8 Focus on outcomes in numeracy

8.1 Numeracy as a priority

Numeracy is fundamental to the development of all other skills associated with the Mathematics KLA. In parallel with literacy, numeracy is a requirement for competence in other KLAs. This section of the *National Overview* is primarily concerned with numeracy as developed in the Mathematics KLA.

The improvement of literacy and numeracy skills of young Australians was articulated as a key priority of the Commonwealth in 1996. In its 1996–97 Budget, the Commonwealth Government advised of its intention to develop a National Literacy and Numeracy Strategy for Young Australians and provided an additional $18 million over the period 1997–99 for this purpose.

Commonwealth funding of $153 million per annum was provided in the Budget to support literacy development strategies for schools from 1997, under the new Literacy Programme. This program, which includes funding under the former Disadvantaged Schools and ESL General Support Programmes, will provide $147 million annually to support literacy and numeracy strategies in schools and $6 million per annum for strategic literacy and numeracy initiatives research.

In the context of the broad agreement among the States on the value of nationally defining a small number of benchmarks or common student outcomes in the areas of literacy and numeracy, MCEETYA agreed that collaborative work should begin on the development of agreed national frameworks for reporting achievement in those areas.

The MCEETYA Benchmarking Taskforce, which is overseeing the work on developing national literacy and numeracy benchmarks, has adopted the following definition:

> *Numeracy is the effective use of mathematics to meet the general demands of life at school and at home, in paid work, and for participation in community and civic life.*

In this context, the numeracy benchmarks refer to the contribution that school mathematics and other areas of learning make to the development of students' numeracy. They will incorporate the development of understanding and competence with number and quantity, shape and location, and the handling and interpretation of quantitative data.

Numeracy, as defined above, is a cross-curricular concept to which mathematics is the major, but not the only, contributing key learning area. The reporting which follows, however, confines itself in a number of sections to considering aspects of mathematics in the curriculum.

8.2 Student outcomes in numeracy - TIMSS

During 1996, the first results from the Third International Mathematics and Science Study (TIMSS) were released. Australia was one of more than 40 countries taking part in TIMSS, the largest and most thorough comparative study of student achievement ever undertaken. Australia's participation was funded jointly by the Commonwealth and States and was managed by ACER.

TIMSS is the most recent in a series of international comparative studies undertaken since 1960 by the International Association for the Evaluation of Educational Achievement (IEA), a cooperative of research centres from 53 education systems. Subject areas for these studies have included mathematics, science, social studies, literacy, second language learning, computers and civics. Prior to TIMSS, the IEA carried out two studies into each of mathematics and science (see Table 53). Australia did not participate in the second mathematics study (1980–1982), opting instead to undertake a replication of the first study which was carried out in Australian schools in 1978.

TIMSS aimed to identify curriculum, instructional and other variables related to differences in student achievement in school-level mathematics and science. The tests used were developed by curriculum and testing specialists on the basis of curriculum guides and textbooks and test items submitted by participating countries. Tests were piloted and field tested, reviewed for gender, racial and cultural bias and rigorously reviewed after translation.

Both multiple-choice questions and items which required constructed answers were included; some called on students to write a paragraph or show extended, detailed working. Some questions assessed basic mathematical and scientific knowledge and routine procedures, but many assessed higher level skills such as problem solving, analysing, investigating, mathematical reasoning and working scientifically. There was also a 'hands on' performance assessment component, with a sample of students carrying out tasks and experiments using equipment. Test marking, using specially-developed scoring guides, was monitored closely for national and international consistency.

Table 53. IEA mathematics and science studies, 1964 to 1995

Study	*Levels*	*Data collected*	*Number of countries*	*Australian participation*
First mathematics	Lower and upper secondary	1964	12	yes
First science	Age 10, age 14, year 12	1970–71	19	yes
Second mathematics	Age 10, age 13, year 12	1980–82	20	no
Second science	Age 10, age 14, year 12	1983–84	24	yes
Third mathematics and science	Age 9, age 13 and year 12	1994–95	48	yes

Source: Australian Council for Educational Research, 1997

There were three TIMSS student populations: in broad terms, 9 year olds (Population 1), 13 year olds (Population 2) and students in the final year of secondary education (Population 3). During 1994–95, over half a million students from 15,000 schools in 45 countries undertook the TIMSS mathematics and science tests. Some 30,000 Australian students from all States and from both government and non-government schools took part in testing and completed a questionnaire about themselves and their studies. Teachers and schools also provided information on curriculum and teaching practice which was analysed together with the student results.

Population 2 could be termed the critical TIMSS cohort: to be considered a member of TIMSS, countries had to participate at the Population 2 level, and the results for this cohort were released first. Population 2 comprised students enrolled in the two adjacent grades that contained the greatest proportion of 13 year old students. In most countries, these were grades 7 and 8 - referred to as the lower grade level and upper grade level respectively. In Australia, Population 2 students were spread across years 7 and 8 in New South Wales, Victoria, Tasmania and the Australian Capital Territory and across years 8 and 9 in the other four States.

In late 1994, a total of 13,704 Australian students from 600 classes in 180 schools sat the Population 2 test. The mathematics and science test took about 90 minutes to complete and was followed by a 30 minute questionnaire.

