

# An Investigation into the Impact of the Secondary Numeracy Project on Student Performance in Two NCEA Level 1 Mathematics Achievement Standards

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In 2007, the Secondary Numeracy Project (SNP) operated in some secondary schools for the third year. This study investigated whether the professional development has had an effect on student achievement in two NCEA Level 1 mathematics achievement standards. Analysis of results for these standards found little apparent difference between the attainments for students in SNP schools compared with the rest of the cohort.

## Background

The Secondary Numeracy Project (SNP) was formally introduced into secondary schools in 2005. Teachers of year 9 mathematics classes in 42 schools undertook professional development in the teaching of mathematics to year 9 classes. Particular focuses of the professional development were: introducing the Number Framework, which specifies a progression of strategies and knowledge in number; using the Numeracy Development Projects (NDP) diagnostic assessment (NumPA) to ascertain students' number strategies, and administering a whole-class test to establish their knowledge; and expanding the range of pedagogical practices used in mathematics classrooms. The results of the SNP diagnostic assessment were used to establish detailed knowledge of the students' number knowledge and skills, and the project focused on extending students' understanding by building on what they already knew. Teachers in the participating schools received continued support in 2006 to embed good practice into their teaching of year 9 students and to extend this practice to their teaching of year 10 students. In 2007, these teachers received further support to consolidate their development of mathematics pedagogy.

In 2007, the students who were taught as year 9 students in 2005 had progressed to year 11 and, by the end of that year, would potentially have experienced "numeracy-project-aware" teaching for their three years of secondary schooling.

NCEA Level 1 is the first national qualification undertaken by students in New Zealand secondary schools. Most students in year 11 undertake study and assessment towards NCEA Level 1 (although in many schools, this opportunity may be offered to selected year 10 students). At NCEA Level 1, mathematics is not formally assessed through one overarching assessment – instead, it is assessed through a collection of smaller blocks of related content called "standards". Two separate but interconnected systems are used for assessment, namely unit standards and achievement standards. Each of these standards has a weighting of typically between 2 and 4 credits – a full-time course in mathematics consists of about 24 credits. All unit standards are internally assessed, and students who meet the required standard are awarded credits.

There are nine achievement standards at NCEA Level 1; six of these are externally assessed in an end-of-year examination, and three are internally assessed. For the achievement standards, students are awarded grades of not achieved, achieved, merit, or excellence.

## Research Question

This study reports on the impact of the SNP on student achievement in year 11 mathematics. Specifically, the research question was:

- What impact on achievement at year 11 in two external assessments can be found for students in SNP schools?

## Rationale

Where the standards are internally assessed, that is, the unit standards and three of the achievement standards, data are sent to the New Zealand Qualifications Authority (NZQA) only if the student has achieved the standard at some level. Analysis of trends in performance for internally assessed standard was outside the scope of this study, so the internally assessed standards have not been analysed in this study. However, this could be the focus of a future study.

The two externally assessed achievement standards, Use straightforward algebraic methods and solve equations (Achievement Standard 90147) and Solve straightforward number problems in context (Achievement Standard 90151), were used for this research because these are the achievement standards where the skills developed through the SNP are most likely to have the greatest impact. Trends in the assessment for these two standards were compared for the two groups (SNP and non-SNP students) over the two years of 2006 and 2007.

## The Sample

Table 1

*Distribution of Candidates by Decile for 2007 Achievement Standard 90147: Use straightforward algebraic methods and solve equations*

	Decile										Total
	1	2	3	4	5	6	7	8	9	10	
SNP schools: number of schools in study by decile	2	4	3	5	4	6	5	4	5	3	41
SNP schools: number of candidates from each decile	74	205	260	329	489	657	507	604	1210	207	4542
SNP schools: percentage of candidates from each decile	1.6	4.5	5.7	7.2	10.8	14.5	11.2	13.3	26.6	4.6	100.0
All secondary schools: number of candidates from each decile	823	1363	1925	3246	3990	4108	4912	4064	4604	6413	35 448
All secondary schools: percentage of candidates from each decile	2.3	3.8	5.4	9.2	11.3	11.6	13.9	11.5	13.0	18.1	100.0*
Non-SNP schools: number of candidates from each decile	749	1158	1665	2917	3501	3451	4405	3460	3394	6206	30 906
Non-SNP schools: percentage of candidates from each decile	2.4	3.7	5.4	9.4	11.3	11.2	14.3	11.2	11.0	20.1	100.0

\* Percentages may not add up to 100 due to rounding.

