CONTENTS

Evaluations of the 2006 Secondary Numeracy Project

Foreword

In 2005, the Secondary Numeracy Pilot Project (SNP) was introduced in a selection of secondary schools to:

- improve outcomes for students by raising their achievement in mathematics, particularly in number and algebra
- enhance the teaching of mathematics so that the needs of individual students are addressed
- enhance the mathematics communities of practice in each participating department
- improve collegiality in and between mathematics departments.

The SNP was expanded in 2006. This report presents the research undertaken alongside the SNP in the second year of its implementation. Teachers have continued to make progress in developing their pedagogy, and students continue to show improved understanding of mathematics. The two chapters in this report have identified aspects of the SNP that need further development and make valuable suggestions for future directions in the project. They also tell a promising story of the progress being made to help students understand mathematics.

Impact of the SNP on Teachers and Facilitators

In Chapter One, "Evaluation of the 2006 Secondary Numeracy Project", Roger Harvey and Joanna Higgins evaluate the impact of the SNP on teachers and in-school facilitators. Based on the feedback they received from teachers and facilitators (both external and in-school) through surveys and some semi-structured interviews, they recommend a further expansion of the SNP to a greater number of secondary schools, the development of guidelines to assist in selecting effective in-school facilitators, and the continuation of support for current SNP schools.

Teachers and in-school facilitators commented very favourably about the impact the SNP has had on their knowledge of teaching mathematics and their knowledge of how students learn mathematics. They rated the diagnostic interview as a very useful tool for supporting and influencing changes in mathematics teaching.

The part that equipment can play in the learning of mathematics in a secondary environment drew several comments, mostly favourable. Harvey and Higgins suggest the identification of "powerfully pedagogical" equipment for secondary classrooms.

Although the Numeracy Development Project support booklets were deemed useful, a need for the inclusion of selected topics specifically for secondary schools was expressed.

The in-school model of facilitation in the SNP is seen as a strength of the project. Practicing teachers are released from some of their teaching load to facilitate the SNP with up to 12 year 9 teachers, usually all at the same school. Teachers recognise that this means that the facilitator knows the culture of the school and how to work effectively in it. It also enhances the credibility of the SNP because teachers can see facilitators implementing the project in their own classrooms. Having an in-school facilitator allows for continuous support of teachers and has an impact on the nature of pedagogical discussions at departmental meetings. If there is an issue with the facilitation model, it is in situations where a facilitator works with more than one school. Further resourcing support is suggested by the researchers to assist facilitators in these more demanding situations.

Student Performance and Progress

In Chapter Two, "Performance of SNP Students on the Number Framework", Andrew Tagg and Gill Thomas continue their analysis of the progress of students in the SNP, measured against the Number Framework. With the SNP in its second year of implementation, comparisons could be drawn between the effects of the SNP for students in 2005 and 2006.

Tagg and Thomas's analysis indicates that the SNP has continued to have a consistently positive impact on student achievement in year 9. For schools new to the project in 2006, significant shifts were achieved in raising the proportion of the student population that could perform in the top two stages of the additive, multiplicative, and proportional domains. These figures are very similar to the gains achieved in the first year of the SNP in 2005 for those domains. Consistent with previous findings, New Zealand European students performed better than Māori or Pasifika students, male students performed slightly better than female students, and students from high-decile schools performed better as a group than students from medium- or low-decile schools.

Schools that entered the SNP in 2005 were also required to re-assess their students at the end of year 10. The results indicate that while these students performed better than the year 9 students in all aspects except the proportional domain, the differences in performance were not great. Anecdotal comments from in-school facilitators and my own observations suggest that many schools in their second year of the SNP spent significant time revisiting their teaching approaches to year 9 in order to consolidate the progress they had achieved in 2005, despite the evidence from the end-of-year 9 interviews in 2005 that signalled further work for 2006. As a consequence, few shifts in achievement occurred in year 10. This is, as the researchers point out, a cause for concern.

Tagg and Thomas draw attention to the proportion of students who perform at stage 5 or lower on the Framework for both the strategies they bring to bear and the knowledge they can quickly recall to help solve a problem. Between 16% and 32% of year 10 students have remained at stage 5 or below in the knowledge domains. This has serious implications for their future understanding and achievement in mathematics. Without a sufficient body of easily recalled knowledge, students are not able to develop more sophisticated strategies to solve problems. As a consequence, their likelihood of succeeding in senior high school mathematics is compromised.

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Evaluation of the 2006 Secondary Numeracy Project

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Introduction

The 2006 Secondary Numeracy Project (SNP) continues the mathematics professional development initiated in the 2005 Secondary Numeracy Pilot Project. In 2005, 320 mathematics teachers in 43 schools received professional development aimed at enhancing the teaching of year 9 mathematics. In 2006, teachers in the same 43 schools were supported in consolidating their teaching of year 9 mathematics and in developing their teaching of year 10 mathematics.

An additional 236 teachers at 37 extra schools were recruited into the SNP for 2006. The teachers of year 9 mathematics in these schools received support of a similar nature to that given in the pilot project the previous year.

The SNP aims to enhance the teaching of mathematics in secondary schools, thereby improving collegial support and practice and the achievement of their students. The professional development focuses in detail on the teaching of number, extending into the teaching of algebra. A Framework of number knowledge and increasingly sophisticated strategies for calculation was developed as part of the Numeracy Development Projects. This Framework, together with the accompanying diagnostic interviews of students, is used to give teachers in-depth knowledge of the number and calculation proficiency of their students and was used by SNP teachers in their year 9 classes. Through workshops and SNP support material, teachers are introduced to techniques for developing more sophisticated number strategies and for generalising these number strategies to provide a basis for algebraic thinking.

This report primarily evaluates the impact of the SNP on those schools newly recruited to the project in 2006, but, where appropriate, reference is also made to the impact of the SNP on schools that have been involved with it for two years.

This research report addresses the following questions:

Teachers

1. Has the 2006 SNP had an impact on teachers' professional knowledge? If so, what changes have occurred in teachers' professional knowledge and how do these changes differ for teachers in their second year of the SNP compared with those for teachers with one year (2005 or 2006) in the SNP?
2. What experiences and factors do teachers report as influencing these changes?
3. Do teachers perceive that changes in their professional knowledge (including knowledge of their subject, the pedagogical content, and learners' cognitions) impact on their classroom practice? If so, how?
4. Is there any evidence of enhanced collegial support within the schools' mathematics departments?