Table 54. Mathematics achievement, mean scores, TIMSS Population 2 (13 year olds), by country, 1995

Country	*Upper grade mean*	*Lower grade mean*	*Country*	*Upper grade mean*	*Lower grade mean*
Australia	530	498	Japan	605	571
Austria	539	509	Korea	607	577
Belgium (Flemish)	565	558	Kuwait	392	–
Belgium (French)	526	507	Latvia	493	462
Bulgaria	540	514	Lithuania	477	428
Canada	527	494	Netherlands	541	516
Colombia	385	369	New Zealand	508	472
Cyprus	474	446	Norway	503	461
Czech Republic	564	523	Portugal	454	423
Denmark	502	465	Romania	482	454
England	506	476	Russian Federation	535	501
France	538	492	Scotland	498	463
Germany	509	484	Singapore	643	601
Greece	484	440	Slovak Republic	547	508
Hong Kong	588	564	Slovenia	541	498
Hungary	537	502	South Africa	354	348
Iceland	487	459	Spain	487	448
Iran, Islamic Republic	428	401	Sweden	519	477
Ireland	527	500	Switzerland	545	506
Israel	522	–	Thailand	522	495
			United States	500	476

Source: ACER, *Maths and Science on the Line: Australian junior secondary students' performance in the TIMSS,* 1996

Table 55. Mathematics achievement – TIMSS Population 2, by State, 1994

State	*Best estimate of mean score*	*State*	*Best estimate of mean score*
WA	546 ± 8	NT	510 ± 18
ACT	546 ± 10	NSW	509 ± 8
SA	536 ± 6	Victoria	492 ± 6
Queensland	529 ± 8	Tasmania	484 ± 11

Source: ACER, *Maths and Science on the Line: Australian junior secondary students' performance in the TIMSS,* 1996

Mathematics results

Looked at internationally, TIMSS showed Australian 13 year old mathematics students as doing well. In the upper grade, eight of the 41 participating countries performed better than Australia, including the top performers, Singapore, Korea, Japan and Hong Kong. Australian students performed on a par with those from 13 other countries, including the Netherlands, France and Canada, and better than students from most other English-speaking countries. Lower grade results were similar, but with only seven countries doing better than Australia. Table 54 shows mean scores for upper and lower grades in participating countries.

Australian students performed particularly well in 'data representation and analysis' and 'algebra', but attained some of the lowest scores internationally on questions involving multiplication and division of fractions and decimals. Australia was one of only six countries in which there were no gender differences in performance in both mathematics and science.

The interpretation of comparative achievement between States was not clear-cut because of structural differences such as entry ages and primary-secondary transition points. Because the sample was chosen from across grades, and the grades do not exactly correspond across the nation, both mean ages and years of schooling varied from state to state. In general states with the lowest scores were those in which the students were younger. Nevertheless ACER concluded that there were significant differences. The three highest-scoring Australian States - Western Australia, the Australian Capital Territory and South Australia - were on a par with the Czech Republic, while Queensland students performed similarly to the relatively highly achieving European countries from the Czech Republic to Austria. Performance of students in the Northern Territory and New South Wales was on a par with the range of countries from Hungary to Sweden (including France and Canada), while Victorian and Tasmanian students achieved similarly to those from Scandinavia and Germany and most English-speaking countries - the United States, New Zealand, England and Scotland.

8.3 Student outcomes in numeracy - reports from the States

In addition to the outcomes in numeracy reported for the States as a result of participation in TIMSS, States also provided information concerning the results of other testing programs undertaken during 1996. However, it is neither possible nor appropriate to directly compare the outcomes of numeracy testing in the States, as each State undertaking a program of numeracy testing administered its own test instruments to its own selected student populations, and according to its own predetermined conditions. In addition, States did not always use nationally compatible definitions to report on students' numeracy outcomes.

However, States' reporting of achievement in mathematics at various levels and sectors provided some evidence of the success rates for different equity groups. For example, while reporting from several States indicated that, in the mathematics areas tested, there was no performance disadvantage for children from isolated or rural schools, there was some disagreement on whether students whose language background was not English performed less well than the State average.

In addition, although there was generally little gender difference evident from the States' reporting of outcomes in mathematics, there were notable exceptions to that general perception, with examples presented of particular cohorts of girls outperforming their male peers. For example:

- in Western Australia, student numeracy, as measured by the proportion of girls passing Stage 3 Unit Curriculum mathematics, was again slightly above that of boys;
- in non-urban schools in the Northern Territory, where students were predominantly Indigenous and from non-English speaking backgrounds, testing covering stages 2 to 5 resulted in girls slightly out-performing boys at each stage; and
- in the Australian Capital Territory, although girls comprised 51.6 per cent of the students enrolled for year 12 certificate mathematics programs, they achieved 59.9 per cent of the A grades.

An area about which there was total agreement among the States, however, was the average achievement levels of

NSW students working mathematically.

Indigenous students. Reporting from all States which identified students by equity group made it clear that the performance levels of Indigenous students were well below the average level for their year. Information was provided to indicate significant allocations of resources, supported by expert advice and curriculum expertise, for specific numeracy action for Indigenous students.

Outcomes data, provided in varying formats and degrees of detail by the various States, are summarised below.

New South Wales

On the basis of mean test scores, results in the 1996 BST program indicate a slight rise in year 3 numeracy levels in government schools, compared with 1995. An increase in mean scores was evident across the whole student population, as well as in key subgroups, including Indigenous students. The mean test score for year 3 girls was marginally greater than for boys in 1996.

An assessment of improvement over time was not possible in the case of year 5 students, as the reporting scale for that group was changed in 1996. There was no noticeable difference in outcomes at year 5 based on either gender or whether students were from a non-English speaking background. The mean scores for Indigenous students were, in common with those at year 3 level, lower than for the overall student population.

In reporting student numeracy outcomes in terms of skill bands, the key results from the 1996 BSTs indicated that:

- 72 per cent of year 3 students were placed in the top three of the five skill bands for numeracy; and
- 77 per cent of year 5 students were placed in the top three of the six skill bands for numeracy.

Results in the 1996 BST suggest that the overall performance of year 3 and year 5 students attending CAP funded government schools was marginally lower than the State average, with outcomes for both girls and boys at year 5 noticeably lower than for all year 5 students. Year 3 girls attending CAP funded government schools achieved higher mean test scores in numeracy than boys.