Table 1 shows the distribution of candidates by decile for the 2007 Achievement Standard 90147: Use straightforward algebraic methods and solve equations. The table shows that the SNP schools come from the full range of deciles. However, deciles 1, 3, and 10 appear to be comparatively under-represented. A comparison of the proportion of candidates from the SNP schools with the national distribution of students shows that the SNP sample significantly over-represents decile 9 candidates and under-represents decile 10 candidates.

The number of candidates at non-SNP schools for each decile was found by subtracting the number of candidates at SNP schools from the number of secondary students.

## Research Method

Data were obtained from the NZQA for two NCEA Level 1 achievement standards and the decile ratings of the secondary schools. The data supplied were: performance of students from the SNP schools, performance by decile of all secondary school candidates, and decile ratings for the SNP schools for 2006 and 2007 (NZQA, personal communications, 2008). The specific achievement standards investigated were: Use straightforward algebraic methods and solve equations (Achievement Standard 90147) and Solve straightforward number problems in context (Achievement Standard 90151). The performance of students at the 41 SNP schools<sup>1</sup> was compared with the national patterns of achievement for all other students in the 2006 and 2007 student cohorts.

Analysis of achievement of students in these two externally assessed standards showed that there was a very strong relationship between the decile rating of the school and the performance of the candidates. This disparity of achievement by social economic status is consistent with data from previously reported studies (for example, Timperley & Alton-Lee, 2008). This relationship can be seen in Figure 1, which shows performance of candidates by decile for the 2007 Achievement Standard 90147: Use straightforward algebraic methods and solve equations.

In order to create a weighted sample of results that matched the decile distribution of candidates in the SNP schools, the performance of candidates in the non-SNP schools, by decile, was weighted by the proportion of candidates from SNP schools of that decile.

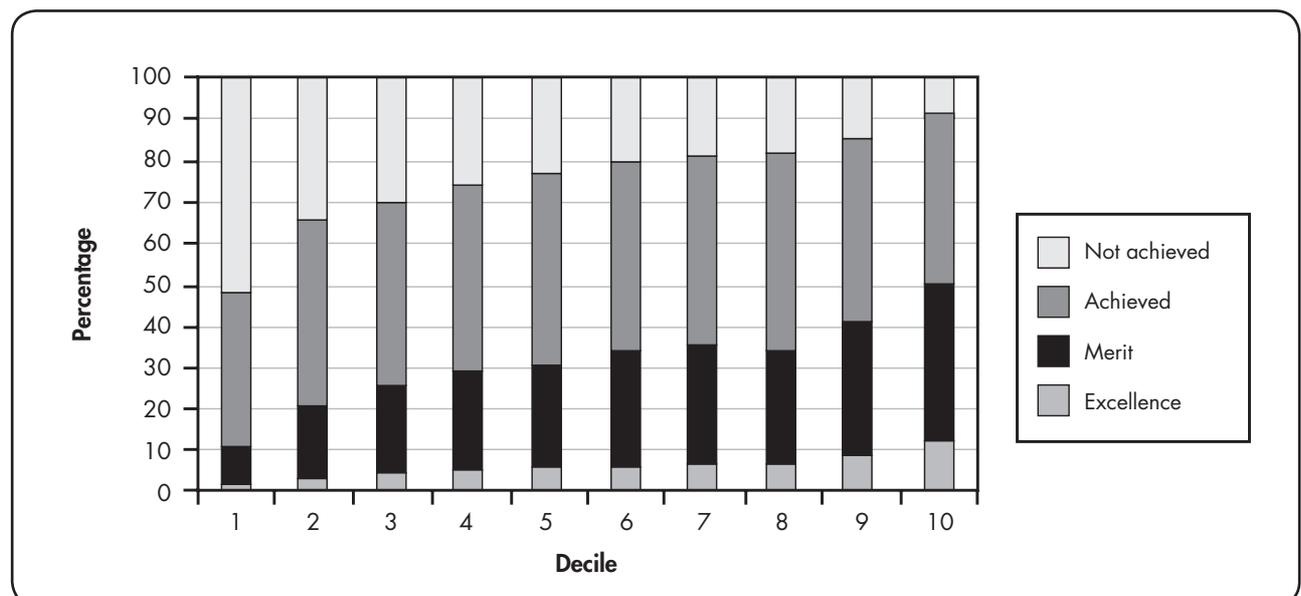


Figure 1. Performance of candidates by decile for 2007, Achievement Standard 90147: Use straightforward algebraic methods and solve equations