Facilitators

1. What is the impact of external and in-school facilitators on raising student achievement and developing teacher subject and pedagogical knowledge for year 9 and year 10 mathematics?

2. What knowledge have the in-school facilitators (ISFs) developed through their participation in the SNP?
3. What are the key qualities and skills required for effective in-school facilitation of the SNP in a school's first year of participation? Are these different from the qualities and skills required for schools that are in their second year of the SNP?
4. What impact has the shift in role from staff member to in-school facilitator had on existing relationships within the school?

In-school facilitation model

1. What evidence is there that an in-school facilitation model is effective in building teacher capability and raising student achievement?
2. What have been the benefits and drawbacks of in-school facilitation, according to different members of the school community?

Key Findings

Teachers

- The SNP had a noticeable impact on teachers' knowledge of teaching mathematics and on their knowledge of how students learn mathematics. The SNP had less impact on the teachers' knowledge of mathematics.
- The SNP had a positive impact on the teaching and learning of mathematics.
- The SNP diagnostic interview is rated as a very useful tool for supporting and influencing changes in mathematics teaching.
- The numeracy booklets are useful for supporting changes in teacher practice. However, participants have suggested modifications to layout and content.
- Participants gave mixed ratings for the equipment introduced through the SNP. However, there were more favourable comments than critical ones.
- The SNP has had a positive impact on the nature and quality of dialogue within mathematics departments and has led to a greater sharing of resources.

Facilitators

- Many ISFs experienced improvement in the skills of working with colleagues and running workshops for their peers.
- People skills, mathematical knowledge, teaching skills, and organisational skills are key requirements for effective in-school facilitation.
- There was no consensus on the differences between facilitation in the first year and second year of the SNP. Those who saw differences felt there was a greater emphasis on organisation in the first year and on leading pedagogical change in the second year.
- Most ISFs found there was little change to relationships within the school as they moved from the role of staff member to in-school facilitator. However, a few ISFs found that there was some initial resistance to their leadership.

In-school facilitation model

- The in-school facilitation model has been effective in building teaching capability. Increased teacher professional knowledge and changes in teacher practice provide evidence of the impact of this model.

- Teachers reported a belief that student achievement had improved through the SNP. However, these findings are tentative and should be examined more closely against the formal monitoring of achievement (Thomas & Tagg, this volume).
- Participants considered the in-school model of facilitation to be beneficial. The advantages of this model include: the ISF knows and works within the culture of the school; their leadership is seen as credible by their colleagues because they are implementing the SNP in their own class; and they are able to give ongoing day-to-day support to their colleagues. Growing the leadership of the SNP within schools increases the likelihood of the pedagogical changes being sustained. Some ISFs found it a disadvantage to be mentoring their peers so soon after being introduced to the new ideas in the SNP, and some wondered whether they were sufficiently knowledgeable to lead all aspects of the change.
- Acting as the facilitator for a cluster of small schools can be a more demanding task than working as an ISF in one school.

Recommendations

- Expand the SNP to provide mathematics teaching professional development to a greater number of schools.
- Develop guidelines to support the selection of in-school facilitators who have sufficient skills and experience to grow into that leadership position.
- Continue support for SNP schools so that they can consolidate and extend their development of mathematics teaching practices.
- Recruit schools and ISFs earlier in the year prior to implementation so that there is more time for ISFs to become familiar with the SNP before leading development in their own schools.
- In the numeracy booklets, include selected topics that are specifically for use by secondary teachers.
- Develop a list of the most "pedagogically powerful" equipment for teaching in secondary classrooms, including video demonstrations on the use of this equipment.
- Increase the time allocated to ISFs working as facilitators in clusters of two or more schools, especially when the schools are remote from each other.

Background

Professional development initiatives to enhance the teaching of mathematics in New Zealand primary schools were established in response to concerns about the mathematics achievement of New Zealand students (Higgins, Parsons, & Hyland, 2003). This work formed the foundation of the Numeracy Development Projects (NDP) in primary schools, which began in 2000 and have now offered professional development to most teachers in primary and intermediate schools. Exploratory work on extending the professional development into secondary schools was carried out from 2001 to 2004. The SNP was piloted in schools in 2005, and the 2006 SNP built on the findings of that pilot work and extended the project to more schools.

Professional development in NDP primary and intermediate schools is provided through external facilitators who go into the schools to run workshops and provide in-class modelling, observation, and feedback. The SNP provides similar support but through a different mechanism. In SNP schools, a member of the mathematics department receives training, support, and a time allowance to become the in-school facilitator (ISF). This person continues teaching in the school but takes on the additional role of facilitating in-school professional development. Their role includes running workshops, critiquing lessons, and mentoring peers in teaching numeracy. These professional responsibilities align with the special classroom teacher policy that has also been supplemented in secondary schools. The initial training of ISFs took place at a two-day national course in the November preceding their school's involvement in the SNP and a further two days in the following February. Additionally, ISFs are supported by working as part of a cluster co-ordinated by a regional facilitator (RF). RFs' roles include mentoring ISFs and supporting them in developing and delivering workshops to staff.

In small secondary schools, an ISF from one school also acts as the facilitator for one or two other nearby schools.

Rationale for the SNP

The purpose of this evaluation is to contribute to policy development in numeracy and to inform the continuing implementation and development of the NDP (Higgins, Parsons, & Hyland, 2003). Evaluations to date have traced policy development and associated practices in schools through principal and teacher questionnaires and interviews, as well as classroom observations. With the SNP's implementation continuing into 2007, it is timely to investigate factors that may lead to the sustainability of the SNP longer term.

This SNP evaluation builds on the findings from the 2005 evaluation of the pilot project (Harvey & Higgins, 2006). It also compares the involvement of schools in their first year of the SNP with that of schools in their second year.

Specific Aims of the Evaluation

The evaluation continues the 2005 investigation of the impact of external and in-school facilitators on the development of teachers' subject and pedagogical content knowledge at the year 9 and 10 level of schooling. It also considers the impact of the 2006 SNP on the development of professional mathematics communities within the mathematics departments of participating secondary schools and the impact on classroom practice in senior mathematics classes in those schools. An important consideration has been to identify differences between the SNP schools participating for the first time in 2006 and those schools participating for a second year.