Among secondary students, the proportion of A grades awarded in School Certificate Intermediate Mathematics increased for girls attending single-sex, specialist and selective high schools in 1996 when compared with 1995. Specialist high schools showed the greatest improvement in School Certificate A grades for girls and for boys in Advanced Mathematics.

Table 56. Mean test scores for numeracy, Basic Skills Tests, government schools, year 3 (1994–1996) and year 5 (1996 only), all students and students in key subgroups, New South Wales

	All students			*Key subgroups*	
Year	*Boys*	*Girls*	*Total*	*NESB (a)*	*Indigenous students*
Year 3 students					
1994	52	52	52	51	46
1995	52	52	52	51	46
1996	53	54	54	53	47
Year 5 students					
1996	60	60	60	60	54

Note: Definitions used in the determination of key subgroups shown in this table may not coincide with definitions used elsewhere in this National Overview.

Prior to 1996, the year 3 and year 5 results cannot be compared as they used separate scales. In 1996, the year 3 and year 5 BST results were reported on a common scale from 25 to 80.

(a) Students from non-English speaking backgrounds.

Source: Department of School Education, New South Wales

Table 57. Mean test scores for numeracy, Basic Skills Tests, years 3 and 5, government schools receiving CAP (a) funding, by gender, New South Wales, 1996

Year 3 students		*Year 5 students*	
Boys	*Girls*	*Boys*	*Girls*
52	53	58	58

(a) Refers to schools funded under the Commonwealth's Country Areas Programme.

(b) In 1996 the year 3 and year 5 BST results were reported on a common scale from 25 to 80.

Source: Department of School Education, New South Wales

Performance in mathematics at the School Certificate level for targeted groups was below the State average. The proportion of A grades awarded in Intermediate Mathematics to girls attending CAP schools was higher than the State average. The proportion of B–D grades awarded in Advanced Mathematics to girls attending CAP schools was also higher than the State average.

Performance in HSC mathematics courses was generally lower for targeted groups than the State average. Indigenous students undertaking 4 Unit Mathematics demonstrated HSC outcomes slightly above the State average. Students attending remote schools also had mean scores in 4 Unit Mathematics similar to those at the State level, while results in general mathematics strands exceeded the State average.

Victoria

Information related to outcomes in numeracy was provided by the Learning Assessment Program (LAP) conducted in 1996 in the key learning areas of English, mathematics and science. About 98 per cent of schools across all sectors participated in this program and more than 95 per cent of students in years 3 and 5 received reports.

The data presented in Table 58 indicate that:

- about 94 per cent of year 3 students were operating at or above the expected level; and
- about 87 per cent of year 5 students were operating at or above the expected level.

Data in Table 58 confirm that the performance of Indigenous students in both year 3 and year 5 was substantially lower than for the whole student population. The table also indicates little difference in achievement on the basis of gender, but noticeable differences for students attending disadvantaged schools and for those whose language background was not English. There was no disadvantage in performance for students from isolated or rural schools.

Table 58. Achievement in mathematics, years 3 and 5, by Curriculum Standards Framework (CSF) levels, all students and students in key subgroups, Victoria, 1996 (per cent)

	All students			*Key subgroups*				
CSF level	*Boys*	*Girls*	*Total*	*LBOTE (a)*	*Indigenous students*	*Attending rural schools*	*Attending isolated schools*	*Attending disadvantaged schools*
Mathematics - Number, year 3								
1	7.4	7.4	7.4	10.8	16.8	6.7	7.1	12.3
2	33.1	35.7	34.4	38.0	46.5	32.6	34.3	38.8
3	51.8	50.8	51.3	44.9	31.0	51.4	51.3	43.2
4	7.7	6.1	6.9	6.3	5.6	9.2	7.2	5.6
Mathematics - Chance and Data, year 3								
1	6.1	4.7	5.4	8.2	14.7	4.6	4.6	8.8
2	27.5	25.1	26.3	32.6	37.9	24.6	26.2	31.8
3	53.6	56.2	54.9	50.5	40.9	55.3	53.9	50.4
4	12.8	14.0	13.4	8.8	6.5	15.4	15.3	9.0
Mathematics - Number, year 5								
2	12.3	11.1	11.7	14.1	34.2	12.5	13.7	17.9
3	54.0	55.1	54.5	51.1	55.2	55.9	55.9	57.0
4	25.7	27.1	26.4	26.6	8.1	24.8	23.6	20.7
5	8.0	6.7	7.4	8.2	3.5	6.8	6.8	4.3
Mathematics - Chance and Data, year 5								
2	16.2	12.5	14.4	18.4	33.5	13.1	14.5	21.0
3	57.5	59.5	58.5	60.2	55.0	58.7	59.2	59.2
4	21.7	23.6	22.7	18.3	10.8	23.1	21.9	17.1
5	4.6	4.4	4.5	3.0	0.8	5.1	4.4	2.7

Note: Definitions used in the determination of key subgroups shown in this table may not co-incide with definitions used elsewhere in this National Overview.

(a) Refers to students from a language background other than English.

Source: Department of Education, Victoria

Queensland

Information was provided on numeracy outcomes for government school students in years 2 and 6 for 1996, together with comparisons with 1995 outcomes, as well as for year 7 students in 1996.

Major trends evident in year 2 outcomes were:

- male students were over-represented in the lowest level of development in 1995, but the gender difference was less marked in 1996;
- gender differences were reversed for the higher levels of performance, with greater representation of boys in 1996 than in 1995;
- in 1995, 40 per cent of the students at the lowest level of performance were Indigenous students, who comprised only five per cent of the student population. In 1996, this over-representation was reduced by almost six per cent;
- a disproportionate number of Indigenous students performed at the higher levels for both 1995 and 1996; and
- in 1996, almost 18 per cent of students in the lowest level of performance had a main language other than English, although this student group comprised only 3.5 per cent of total students.

