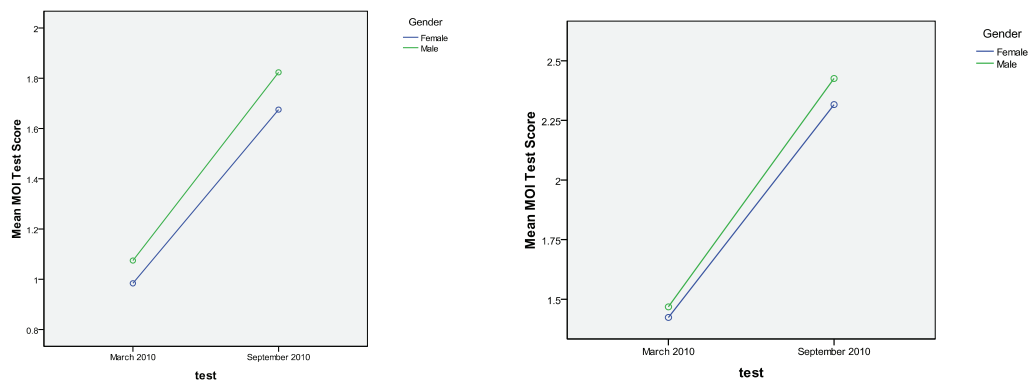


Figure 1. Mean scores for Place Value and Addition and Subtraction for female and male students in Years P-2, March to September 2010(MOI growth points).

Gender differences in the middle years (3-10)

Mean scores for female and male students in Years 3, 4, and 5 in March 2009 and Years 4, 5, and 6 in September 2010 are recorded in Table 2 and illustrated in Figure 2. Overall growth in achievement is significantly greater than expected (0.75 VELs points in 18 months). Gender differences in achievement favour males and are statistically significant. Over the period, the gap in favour of males doubles (0.06 VELs points in March 2009 to 0.13 VELs points in September 2010) and is statistically significant ($F=3.868$, $p<0.05$).

Table 2. Achievement and growth for primary students, March 2009 – September, 2010 (VELs).

Year	Month	Females (N= 667)		Males (N= 697)		Mean difference
		Mean	SE	Mean	SE	
2009	March	2.690	0.030	2.749	0.029	-0.059
	Sept	3.018	0.031	3.111	0.030	-0.093
2010	March	3.185	0.033	3.247	0.033	-0.062
	Sept	3.509	0.033	3.639	0.033	-0.130*
Growth Mar09–Sept10		0.819*		0.890*		-0.071*

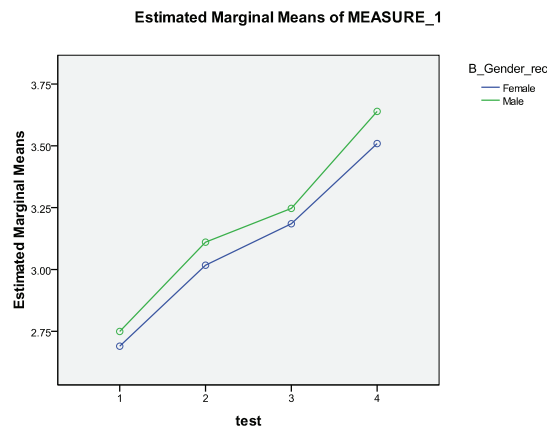


Figure 2. Mean number scores for female and male primary students March 2009 – September 2010.

Mean scores for female and male students in Years 6 and 7 in March 2009 and Years 7 and 8 in September 2010 are recorded in Table 2 and illustrated in Figure 3. Growth in achievement is well below the expected level (0.75 VELs). The gender difference is negligible at the beginning and end of the 18-month period.

Table 2. Achievement and growth for secondary students, March 2009 – September, 2010 (VELs).

Year	Month	Females (N=453)		Males (N= 496)		Mean difference
		Mean	SE	Mean	SE	
2009	March	3.807	0.042	3.833	0.040	-0.026
	Sept	4.075	0.042	4.081	0.041	-0.006
2010	March	4.178	0.044	4.222	0.042	-0.044
	Sept	4.351	0.044	4.353	0.042	-0.002
Growth Mar09– Sept10		0.544		0.520		0.024

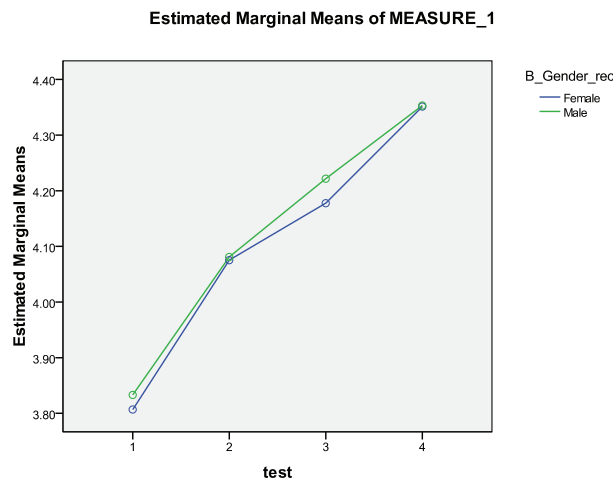


Figure 3. Mean number scores for female and male secondary students March 2009 – September 2010.

The different rates of growth for male and female students indicate the way in which classroom approaches support their learning and how they are affected by the summer slow-down. Growth in number achievement is higher for primary males than primary females from March to September and lower over the summer months. The opposite is the case for secondary students. Growth in number achievement for secondary females is higher than for males during Terms 2 and 3 and lower in Terms 4 and 1.

Numeracy intervention

There were more female than male primary students participating in numeracy interventions as expected, given the difference in achievement favouring male students in the primary years (see Table 4). In secondary schools there were more males than females who participated in numeracy intervention programs. The primary numeracy intervention programs especially benefited male students as their growth in achievement was significantly greater than the expected level (0.25 VELs for 6 months) and greater than the growth achieved by female students participating in these programs, though this gender difference was not significant. Students participating in secondary numeracy intervention programs recorded growth in achievement at the expected rate for 6 months

and there was no difference between males and females. Hence while the primary numeracy intervention programs supported these students to achieve growth at above the expected rate they did not make an impact on closing the gender gap in achievement, and may have contributed to widening the gap.

Table 4. Growth in number achievement for students in numeracy intervention programs from March to September 2010.

Cohort	Primary (Year 3–6)		Secondary (Year 7–10)	
	N	Mean Growth	N	Mean Growth
Females	77	0.301	32	0.287
Males	51	0.428	38	0.283

Conclusion

Students in primary schools benefited from the student centred differentiated pedagogical approaches of the Pilot, since growth in achievement was greater than the expected level. However the stereotype of male mathematics hegemony was not challenged as the gender gap widened for students in all primary year levels. This was despite the fact that more females participated in numeracy intervention programs. The different effect of the summer slow-down on female and male primary and secondary students requires further investigation, however it is clear that student centred approaches must involve more than differentiated tasks if we are to close the gender gap in primary settings. It seems to us that a transformative approach that embraces the socio-constructivist perspective of learning is required if we are to address the intransigent gender differences in affect in mathematics and the persistence of gender differences in achievement.

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