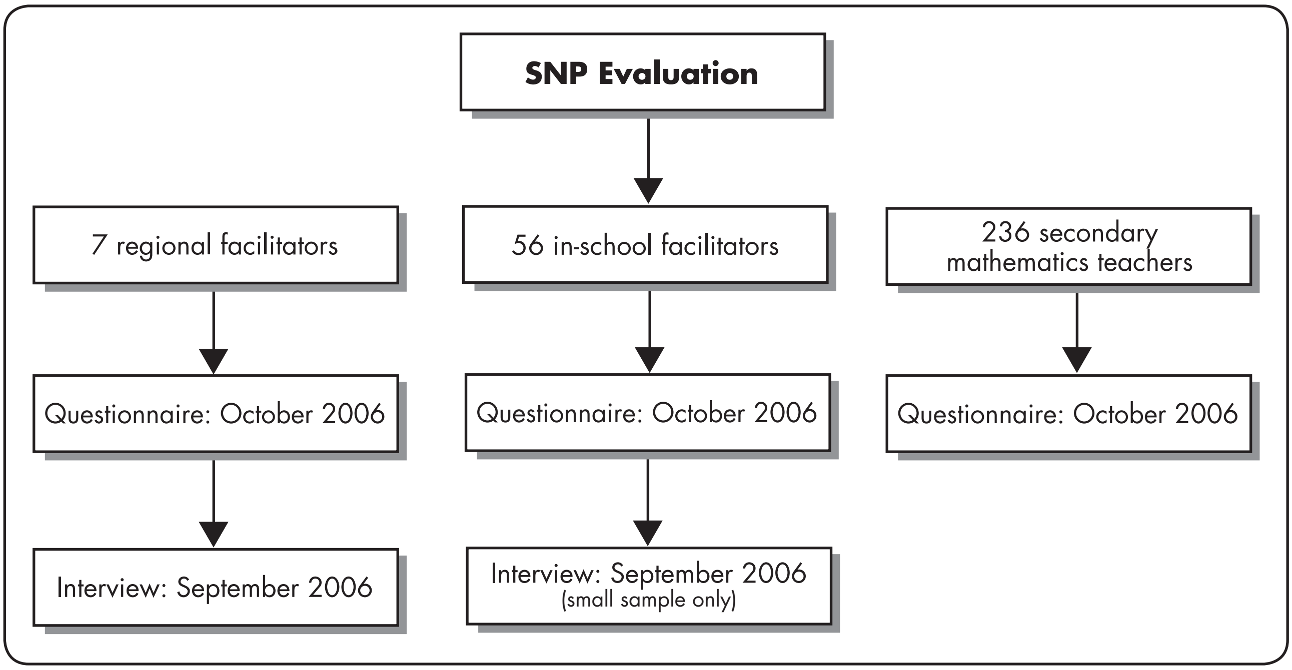

Figure 1: Overview of the evaluation of 2006 SNP

Design and Methodology

Similar to the 2005 evaluation of SNP, the methodology took the form of an extended case study (Stake, 1998) to assess whether changes to teacher knowledge and practices have occurred as a result of the schools' involvement in the 2006 SNP. Data was used from semi-structured interviews with ISFs and RFs, and baseline biographical data was collected from the first-year ISFs. The analysis has been informed by the teacher-centred model of professional development outlined in the 2001 evaluation of the Advanced Numeracy Project (Higgins, 2002) and by more recent work on contextually responsive teacher education (Higgins, 2005), along with the findings of the evaluation of the 2005 Secondary Numeracy Pilot Project (Harvey & Higgins, 2006).

In the fourth term of 2006, RFs, ISFs, and participating teachers were sent questionnaires (see Appendices A–D, pp. 40–49). In addition, more in-depth information was sought from six first-year ISFs through a follow-up survey and a telephone interview. The questionnaires asked for biographical data from all first-year participants.

The foci of the questionnaire for teachers examined:

- the impact of the SNP on teachers' professional knowledge
- the impact of the SNP on the teaching and learning of mathematics in their own classroom
- elements of the SNP that enhanced teacher knowledge and practice
- the nature of professional discussion within the school's mathematics department.

The questionnaire for first-year ISFs included the questions for teachers and additionally examined:

- the impact of the SNP on the knowledge and practice of the school's mathematics department
- the development of their facilitation skills
- the qualities required for effective facilitation
- the impact on relationships due to them taking on the role of ISF.

The follow-up survey for the sample of first-year ISFs focused on the effectiveness of the in-school facilitation model.

ISFs at schools that were in the second year of the SNP were surveyed by a questionnaire that examined:

- the impact on teaching and learning at their school
- the development of their facilitation skills
- the difference in facilitation between the first and second year of the SNP
- the effectiveness of the in-school facilitation model.

The views of RFs were sought by survey or semi-structured interview. These focused on:

- the impact of the SNP on teaching and learning in a school that was in its second year of the project
- the development of the facilitation skills of ISFs in their second year in the project
- the difference in facilitation between the first and second year of the SNP
- the effectiveness of the in-school facilitation model.

Overview of 2006 Participants

In 2006, 236 teachers at 37 schools were recruited into the SNP. The number of members in each mathematics department ranged from 1 to 16. The Ministry of Education funded 27 ISFs, and the largest school taking part funded an additional staff member's training as an ISF.

Small schools were formed into clusters, with one cluster of three schools and four clusters of two schools. Each of these clusters was facilitated by an ISF from one of the schools. Additionally, a RF facilitated the SNP in three small schools and two other RFs facilitated in two other small schools.

Response Rate

Of the 236 teachers taking part in the SNP for the first time, 102 (43%) questionnaires were returned, with two of the questionnaires being returned too late to be analysed.

Questionnaires were returned from 22 (79%) of the 28 ISFs in their first year of the SNP and from 14 (50%) of the 28 ISFs in their second year of the SNP.

Factors that affected the return rates included turnover of staff and ISFs and teachers withdrawing from the survey because they were not timetabled with year 9 mathematics classes and were therefore unable to implement the ideas.

Demographic Data of Participating Teachers

Table 1
Years of Teaching Secondary Mathematics of Participating Teachers[1]

Number of Years	Frequency	Percentage
1–5	29	29
6–10	19	19
11–15	9	9
16–20	10	10
21–25	13	13
26–30	8	8
31 +	2	2
No response	10	10
Total	100	100

[1] Sixteen teachers had a total of 140 years of experience in teaching mathematics in other sectors.