Data in Table 59 comparing year 6 outcomes from 1995 with their 1996 equivalents indicates that:

- overall, the mean scale scores in all numeracy strands increased significantly;
- the levels of performance in 1996 were considerably higher in all numeracy strands for boys, girls and students whose main language was not English; and
- Indigenous students scored higher in 1996 in Number and Space, but not in Measurement.

The different testing program applied at year 7 level indicated that:

- four out of five year 7 students performed at or above the minimum level of functional competence in mathematics;
- the 'typical' year 7 student performed at a level of mathematics competence compatible with successful functioning in everyday life; and
- almost 60 per cent of year 7 students performed at or above this level of competence.

Table 59. Test outcomes in areas of numeracy, year 6 students, by gender and key subgroup, all schools, Queensland, 1995 and 1996.

Student cohort	*Year*	*Number*	*Measurement*	*Space*
Boys	1995	37.7	38.0	37.6
	1996	39.2	39.9	39.3
Girls	1995	38.0	37.5	37.4
	1996	40.2	38.6	39.8
All students	1995	37.8	37.8	37.5
	1996	39.7	39.3	39.5
NESB (a)	1995	37.9	37.7	37.2
	1996	40.8	39.7	40.1
Indigenous students	1995	28.6	29.1	30.6
	1996	30.6	29.1	31.2

(a) Refers to students from a non-English speaking background, in this instance defined as students who indicated that English was not the language spoken at home most of the time, or that English was not the first language of parents or caregivers, except for students also identifying as Indigenous.

Source: Department of Education, Queensland

South Australia

On the basis of results from the BSTs, administered at year 3 and 5 in South Australian government schools and summarised in Table 60, the following analysis is possible:

- the average score for Indigenous students was considerably lower than for other groups of students;
- students attending DSP schools did not achieve to the same level, on average, as other student groups, with the exception of Indigenous students;
- the average achievement of students who had a main language other than English was slightly below the State average; and
- socioeconomic background is a stronger factor in influencing test outcomes than is geographic isolation.

Further data presented in Table 61 enables a more detailed assessment of gender-based performance in numeracy, as well as a comparison of outcomes in CAP schools with those for the whole student population. For example:

- across all schools, in year 3 girls demonstrated levels of numeracy skills marginally higher than those of boys, while in year 5 results for girls were slightly below those of boys;
- in CAP schools, girls performed at a higher level than boys in both year 3 and year 5; and

- overall, student outcomes in CAP schools were slightly above the State average at year 3, but below at year 5.

Reporting on the outcomes from the 1995 data provided by the Senior Secondary Assessment Board of South Australia (SSABSA) revealed that:

- there was a slight difference between the achievement of boys and girls, with girls performing better than boys in Stage 1 Mathematics, while at Stage 2, boys scored slightly better, on average, for Mathematics 1 and girls performed better in Mathematics ll; and
- participation and achievement in Stage 2 PES (Publicly Examined Subject) mathematics were higher where student socioeconomic level was higher.

Table 60. Mean scores for numeracy, Basic Skills Tests, years 3 and 5, all students and students in key subgroups, government schools, South Australia, 1996

Student groups	*Year 3*	*Year 5*
All students	48.8	57.0
Girls	50.0	56.9
Indigenous students	42.1	49.7
NESB (a) students	48.2	56.3
Geographically isolated students	50.5	56.0
Students in DSP (b) schools	47.3	53.8

Note: Definitions used in the determination of key subgroups shown in this table may not coincide with definitions used elsewhere in this National Overview.

(a) Refers to students from a non-English speaking background.

(b) Refers to schools funded under the Commonwealth's Disadvantaged Schools Programme.

Source: Department for Education and Children's Services, South Australia

Table 61. Mean test scores for numeracy, Basic Skills Tests, years 3 and 5, all students and students attending CAP (a) schools, year 3 and year 5, South Australia, 1996

	All students			*CAP students*		
	Boys	*Girls*	*Total*	*Boys*	*Girls*	*Total*
Year 3	50.2	50.4	50.3	49.8	51.2	50.5
Year 5	57.1	56.9	57.0	55.3	56.7	56.0

(a) Refers to schools funded under the Commonwealth's Country Areas Programme.

Source: Department for Education and Children's Services, South Australia

Western Australia

The assessment tasks used in the 1996 Monitoring Standards in Education (MSE) testing program were undertaken by a stratified random sample of students drawn from years 3, 7 and 10 in government schools throughout the State. The results of that process of testing are summarised in Table 62, which indicates outcomes, by level, for all students, as well as for key subgroups.

Further analysis of information in respect of students attending the government schools indicated that:

- there was a small improvement in the overall achievement of students tested in 1996 compared with 1992. This difference was statistically significant only for years 7 and 10 students;

Table 62. Percentage of sample of students achieving at or above a specified level in key areas of numeracy, years 3, 7 and 10, government schools, Western Australia, 1996

Student groups	*Yr 3 Level 2*	*Yr 7 Level 3*	*Yr 10 Level 4*
Numeracy area – Number			
All students	90	93	91
Boys	90	93	90
Girls	90	93	92
Indigenous students	62	70	74
Non-English speaking background	89	89	90
Geographically isolated	89	93	89
Numeracy area – Space			
All students	76	78	62
Boys	73	78	63
Girls	77	78	61
Indigenous students	51	47	34
Non-English speaking background	71	73	52
Geographically isolated	74	77	54
Numeracy area – Chance and Data			
All students	96	97	81
Boys	96	96	79
Girls	95	97	83
Indigenous students	78	83	57
Non-English speaking background	93	95	70
Geographically isolated	94	95	76
Numeracy area – Measurement			
All students	84	95	75
Boys	84	96	74
Girls	85	95	73
Indigenous students	58	79	42
Non-English speaking background	81	92	68
Geographically isolated	82	95	71

Note: Definitions used in the determination of key subgroups shown in this table may not coincide with definitions used elsewhere in this National Overview.