<sup>1</sup> One school that completed the SNP in 2005 withdrew from the project in 2006, so the data from this school have not been included with the SNP schools.

## Results

### *Achievement Standard 90147: Use straightforward algebraic methods and solve equations*

In the material that follows, “SNP” refers to the students in the 41 schools who first participated in the SNP in 2005. “Non-SNP” refers to those students who were in schools that did not participate in the SNP in 2005.

Table 2  
*Results for Achievement Standard 90147: Use straightforward algebraic methods and solve equations*

	Number	Not Achieved	Achieved	Merit	Excellence
2006 all candidates	35 415	12 495	12 720	6704	3496
2006 SNP	4915	1871	1726	871	447
2006 non-SNP	30 500	10 624	10 994	5833	3049
2007 all candidates	35 448	13 013	15 700	4173	2562
2007 SNP	4542	1866	1935	474	267
2007 non-SNP	30 906	11 147	13 765	3699	2295

Table 3  
*Comparison of Performance of Students in SNP Schools with Weighted National Distribution of Students in Non-SNP Schools for Achievement Standard 90147: Use straightforward algebraic methods and solve equations*

	% Not Achieved	% Achieved	% Merit	% Excellence
2006 SNP	38.1	35.1	17.7	9.1
2006 weighted non-SNP	34.0	35.8	19.5	10.8
2007 SNP	41.1	42.6	10.4	5.9
2007 weighted non-SNP	37.1	44.8	11.4	6.8

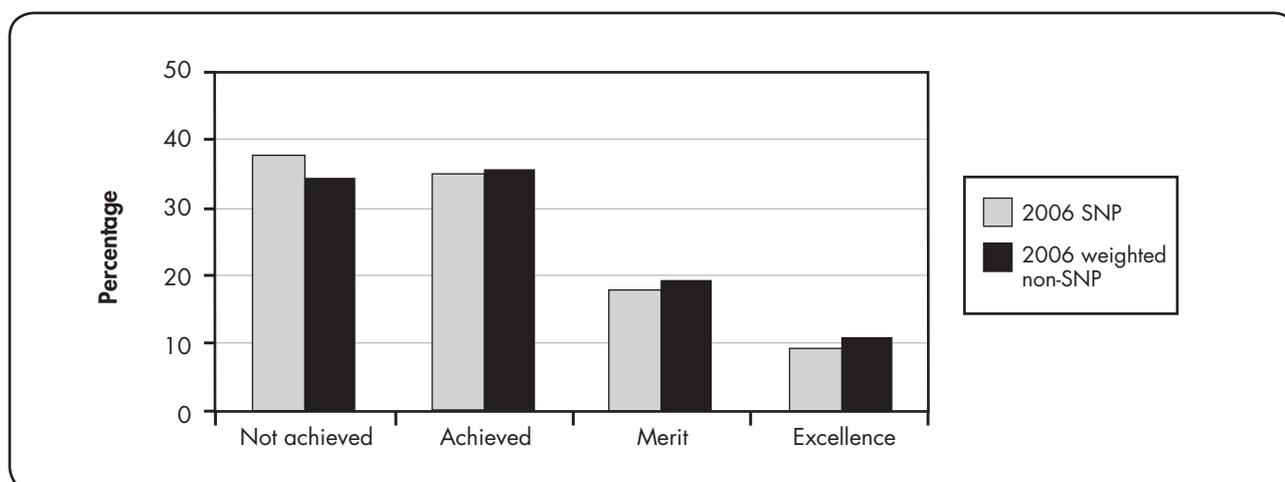


Figure 2. 2006 proportion of students gaining grades for Achievement Standard 90147: Use straightforward algebraic methods and solve equations