Table 2
Highest Mathematics Qualification of Participating Teachers

Mathematics Qualification	Frequency	Percentage
Secondary school	1	1
University 100 level	11	11
University 200 level	11	11
University 300 level	42	42
University Honours papers	3	3
Masters degree	2	2
PhD	1	1
Primary teacher education	7	7
No response	22	22
Total	100	100

Table 3
Hours per Week Timetabled for Mathematics Teaching in 2006

Hours per week	Frequency	Percentage
1–4	8	8
5–8	9	9
9–12	5	5
13–16	19	19
17–20	36	36
21 +	11	11
No response	12	12
Total	100	100

Demographic Data of First-year ISF Participants

Table 4
Participating ISFs' Years of Teaching Secondary Mathematics[2]

Years	Frequency	Percentage
1–5	10	45
6–10	5	23
11–15	4	18
16–20	2	9
21–25	1	5
26–30	0	0
31 +	0	0
No response	0	0
Total	22	100

[2] Five facilitators had a total of 46 years of experience of teaching mathematics in other sectors.

Table 5
Highest Mathematics Qualification of Participating ISFs

Mathematics Qualification	Frequency	Percentage
Secondary school	1	4
University 100 level	4	18
University 200 level	5	23
University 300 level	7	32
University Honours papers	0	0
Masters degree	0	0
PhD	0	0
Primary teacher education	0	0
No response	5	23
Total	22	100

Table 6
Participating ISFs' Hours per Week Timetabled for Mathematics Teaching in 2006

Hours per Week	Frequency	Percentage
1–4	0	0
5–8	1	4
9–12	9	41
13–16	9	41
17–20	3	14
21 +	0	0
No response	0	0
Total	22	100

Impact of Participation in the SNP on Professional Knowledge

Participants were asked to determine the impact of the SNP on three aspects of their professional knowledge: mathematical content knowledge, knowledge of teaching mathematics, and knowledge of how students learn mathematics. Likert scales (see Appendices A and C, pp. 40–46) were used, rating impacts from a 1, indicating little impact, to a 5, indicating considerable impact.

Impact on Teachers' Mathematical Knowledge

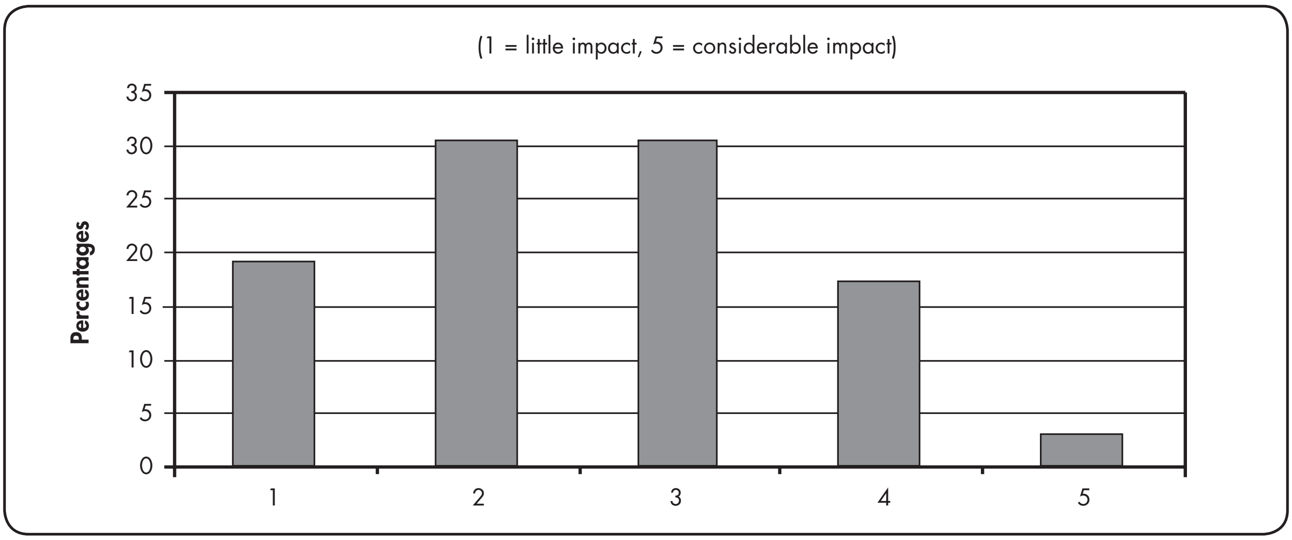

Figure 2: Impact of SNP on teachers' mathematical knowledge

As shown in Figure 2, while most teachers reported some impact on their mathematical knowledge as a result of taking part in the SNP, few considered the changes to be considerable. Many teachers commented that the development had reinforced previous knowledge:

> Participation in SNP formalised strategies I already know, and I picked up a few new ones.

Less common were stronger statements about the impact of the SNP on the teacher's mathematical knowledge:

> Mathematics is my subject, but there were some processes I had not thought of until I taught this.

or statements about the lack of impact:

> I was already aware of the content.

Of the three areas of professional knowledge, participants felt that their participation in the SNP had the least impact on their mathematical content knowledge. This is consistent with the notion that specialist teachers of mathematics should already have a well-developed body of mathematical knowledge.