Source: *Monitoring Standards in Education,* 1996, Education Department of WA

- there was very little change in the relative performance of boys, girls, Indigenous students and students from non-English speaking backgrounds compared with 1992. However, while in 1992 year 10 boys performed significantly better than girls, in 1996, girls' results had improved to the extent that there was no significant difference;
- the performance of students from non-English speaking backgrounds was slightly lower than that of students from English speaking backgrounds. The difference was least for year 3 students, increased slightly for year 7 students and was greatest for year 10 students. While the differences were statistically significant, they were nevertheless small and do not appear to be of practical significance; and
- there was a significant difference between the performance of Indigenous and non-Indigenous students in years 3, 7, or 10. While the results for the former showed clear improvement in achievement from year 3 through year 7 to year 10 at approximately the same rate as the rest of the population, their performance at each year level was substantially lower than all other students tested in the sample. The difference in performance increased slightly at years 7 and 10, so that the results achieved by Indigenous students were almost one outcome level below the results achieved by other students at these year levels.

Formal testing was also reported in the independent school sector, with a view to benchmarking, assisting diagnostic assessment, or the appropriate grouping of students. No reporting of outcomes was provided.

Tasmania

No numeracy monitoring program was undertaken in 1996. All students study mathematics in year 10 and 96 per cent of them received an award in 1996 in one of the four mathematics courses available – 31.9 per cent received an award in the most difficult course.

Of those students studying mathematics in years 11 and 12, 93.4 per cent received an award in one of the eight mathematics courses available, with 23.7 per cent receiving an award in a pre-tertiary course. A small number of students successfully completed an additional pre-tertiary mathematics course.

Northern Territory

Outcome data from the 1996 Urban and Non-Urban Multilevel Assessment Program (MAP) mathematics tests present an overview of the mathematics achievement for the predominantly Indigenous students attending non-urban schools, as well as for the whole student population attending urban schools.

Summary data for the non-urban schools provided a gender breakdown of student outcomes at Stages 2 to 5, summarised in Table 63. Among students attending non-urban schools, the average result for girls was higher than for boys at each of the four stages.

Urban school data was provided in respect of only Stages 5 and 7, as shown in Table 64, although it reported on the performance levels of students in two of the key subgroups, in addition to the whole student population. In reporting on urban schools, Stage 5 was chosen as being generally representative of year 5 students and Stage 7 as being representative of year 7 students, because the participation level was close to 100 per cent. For non-urban schools, where students are predominantly Indigenous, there is no such distinction.

In the urban schools, as shown in Table 64, boys outperformed girls at both levels except for Indigenous students in Stage 7 mathematics, where girls marginally outperformed boys.

Table 63. Non-urban schools 1996 results, all schools, all stages of mathematics, number of students participating, average percentage correct

	Stage 2	*Stage 3*	*Stage 4*	*Stage 5*
Female	749–61%	680–62%	556–44%	407–24%
Male	617–59%	544–58%	411–39%	286–19%

Note: Non-Urban Mathematics breakdowns have been provided by gender only as students are Indigenous from a non-English speaking background.

Source: Northern Territory Department of Education

Table 64. Results of MAP tests in mathematics, Stages 5 and 7, all urban schools, Northern Territory, 1996

	All students	*ESL*	*Indigenous*
Stage 5 mathematics			
Boys	1,147 – 65%	96 – 53%	172 – 51%
Girls	1,030 – 64%	81 – 48%	162 – 49%
Stage 7 mathematics			
Boys	952 – 60%	38 – 54%	92 – 41%
Girls	939 – 58%	42 – 52%	104 – 43%

Source: Northern Territory Department of Education

Australian Capital Territory

Data on student outcomes in numeracy in government schools in 1996 were not available, as no testing program was in place in 1996. However, a decision was made to enhance the monitoring and reporting of student outcomes and, as a result, the ACER numeracy instrument will be trialled in government schools in 1997 for year 5 students, with implementation to follow in 1998. A similar process is planned for government high schools.

Information about participation and outcomes for year 12 students in 1996 indicated that, in government colleges:

- more courses were undertaken in mathematics than in any other key learning area except English; and
- girls undertook 50.5 per cent of all year 12 subject enrolments in mathematics and achieved 54.5 per cent of all A and B grades in year 12 mathematics subjects.

In non-government schools there were more student enrolments in both English and the humanities key learning areas than in mathematics. Gender differences were again evident, as 54.1 per cent of year 12 subject enrolment in mathematics were in respect of girls, who also achieved 56.7 per cent of all A and B grades awarded in year 12 mathematics.

8.4 Student participation in mathematics courses

Participation in a mathematics course is a key component of studies undertaken by all pupils in Australian primary schools and for all secondary students to the end of year 10. At senior secondary level, the study of mathematics was optional for most students. In South Australia and the Northern Territory, at least one unit of mathematics must be included in the pattern of study for the certificate each provides to acknowledge the satisfactory completion of secondary schooling.

Despite being an optional area of study for most senior secondary students, the States generally reported relatively high rates of participation by those students in some sort of mathematics course. The range of mathematics subjects available for study at senior secondary level has expanded in recent years, providing greater opportunities for students to undertake personally-relevant courses.

Data sampled from the reports submitted by the States exemplifies the high level of student participation in mathematics at senior secondary level in 1996:

- 96 per cent of the HSC students in New South Wales government schools sat a mathematics examination, the great majority at the 2 unit level;
- over 60 per cent of students attending Queensland's Catholic schools and between 50 and 60 per cent of students in government schools studied mathematics at an advanced level in years 11 and 12; and
- the actual numbers as well as the proportion of senior secondary students in Western Australia's government schools studying mathematics increased in 1996, while almost all students in Catholic schools and the great majority of students in independent schools studied at least one mathematics subject.