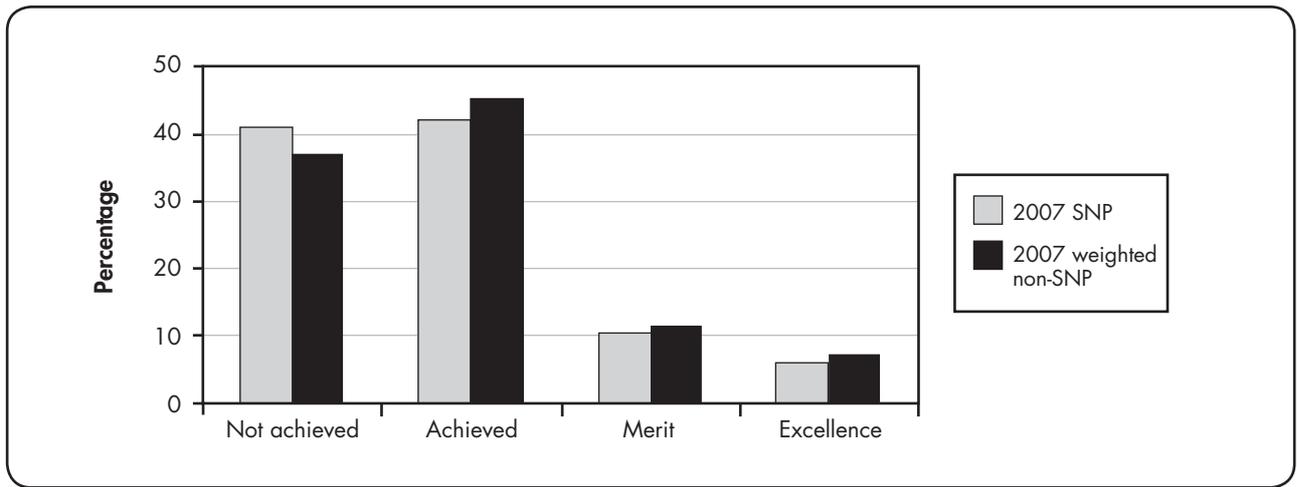


Figure 3. 2007 proportion of students gaining grades for Achievement Standard 90147: Use straightforward algebraic methods and solve equations