Impact on ISFs' Mathematical Knowledge

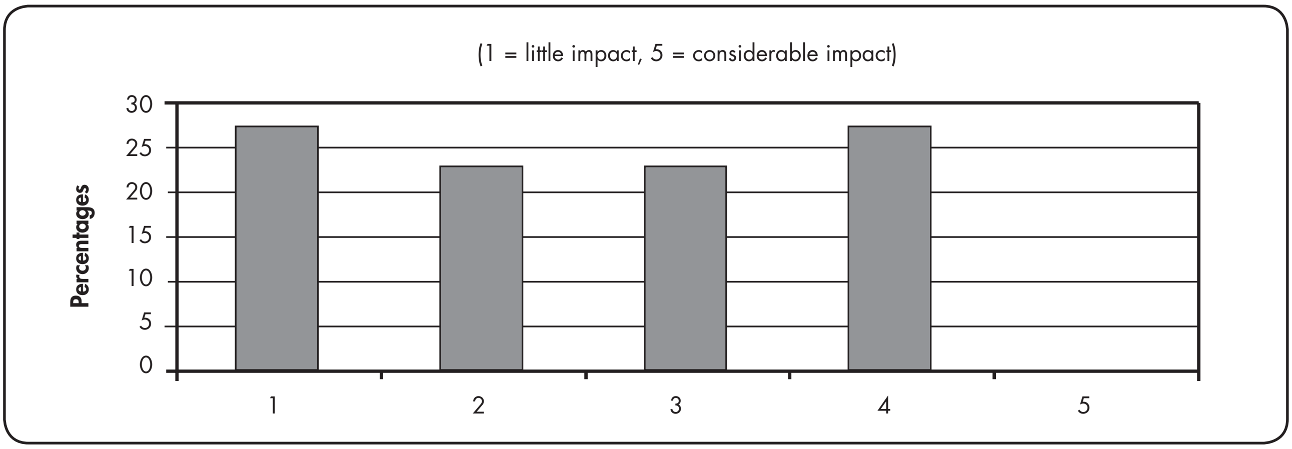

Figure 3: Impact of SNP on ISFs' mathematical knowledge

Figure 3 shows that no ISFs reported that their involvement in the SNP had a considerable impact on their mathematical knowledge, although many ISFs considered there to be some impact. Most ISFs wrote that they were confident in their personal mathematical knowledge. However, two responses mentioned extending their own range of strategies, and two spoke of an increase of depth in their knowledge.

Impact on Teachers' Knowledge of Teaching Mathematics

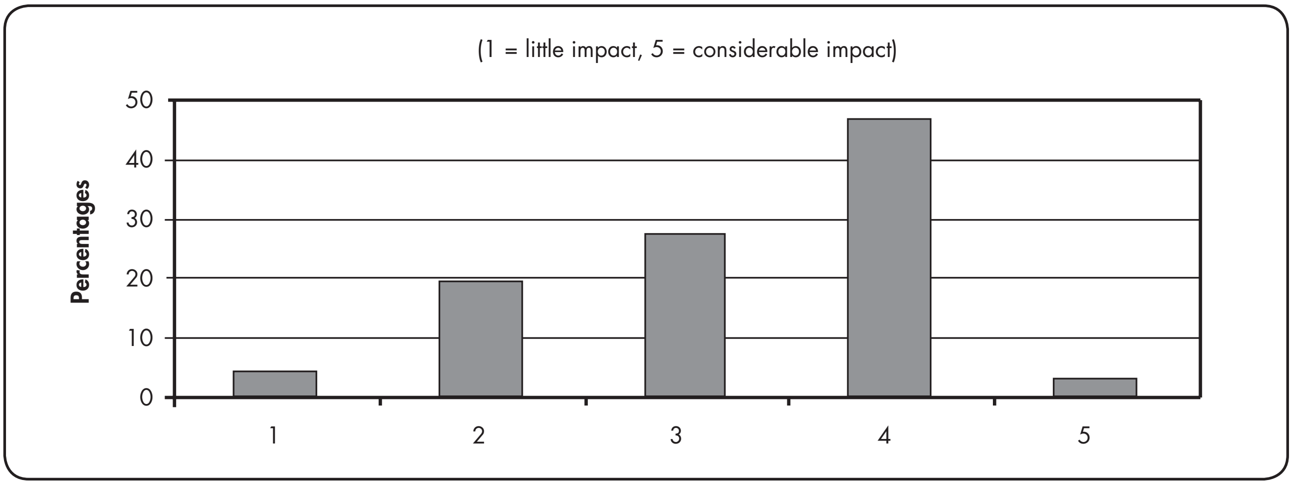

Figure 4: Impact of the SNP on teachers' knowledge of teaching mathematics

Most teachers indicated that the SNP had a substantial impact on their knowledge of teaching mathematics, as shown in Figure 4. Comments show that the changes have been over a range of aspects of teaching:

> Have had to learn, model and teach strategies. Have had to force myself to think in new ways rather than use algorithms.
>
> Heaps of new ideas, approaches and ways of getting students to participate and gain understanding.
>
> Learnt logical ways of introducing and developing concepts of proportions (fractions, decimals, percentages, etc).
>
> I had not realised students had so little understanding of processes. I had assumed students had a lot more knowledge than they actually had.

Impact on ISFs' Knowledge of Teaching Mathematics

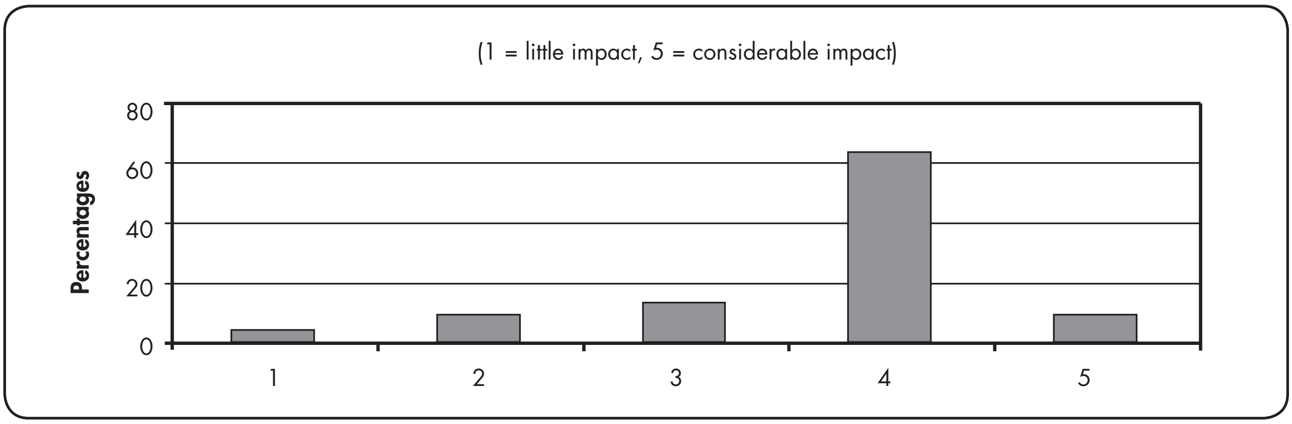

Figure 5: Impact of the SNP on ISFs' knowledge of teaching mathematics

Figure 5 shows that the SNP has had a powerful effect on ISFs' knowledge of teaching mathematics. The participants identified a range of influences, including reinforcement of their own knowledge, development of a greater range of teacher strategies including discussion, and greater attention to matching teaching to student needs, including catering more effectively for a diverse range of students:

> It has made me think about what I am teaching in a lot more detail. I more carefully scaffold my lessons and expect a lot more discussion and input from the students.