Not all States provided data on participation trends in senior secondary mathematics courses. Of those which did, government schools in the Northern Territory displayed no consistent trend over the period from 1992 and data from South Australia government schools indicated a decline in the number of year 12 students studying mathematics in the period 1993–96, in part reflecting a decrease in retention.

Nearly all independent schools surveyed advised that most of their students chose to study mathematics in years 11 and 12. Many of these schools reported offering a range of mathematics subjects at these levels, from specialist courses in areas such as geometry or trigonometry, to courses aimed at improving general skills. Where students had a strong vocational orientation, practical approaches to mathematics were perceived to be more relevant.

Participation in mathematics was compulsory for all students in the primary and junior secondary years. However, in years 11 and 12 where mathematics was often an optional area of study, some gender-based participation differences were evident, but inconsistent. For example:

- South Australian Catholic schools reported that 83.3 per cent of male year 12 students and 62.6 per cent of female year 12 students studied at least one mathematics course;
- government schools in Western Australia and the Northern Territory reported lower participation rates in mathematics for girls than for boys;
- in the Australian Capital Territory, marginally more girls than boys studied year 12 certificate mathematics; and

- in New South Wales, only 37 per cent of those studying 4 unit mathematics and 46 per cent of those studying 3 unit mathematics were girls.

8.5 Curriculum time for the Mathematics KLA

There were significant variations in the amount of curriculum time devoted to mathematics in Australian schools in 1996, particularly at the primary and junior secondary levels. Even within individual States and sectors there were differences in time allocations, with only general principles to help individual schools determine how best to allocate the time available among the many competing demands.

At primary level, the amount of time per week reported by the States as being devoted to mathematics appeared to vary significantly, as indicated in the examples which follow:

- in Victorian government primary schools, the average was five hours per week;
- allocations for mathematics in Queensland's Catholic schools were generally in the range 5–6 hours per week;
- in South Australia, the majority of students attending government schools participated in approximately 3.3 hours of mathematics per week; students who attended non-government schools undertook from 3.5 to 4.5 hours of mathematics per week;
- the recommended minimum time was five hours per week in Northern Territory government schools;
- in the Australian Capital Territory, it was generally expected that three hours per week would be allocated to mathematics; and
- most independent schools offered from 3.5 hours per week to more than six hours per week at the primary levels. Few schools offered more than six hours per week.

At the junior secondary level, there was also great variation in the amount of time allocated by schools to mathematics, the differences reflecting not only varying philosophical and organisational approaches to curriculum planning, but also the number and nature of mathematics courses available in Australian schools. Examples include:

- the average drops to 4.75 hours per week in years 7 and 8 in Victorian secondary schools;
- Catholic schools in Queensland had variations from 33 hours per semester to over 60 hours per semester, a reflection of the diversity of available courses;
- South Australian government school students undertook an average of around 3.5 hours of mathematics weekly;
- students attending government schools in Western Australia were required to spend at least four hours per week studying mathematics, while students attending Catholic schools typically spent a slightly shorter time; and
- in the Northern Territory, the recommended minimum period for mathematics was 400 hours over three years.

At senior secondary level, the range of mathematics courses was extensive and participation in mathematics for many students was no longer compulsory. At this level, some States reported specific time requirements associated with particular mathematics courses, and others had a requirement for a minimum total exposure to mathematics over the two-year period. However, there was no nationally-accepted time requirement. The number of hours of mathematics studied by each student therefore varied greatly, ranging from zero to as many as eight hours per week for a year 12 student taking a full course of pre-tertiary-level mathematics.

8.6 Changed emphases in numeracy

A number of States reported significant changes in emphasis in the teaching of mathematics, in particular because of the influence of the *National Statement on Mathematics for Australian Schools* and the associated curriculum profile. Although yet to be fully adopted at a national level, with some schools still at an evaluation stage and others using the documents as underlying background and source materials, the mathematics curriculum and profile began to emerge as instrumental in leading schools and systems to re-evaluate the content and place of mathematics in the 1990s.

The Statement's foreword explains that it was developed "to provide a framework around which systems and schools may build their mathematics curriculum". Rather than providing a direct syllabus, the Statement establishes "a foundation for appropriate courses which will meet students' needs and reflect advances in our knowledge - both of the subject mathematics itself and of the ways in which students learn mathematics." Although not adopted by all schools, the Statement was influential in 1996 in fostering development of curriculum and changes in the focus on mathematics in schools.

On the basis of information reported by States, 1996 saw significant impacts from the mathematics profile, particularly through the incorporation of outcomes-based approaches into teaching, assessment and reporting. Professional development of teachers and the exposure of teachers to the application of the profile in their work also enhanced teachers' views about numeracy, refocused their assessment practices and turned more attention to developing the ability of their students to apply mathematics learning in a range of contexts.

Among the specific changes reported by the States were:

- the development of mathematics syllabus outcomes in several States, across each of the sectors, commonly put into practice as trials of profile-based assessment of student performance at the primary level;
- the inclusion of teaching and learning about new areas, such as chance and data, not commonly included in schools' mathematics programs;
- the acceptance by an increasing number of schools of the challenge to provide a wider range of skills and processes and to make mathematics relevant to students;
- an increasing emphasis on 'working mathematically' as an important process for students; and
- the involvement of parents and the community in supporting student learning in mathematics.

8.7 Teacher availability and training

Most States reported an adequate supply of both primary and secondary mathematics teachers in 1996, although South Australia and Western Australia referred to some difficulties, in both government and non-government sectors, in appropriately staffing schools in some country areas. A particular issue of concern in Queensland was the availability of sufficient teachers with the skills needed to teach the new mathematics courses in years 11 and 12.