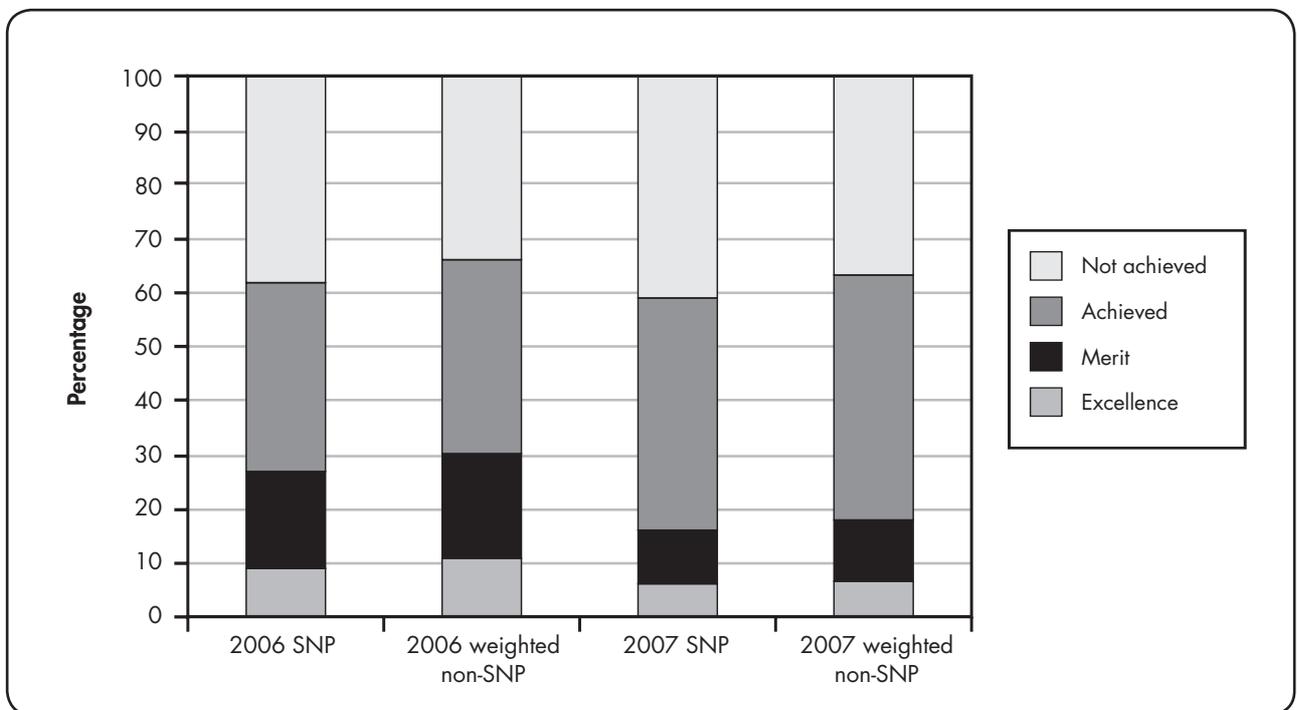


Figure 4. 2006 and 2007 proportions of students gaining grades for Achievement Standard 90147: Use straightforward algebraic methods and solve equations

Table 4

*Analysis of Results for Achievement Standard 90147: Use straightforward algebraic methods and solve equations*

	Percentage of Students		
	Gaining achieved, merit, or excellence	Gaining merit or excellence	Gaining excellence
2006 SNP	61.9	26.8	9.1
2007 SNP	58.9	16.3	5.9
Progress for SNP	-3.0	-10.5	-3.2
2006 weighted non-SNP	66.0	30.2	10.8
2007 weighted non-SNP	62.9	18.1	6.8
Progress for weighted non-SNP	-3.1	-12.1	-4.0
Growth = progress SNP – progress non-SNP	0.1	1.6	0.8

Results for Achievement Standard 90147: Use straightforward algebraic methods and solve equations are shown in tables 2–4 and figures 1–4. It is clear that students at both SNP and non-SNP schools were less successful in this standard in 2007 than in 2006. In particular, there was a marked decline in 2007 in the proportion of students gaining merit or better compared with 2006. The data also show that, in both 2006 and 2007, students in non-SNP schools were more successful than those in the SNP schools.

Table 4 has been used to compare the performance between the two groups in greater depth. The term “progress” has been used to quantify the improvement in attainment from 2006 to 2007. In every case, for both the SNP and non-SNP students, this figure is negative, indicating that, as a group, the 2007 students found this assessment more demanding than did the 2006 cohort.

“Growth” is the measure of how much students in the SNP schools improved their performance compared with the students in the non-SNP schools. For Achievement Standard 90147: Use straightforward algebraic methods and solve equations, the growth is small and positive for all three measures, although the 0.1 for the proportion gaining an achieved grade or better may be regarded as negligible. This indicates that over the two years, 2006–2007, the students in the SNP schools showed a modest improvement in the proportion who gained merit or excellence when compared with the students in the non-SNP schools.

For this standard, the variation in results between 2006 and 2007 for the SNP schools is largely explained by the change in performance in the whole cohort. However, there may have been a small improvement in performance for SNP students when compared with the rest of the cohort.

*Achievement Standard 90151: Solve straightforward number problems in context*

Table 5

*Results for Achievement Standard 90151: Solve straightforward number problems in context*

	Number	Not Achieved	Achieved	Merit	Excellence
2006 all candidates	37 878	5894	19 217	9124	3643
2006 SNP	5563	973	2889	1197	504
2006 non-SNP	32 315	4921	16 328	7927	3139
2007 all candidates	37 295	7330	16 751	10 643	2571
2007 SNP	5144	1148	2332	1314	350
2007 non-SNP	32 151	6182	14 419	9329	2221

Table 6

*Comparison of Performance of Students in SNP Schools with Weighted National Distribution of Students in Non-SNP Schools for Achievement Standard 90151: Solve straightforward number problems in context*