Impact on Teachers' Knowledge of How Students Learn Mathematics

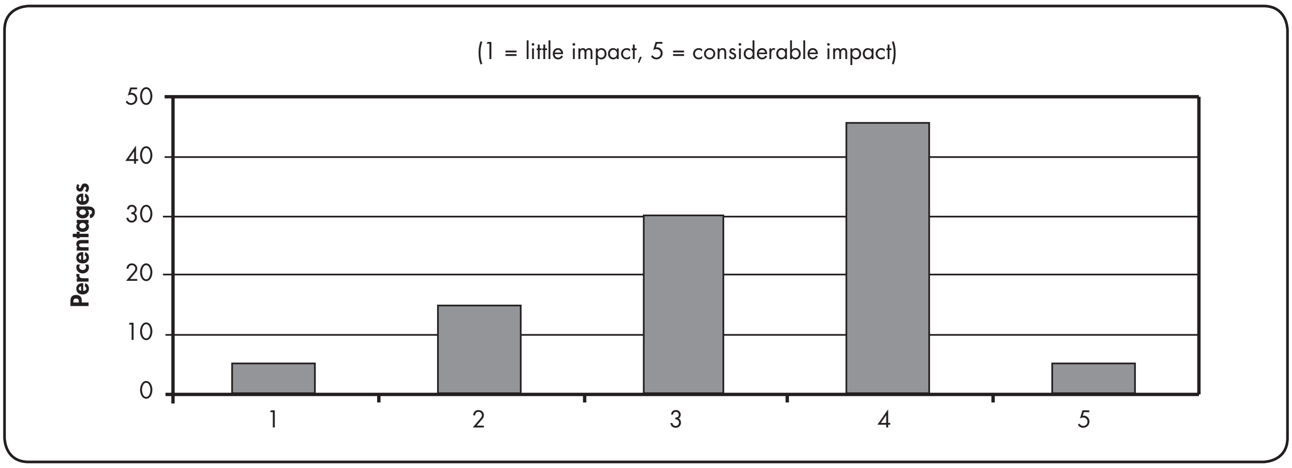

Figure 6: Impact of the SNP on teachers' knowledge of how students learn mathematics

The impact of the SNP on the teachers' knowledge of how students learn mathematics was similar to its impact on the teachers' knowledge of teaching mathematics. Figure 6 shows that 80% of the teachers rated this factor at least a 3. A small minority of teachers remain unconvinced about the value of the SNP:

> ... but not necessarily all positively. I've had some doubts about the pedagogical worth of teaching numerous strategies to solve one type of problem.

Typically, the responses were more positive:

> Good to see how students understand numbers now, to learn about misconceptions, etc, and how to improve understanding.
>
> Small group teaching/learning has given me much fuller and more immediate feedback of what is going on with my students.

Impact on ISFs' Knowledge of How Students Learn Mathematics

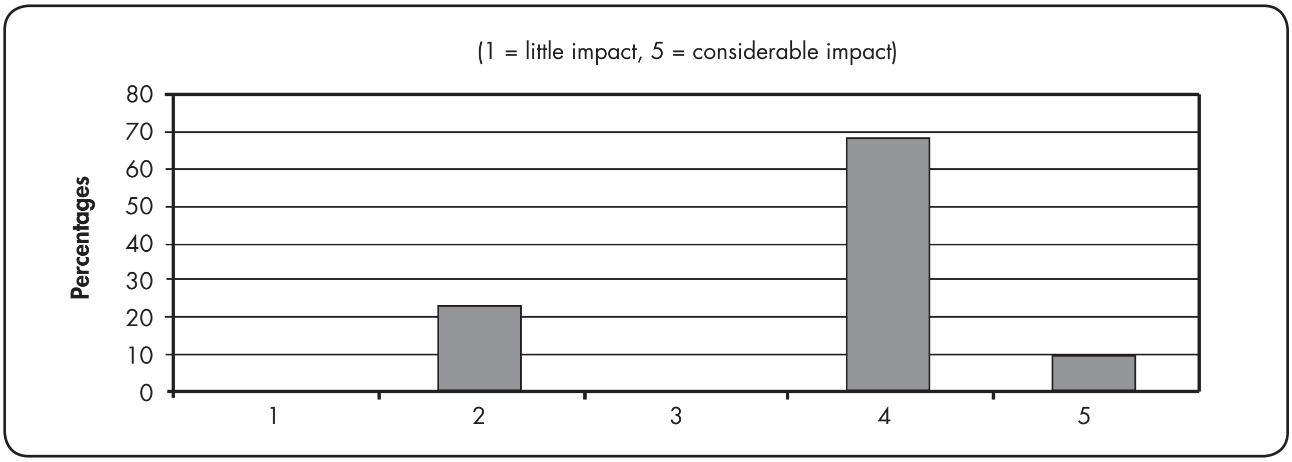

Figure 7: Impact of the SNP on ISFs' knowledge of how students learn mathematics

Figure 7 shows that 80% of responses about this factor were positive. One ISF expressed doubt about their own knowledge of student learning, and one expressed concerns about students entering secondary school holding entrenched attitudes to mathematics. One-third of ISFs mentioned improved knowledge of the stages detailed in the Number Framework as a result of taking part in the SNP, and one-quarter mentioned an improvement in their understanding of students' learning strategies:

> I've learnt strategies on how to move students through the levels. Almost like pushing them to be uncomfortable so they move up.
>
> The Framework has given me insight into the stages students go through to learn basic numeracy.
>
> Primary school was a closed book to me previously. This knowledge has given me the skills and confidence to prepare lessons and deliver, which I didn't have before. I was a confident teacher with my existing knowledge but having the whole picture is of immense value to me.

Summary of the Impact of the SNP on Professional Knowledge

The SNP's impact on the professional knowledge of teachers and ISFs follows similar trends to the impact on their mathematical knowledge, that is, having less impact compared with the impact on their knowledge of the teaching and learning of mathematics. This is consistent with the results found in the 2005 evaluation (Harvey & Higgins, 2006). It is noticeable, however, that in both the areas of knowledge of teaching mathematics and knowledge of how students learn, the ISFs reported a greater impact from participating in the SNP than did the teachers. The greater impact in these two dimensions for ISFs may be explained by their greater familiarity with the SNP. This greater knowledge is likely to result from the training that ISFs received, together with the additional knowledge that they would have developed in order to lead the SNP in their schools. Increasing teachers' knowledge is important in changing teacher practice and student learning. These two aspects are investigated in more depth in the following pages.