Even where levels of supply and demand were not currently seen as major issues, a number of States anticipated a future shortage of mathematics teachers, particularly of teachers qualified to teach the highest level courses for senior secondary students. Western Australia reported an expected shortage of mathematics teachers in 1997–1999, based on a significant decline in the number of people beginning courses to train as secondary mathematics teachers, as well as a drop in the number of graduates from 1994 to 1996. Tasmania and the Northern Territory also reported the likelihood of a future shortage. The Northern Territory particularly is vulnerable, as it relies almost entirely on southern tertiary institutions for its secondary mathematics teachers.

The level of mathematics qualification and teaching experience was an issue for several States.

A number of States reported on activities to address their concerns about mathematics teacher supply and demand. Dialogue with university providers of teacher training was reported from Queensland, South Australia and Western Australia, in each case with a view to ensuring an adequate future supply of appropriately qualified mathematics teachers. In terms of specific programs, Queensland initiated dialogue with the Queensland University of Technology to establish a Graduate Certificate course to address the need for specialist skilling of senior mathematics teachers and Tasmania offered scholarships to students beginning courses of training at the University of Tasmania to become secondary mathematics teachers.

Information provided on the pre-employment education of teachers suggests significant differences between the preparation of teachers who will work with primary students and those who will work in the secondary sector. Those training to work as primary teachers, for example, undertake a course aimed at providing a broad understanding of all curriculum areas, without necessarily acquiring a specific qualification in numeracy. Students training to become mathematics teachers at a secondary level, however, are generally expected to gain a major in this field, as well as undertaking appropriate professional studies, including teaching practice, with a focus on numeracy.

For practising mathematics teachers, the task of maintaining the currency of teacher knowledge and skills was managed in each State through extensive programs of professional development activities. Subject association seminars and workshops, Statewide or regional programs offered through system authorities, those provided through credentialling authorities, and those designed to assist teachers from within a particular educational sector, all contributed to bringing teachers up to date with current trends and practices. A significant proportion of those activities related to the use of the national statement and profile, although other numeracy-related areas, including problem solving, the use of graphics calculators, and computer-based literacy development, were reported.

Teachers considered that most professional development programs were successful in bringing them up to date with current trends and practices. Success was also contingent on the skill of the course instructors, the support and commitment of the teachers and participation of all staff.

8.8 Research relating to numeracy

Not all States reported on research activities undertaken in 1996 in the area of numeracy, but States doing so provided an overview of projects across a wide range of numeracy-related areas, from the broadest of issues relating to the definition of the term numeracy, to the specifics of how children learn mathematics.

In 1996, research on children's number strategies in New South Wales sought to provide a picture of how children acquire increasingly sophisticated approaches to solving numerical problems. The Count Me In project ran as an applied research and development pilot to assist K–2 teachers to broaden their knowledge of how children learn mathematics. It incorporated the best of current national and international research in the formation of an initial learning framework that was then modified through a 'grounding' in classroom practice. A key outcome of the project was professional development for the teachers involved, resulting in improved student learning outcomes.

A new emphasis on student learning outcomes is driving many of the current projects at all levels of education in Queensland. The Year 2 Diagnostic Net Number Development Continuum will have the capabilities to provide current and accurate data about students' achievements at the end of year 1, year 2 and year 3. There are plans to interview teachers and principals and to interrogate a large quantity of Individual Student Profiles, with a report due at the end of 1997. In addition, the Junior Secondary Literacy and Numeracy Investigative Study provided case studies of strategies designed to improve the abilities of students experiencing numeracy difficulties in the early stages of secondary schooling. Studies included:

- computer support for numeracy intervention in mainstream classrooms;
- Flying Start, an integrated approach using computer technology;
- numeracy across the curriculum;
- teacher aide support in mathematics classrooms; and
- the use of task centres in year 8 mathematics.

Numeracy research in South Australia included the analysis of students' results in the BST and the establishment of an information base of research to support the effective teaching of numeracy in the early years.

In Western Australia, work continued on First Steps in Mathematics (FSIM) to develop a research base, produce teacher support materials and establish professional development models, particularly for the support of primary students at risk. In conjunction with Murdoch University, a two-year project, funded by the Education Department and the Australian Research Council, is to investigate and develop a model for describing and enhancing numeracy, particularly across the curriculum. Strategies will be developed to assist schools to perform numeracy audits and help teachers enhance student numeracy. In association with the Australian Association of Mathematics Teachers, the Education Department applied to DEETYA for funding to mount a national forum on numeracy in May 1997. This will bring together numeracy specialists from throughout Australia to map current thought and research and develop a view of numeracy for wider discussion by stakeholders who will identify areas for future action and develop strategies for collaborative local, State and national action.

8.9 Involving parents and the community in improving numeracy

School programs to support the development of numeracy operated in response to locally identified needs. At the most common level schools encouraged parents to support home learning, oversee homework and positively encourage their children in the area of numeracy. Many school programs move far beyond that, seeking to strengthen links between what happens in the home and what happens in the classroom, increasing parents' understanding of the way children learn mathematics and helping them to consider the role they can play in the development of their children's attitudes to mathematics.

While programs to foster the involvement of parents and the wider community in the development of numeracy skills in Australian children take many forms, those reported in 1996 included:

- the use of parents, both in the classroom and with individual students, in programs supporting students' needs for either extension or remediation activities in the area of numeracy;
- information sessions to assist parents to better understand ways of helping students at home, including the provision of advice about the purchase of aids to numeracy for children;
- the use of parents with special mathematical skills, for example in the engineering area, to assist with projects, games and special presentations;

- parent seminars and training on issues related to numeracy and mathematics methodology;
- as part of the Year 2 Diagnostic Net development in Queensland, a brochure providing a range of common numeracy-related activities and experiences that would relate to most families was well received by parents;
- in South Australia, a Mathematics Reference Group, which had representation from peak parent, tertiary and industry bodies, provided advice on mathematics curriculum development, professional development and inservice training;
- the involvement of parents and the community in mathematics activities days and annual Mathematics Week activities; and
- the use of communication books or continuous assessment materials to include parents in the numeracy learning process.