	% Not Achieved	% Achieved	% Merit	% Excellence
2006 SNP	17.5	51.9	21.5	9.1
2006 weighted non-SNP	16.1	51.4	23.4	9.1
2007 SNP	22.3	45.3	25.5	6.8
2007 weighted non-SNP	20.3	45.3	28.0	6.4

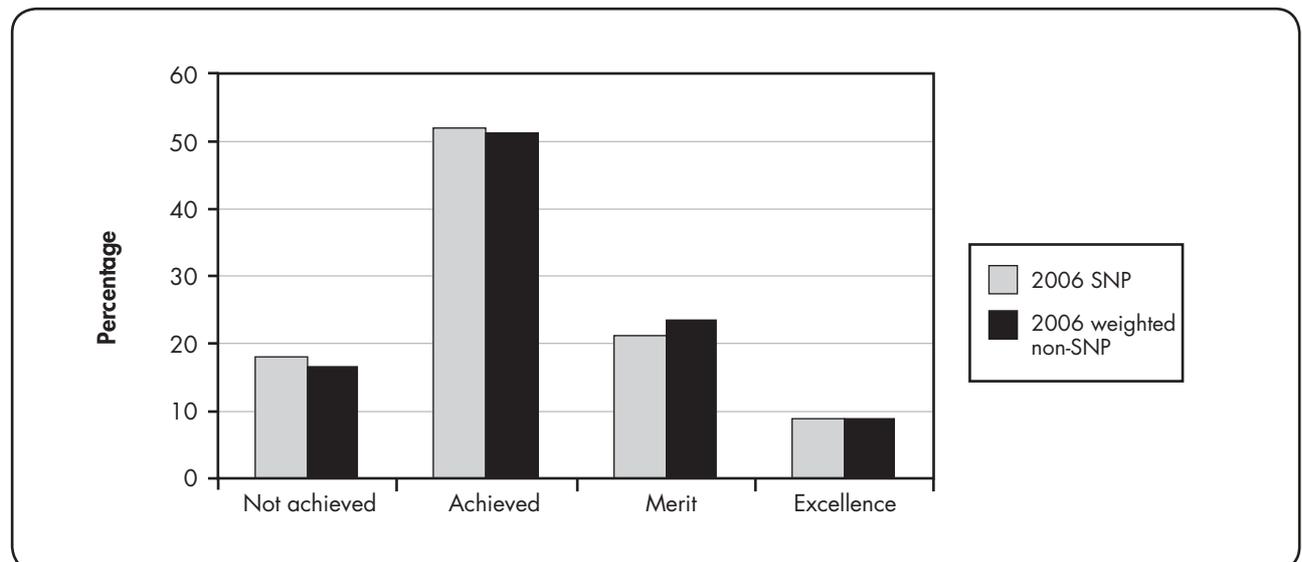


Figure 5. 2006 proportion of students gaining grades for Achievement Standard 90151: Solve straightforward number problems in context