Impact of Participation in the SNP on Teaching and Learning

Impact of the SNP on Teaching (Teachers' Responses)

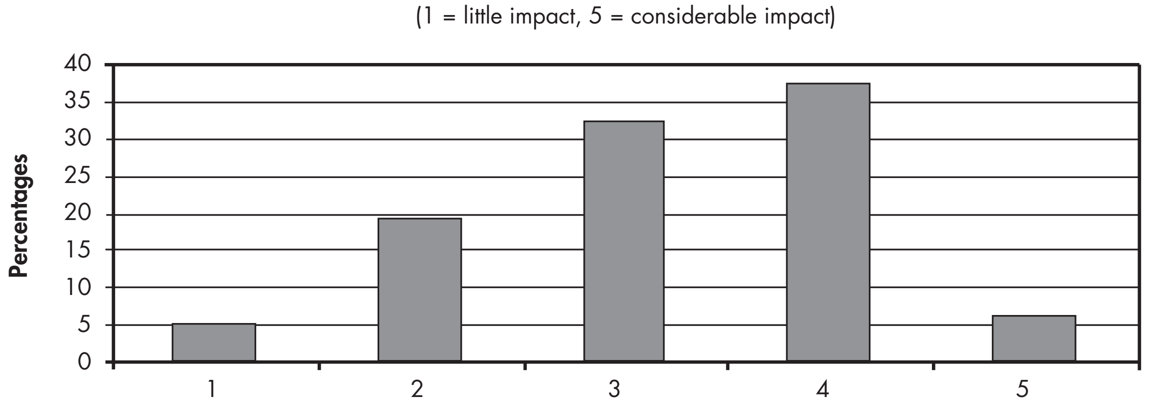

Figure 8: Impact of the SNP on teaching in teachers' classrooms

The majority (70%) of the teachers rated the impact of their participation in the SNP as a 3 or 4, as shown in Figure 8. Although this figure shows that participants experienced a major impact on their practice as a result of taking part in the SNP, the impact appears to be slightly less than the impact on teacher knowledge of mathematics teaching. This may be explained by the notion that it is easier to change knowledge than it is to change practice. A very small number of comments from participants expressed dissatisfaction with their teaching development:

> Lessons were tricky to implement and caused differentiation issues.

However, consistent with the ratings shown on the figure, most of the comments made in response to this topic were positive:

> I often look at different solution pathways anyway but tend to tailor them to individuals now.
>
> I had been very scared of the concept of group teaching (especially where I am not able to walk around "controlling" the groups). I am amazed at how well it has worked.

Impact of the SNP on Teaching (ISFs' Responses)

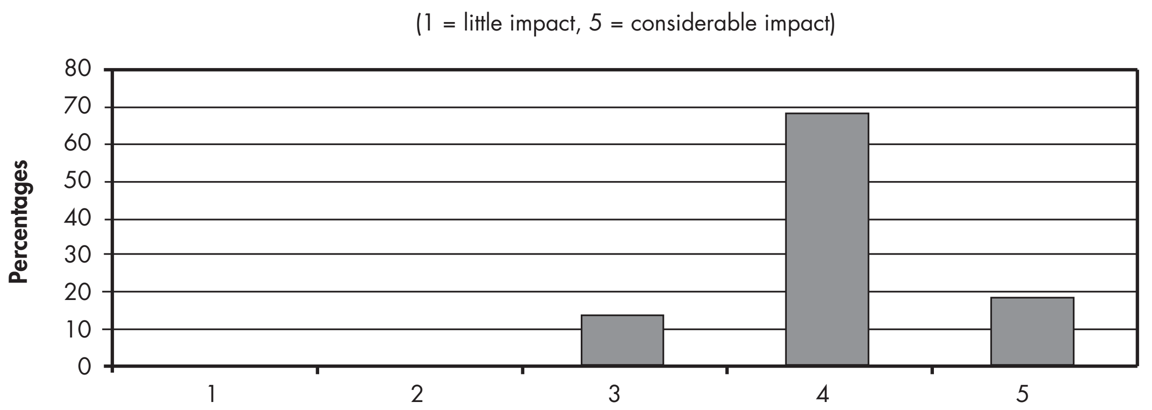

Figure 9: Impact of the SNP on teaching in ISFs' classrooms

As indicated in Figure 9, many ISFs reported that the SNP had a considerable impact on their teaching, with the majority rating this aspect as a 4 or higher. Comments cover a wide range of facets:

> I am more focused on the way students are developing.
>
> I am more likely to use materials or model with diagrams then move to the abstract.
>
> We have been able to group our students in ability levels so our teaching is more targeted to levels. It has made a difference to many.

Some recognised that embedding new teaching skills takes time:

> First year – I am looking forward to developing my skills for the student benefit next year.

Impact of the SNP on Students' Learning (Teachers' Responses)

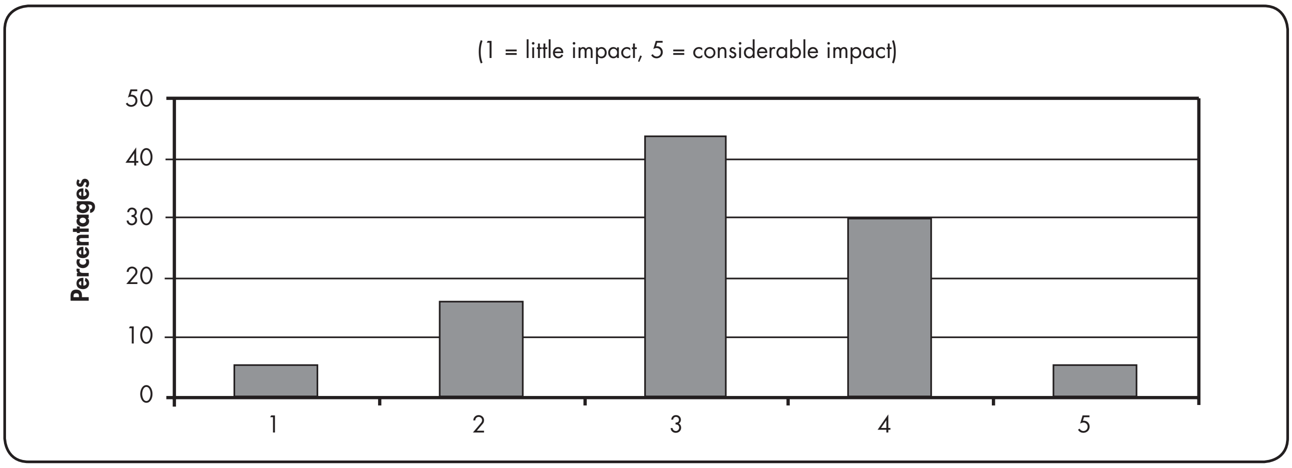

Figure 10: Impact of the SNP on learning in teachers' classrooms

The ratings of impact on learning had a similar distribution to the rating of impact on teaching. Figure 10 shows that over 70% of responses offered a rating of 3 or more in this area. The anecdotal responses to this question are wide ranging, with a number of the statements being qualified by observations indicating other aspects of the impact:

> For some students it has opened doors. Other students have been hard to shift from algorithms that they have learnt for a number of years.
>
> Some students seem to remember the activity but not the theory behind it.
>
> [Impact] varies on the students. Negatively on good kids, positively on low ability.