From State reporting it is evident that parents in particular are perceived as having an important role in developing numeracy skills in Australian children. The involvement of parents is generally more focused in the primary and lower secondary areas, with programs existing to provide extension for able students, as well as to assist in remediation for those in difficulties with numeracy. A continuing community focus on numeracy is likely to ensure the further development of strategies to involve parents and the community in the future.

8.10 Significant numeracy initiatives

Initiatives in numeracy in 1996 included further work on the development of a nationally accepted definition of numeracy, the introduction and application of specially-devised programs, a range of developments in areas of the mathematics curriculum, inputs into teacher professional development and the fostering of student participation in special mathematics events.

Specially developed numeracy programs were central to the initiatives put in place by a number of States. The major focus for these programs was the development of numeracy in the early years of schooling, although the primary-secondary transition was also recognised as important. Among the special programs established in 1996 were:

- in New South Wales, Count Me In, a program focusing on developing the strategies children use when learning mathematics in the early years of schooling, was introduced in government schools in four districts as a research and development pilot, while Catholic schools continued with the Numeracy for All program focusing on early intervention;
- the Queensland School Curriculum Council (P–10) conducted a parent information project, titled Hand-in-Hand, which incorporated a significant focus on the development of numeracy knowledge, skills and abilities;
- a numeracy project was initiated in South Australian Catholic schools, aimed at identifying key issues in numeracy, as well as researching and developing programs which support student numeracy;
- in Western Australia, work continued on the development of FSIM which was first introduced in 1995 with the aim of improving primary teachers' understanding of teaching and learning in mathematics within a developmental framework; and
- the Flying Start program in Tasmania, to be fully implemented in years K–2 from early 1997, was devised as a means to extend the successful Prep Literacy Program to include numeracy.

Developments occurring in mathematics curricula had basic numeracy as a key focus, but also included upper primary, primary-secondary transition and specialist mathematics for secondary students. For example:

- reporting from the independent school sector indicated that many schools introduced problem solving and an investigative approach to numeracy across all levels. Emphasis was also placed on basic numeracy skills and specialist mathematics for secondary students;
- activities with a focus on supporting early childhood teachers and administrators in recognising and interpreting students' numerate abilities and providing strategies to further enhance students' numeracy development were reported from several States, including Queensland and South Australia;
- in New South Wales, case studies addressing the middle school transition in mathematics were conducted in 25 districts, the outcomes of this project reflecting the emerging issue of continuity of numeracy across the transition from primary to secondary education;
- work on the development of student outcome statements, consistent with those published in the mathematics profile, was reported from some States, with Tasmania in particular reporting extensive work on a draft set of Key Intended Numeracy Outcomes (KINOs);

- analysis of information gained from large-scale testing programs such as Queensland's Year 2 Diagnostic Net and the BST information for years 3 and 5 in South Australian government schools helped improve understanding of the numeracy development of children and the planning of mathematics programs to best address the varied needs of students, including appropriate intervention programs; and
- the amount of curriculum time allocated to mathematics was addressed in some States, including Western Australia and Tasmania, the latter developing a policy on mathematics and mandated dedicated mathematics time in Tasmanian government schools, to take effect in 1997 in primary schools and in 1998 in high schools.

In 1996, many schools at both primary and secondary level were involved in a range of State and national mathematics competitions, with the aim of testing students' problem solving abilities and to encourage enjoyment of the study of mathematics. Some schools used the results of such competitions to monitor strengths and weaknesses in their mathematics programs, while others used the data for course and career counselling.

8.11 Emerging or continuing issues

A number of States reported that they were grappling with the theoretical complexities of the concept of numeracy. There was a greater level of understanding of the concept of numeracy which enabled work to progress towards national agreement on a definition of numeracy, which would have an emphasis on outcomes, in place of many existing programs which have tended to have an 'input' focus and have not identified the specific needs of the student population, nor identified what would be reasonable expectations in relation to the learning outcomes - at particular year levels, stages of development or on exit from the school.

Further issues identified by States as having ongoing importance related to curriculum, effective mathematics teaching and assessment. The range of curriculum-related issues included:

- the need for future curriculum development and program design to focus on applying mathematics skills in real situations relevant to daily life, which would be of benefit to all students but particularly to those at risk of not completing secondary schooling;
- a greater emphasis on problem solving and the development of lateral thinking;
- concerns about the immediate relevance of senior mathematics courses which have led to the introduction of new mathematics programs in some States and to increased pressure to review and revise the senior mathematics curriculum in others;
- the need to examine the cross-curriculum aspects of numeracy, which were still not being adequately addressed, although development of integrated units for the primary years was improving awareness;
- that numeracy must be considered when any curriculum or syllabus development takes place, with each key learning area acknowledging its role in contributing to students' development of numeracy; and
- the integration of vocational education and mathematics is evident in the embedding of aspects of mathematics within courses with a vocational focus.

Issues relating to the effectiveness of mathematics teaching included:

- the development of strategies to ensure that the quality of mathematics provision is maintained in the face of the increasing demands on time for teaching and learning in schools;
- in terms of the targeting of numeracy programs, a need was perceived to further develop teachers' skills in understanding and applying a broader view of numeracy, on the appropriate assessment of levels of numeracy and on the specific steps to be undertaken to ensure that all students at risk were adequately provided for in numeracy programs;
- the need for continuing professional development in relation to the mathematics statement and profile, particularly in secondary schools, as well as greater opportunities for professional development to help teachers stay abreast of current best practice in other areas of their teaching; and
- strategies to ensure the best support for quality teaching and learning of mathematics included trialling explicit curriculum materials which assist teachers to align their practices with the statement and profile and drawing feedback from professional development programs.