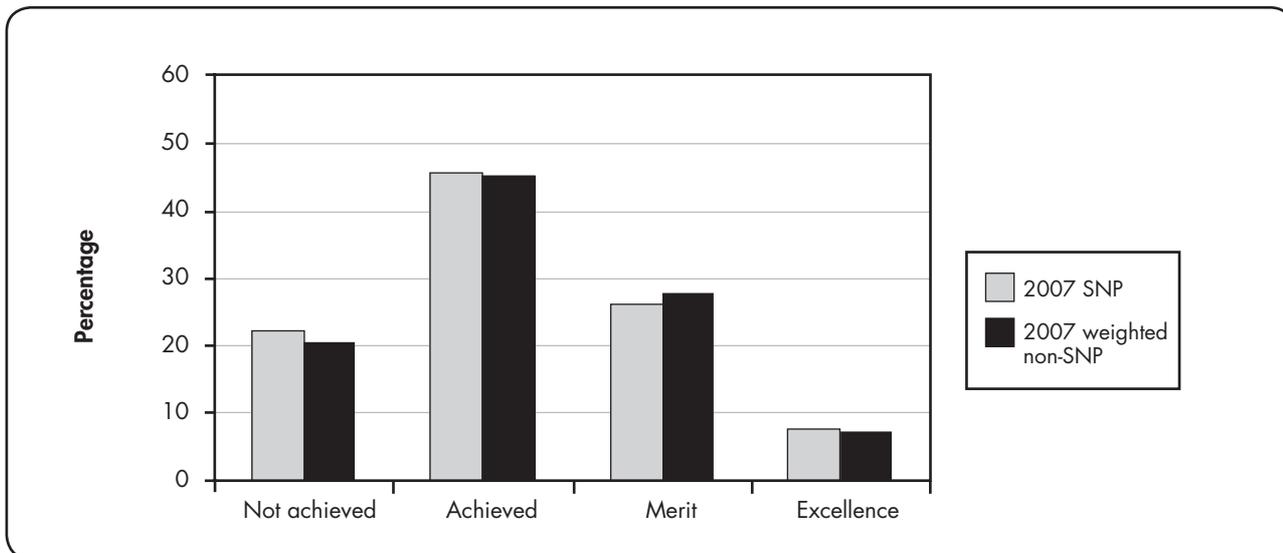


Figure 6. 2007 proportion of students gaining grades for Achievement Standard 90151: Solve straightforward number problems in context

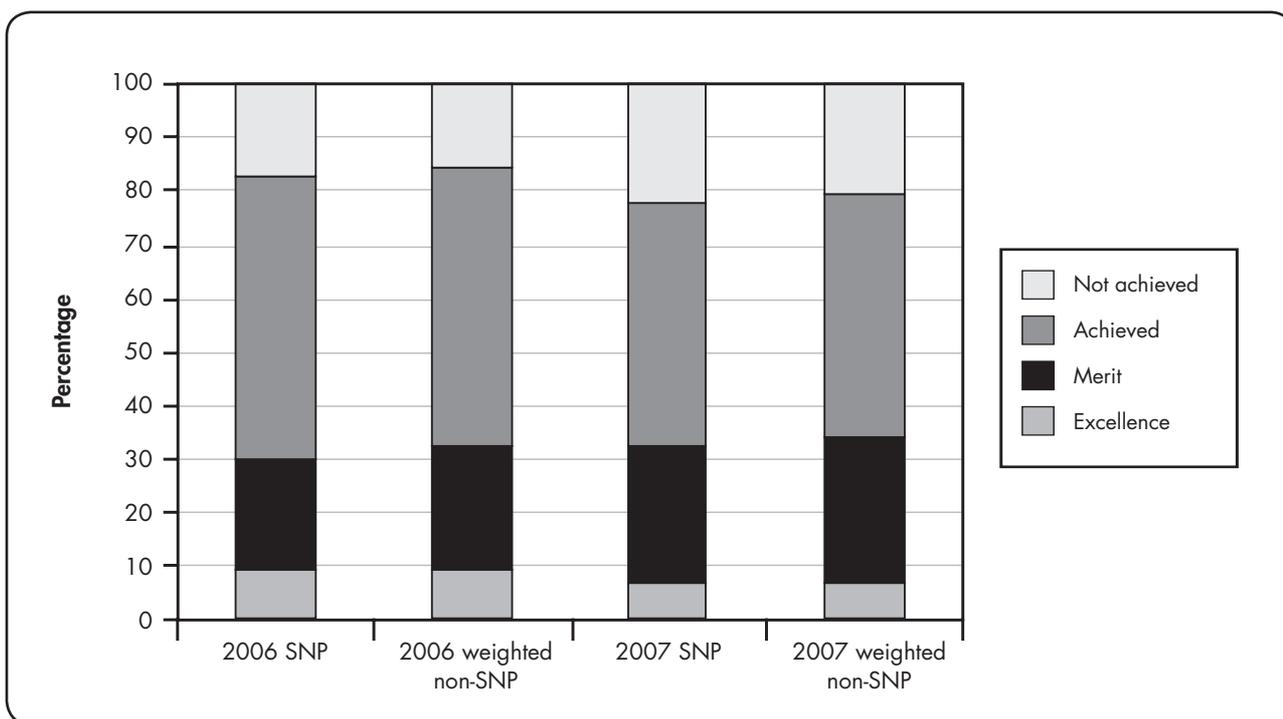


Figure 7. 2006 and 2007 proportions of students gaining grades for Achievement Standard 90151: Solve straightforward number problems in context

Table 7

*Analysis of results for Achievement Standard 90151: Solve straightforward number problems in context*

	Percentage of Students		
	Gaining achieved, merit, or excellence	Gaining merit or excellence	Gaining excellence
2006 SNP	82.5	30.6	9.1
2007 SNP	77.7	32.3	6.8
Progress for SNP	-4.8	1.8	-2.3
2006 weighted non-SNP	83.9	32.5	9.1
2007 weighted non-SNP	79.7	34.4	6.4
Progress for weighted non-SNP	-4.2	1.9	-2.7
Growth = progress SNP – progress non-SNP	-0.6	0.1	0.5

Results for Achievement Standard 90151: Solve straightforward number problems in context are displayed in tables 5–7 and figures 5–7. These results for the two cohorts (SNP and non-SNP) indicate very similar patterns in both 2006 and 2007. However, the results also show that, compared with 2006, a lower proportion of 2007 students attained excellence and a lower proportion gained achieved or better. However, a greater proportion achieved merit or excellence.

Analysis of the growth in Table 7 shows a slight relative increase in attainment in the proportion of students gaining excellence for the SNP schools and a slight relative decrease in the proportion attaining achieved or better.

Overall for this achievement standard, the variation of results between 2006 and 2007 students in SNP schools matches very closely to the variation of results for all other candidates.

## Discussion

The analysis of results shows that, for students involved in the SNP, there may have been a very modest improvement of achievement in Achievement Standard 90147: Use straightforward algebraic methods and solve equations, but there was no apparent difference in the results for Achievement Standard 90151: Solve straightforward number problems in context.

Interpretation of these results needs to be treated with caution. The SNP aims to enhance students' conceptual understanding and achievement in number and algebra strategies, whereas the standards were developed at a time when procedural approaches to answering questions was the focus. The SNP approach includes more judicious use of calculators. However, assessments for the achievement standards are conducted with students being able to use calculators freely. It is possible that ways of showing thinking that are encouraged through the SNP may not yet have been recognised as valid in the marking of the achievement standards assessments.

The assumption that is required to compare the results for the two years is that the cohorts of students in the two groupings will be roughly comparable year to year. This may or may not be true. School-based decisions, such as the setting of the criteria for which students do which courses, may influence the quality of the student population. It is noticeable that between 2006 and 2007, there was a decline of approximately 7.5% in the number of students from SNP schools entered for each of the

achievement standards, whereas the comparable numbers in non-SNP schools has remained relatively stable. This change in student numbers may have had an impact on the profile of performance for the SNP students.

The groups of students taking these assessments does not include the students doing the “alternative” courses. It must be remembered that the teachers of alternative courses in general reported greater impact on the teaching and learning of mathematics than the teachers of the achievement standards classes.

One of the SNP schools changed their decile rating between 2006 and 2007; acknowledging this factor in the make-up of the weighted sample had a noticeable effect on the results for growth for each standard. While the use of decile-weighted results enabled more robust scrutiny of the information, there could be other important factors that need to be considered in order to make a more reliable analysis of the sample compared with the rest of the cohort.

This study has focused on the achievement of students on two externally assessed achievement standards. It is important that these results are not over-generalised. Harvey and Smith (this volume) found that the SNP had a greater effect on the teaching of year 11 students who were doing courses predominantly assessed by unit standards. It is likely that other studies focusing on different standards could produce different conclusions.

A more in-depth study, using students’ assessment scripts for these standards, is likely to give more detailed information about the ways in which students in SNP schools carry out mathematical tasks. Tracking these data may provide information that is of great use in ensuring continued improvements in the ways in which mathematics is taught.

## Recommendation

It is recommended that research be carried out on student performance using examination scripts for year 11 external assessments to better assess the way in which the SNP has impacted on student performance.

## References

- Harvey, R., & Smith, D. (this volume). What views do teachers hold on the impact of the Secondary Numeracy Project on the teaching of year 11 classes? In *Findings from the New Zealand Secondary Numeracy Project 2007*. Wellington: Learning Media.
- Timperley, H., & Alton-Lee, A. (2008). Reframing teacher professional learning: An alternative policy approach to strengthening valued outcomes for diverse learners. *Review of Research in Education*, 32, 328–369.