Again, the majority of the comments were positive:

> The students now give the how before the what when we discuss questions.
>
> I've been amazed at the continued positive attitude and progress of all students. The low ability students have become confident risk takers – they will question, discuss, support others, etc. We have not measured their "learning", but their attitudes are great.

Impact of the SNP on Students' Learning (ISFs' Responses)

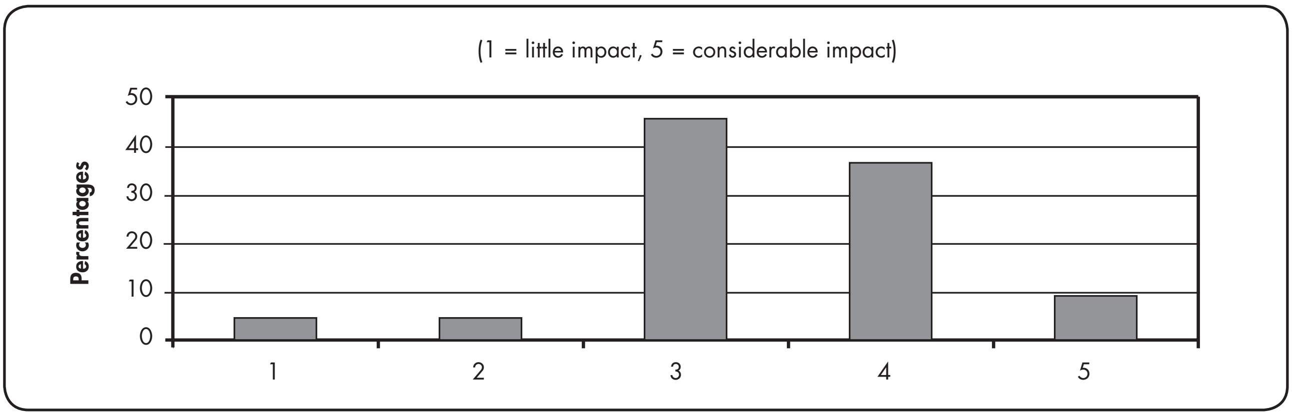

Figure 11: Impact of the SNP on learning in ISFs' classrooms

ISFs responded more tentatively to the question of the impact of the SNP on learning in their own classrooms (see Figure 11). Some noted that they felt there was an improvement in the tone in the mathematics classes, which they felt should result in an improvement in learning:

> A little unsure till results are in, but weaker students are enjoying and more able students [give a] very clear expression of what they are doing.

One-third of ISFs noted some student resistance to aspects of the SNP:

> However, some students have been resistant to using mental strategies and number lines as they prefer to use the algorithm.

However, positive comments were again more common:

> Students are more confident about talking about mathematics. They feel more encouraged to think for themselves and understand content, skills, etc.

Main Changes to Teaching of Year 9 Classes (Teachers' Responses)

Eighty-five percent of the teachers surveyed discussed changing their teaching practice as a result of taking part in the SNP. A wide range of changes were reported. The most frequent changes are described below. Sixteen percent of teachers reported changing the content or the pace of delivery of their year 9 course in some way:

> Less content centred, slower progress, less content, more depth.
>
> More time on number and algebra, less time on other topics.

With regard to changing the content of lessons, teachers identified greater use of discussion (7%), encouraging the use of strategies (7%), and more emphasis on understanding and mathematical processes (6%) as being important areas of change. Twenty-two percent of the teachers reported an increase in the use of group work as a result of taking part in the SNP:

> Differentiated learning in groups at different levels.

Twenty percent of teachers responded that they were making greater use of "hands-on" teaching materials in their classrooms:

> Use of practical resources to introduce a concept.

Other changes noted included increased use of assessment data (3%) and greater variety in teaching within lessons (5%).

Consolidating the Changes (Teachers' Responses)

Forty-six percent of teachers indicated that they intend to consolidate the changes they made in 2006 into their subsequent teaching. Most of the other responses can be interpreted as suggesting that teachers intend to consolidate their teaching from 2006 and continue developing at least one aspect of the teaching they had trialled in 2006:

> Given that I will be teaching lower ability students in the future I will use the number strategies especially.

Many teachers took this opportunity to set personal teaching goals, so a wide range of responses was given to this question. The most frequent responses were increasing use of group work (7%), making changes to content of the year 9 course (6%), making greater use of "hands-on" materials (7%), and developing a greater range of resources (6%).

Main Factors that Influenced Changes to Teaching (Teachers' Responses)

Unsurprisingly, the most frequent stimuli to changing teacher practice offered by participant teachers related to their numeracy professional development. Forty-three percent of responses mentioned the professional development, including 6% who specifically cited resources and 6% who cited the value of the numeracy diagnostic assessment. Ten percent of teachers recorded concerns that they had felt about student learning, and 6% mentioned the positive student responses they had gained when implementing aspects of the SNP. Three percent of teachers suggested that they had made changes to their teaching in order to comply with school policy.

Teachers were asked whether there were practices advocated by the SNP that they did not want to implement. Fifteen percent of teachers responded that they were comfortable implementing all the practices of the SNP, and 32% of teachers left this question blank. Nine percent of teachers proposed to make less use of group work, some of them offering alternative ways of differentiating the curriculum in their classroom:

> I find physical grouping of pupils disruptive and detrimental. Instead, I offer different methods of solving and the choice of which method to tackle to the whole class.

Six percent of teachers suggested that they would reduce their use of physical resources:

> While the use of materials is to be commended, I do think that they can be over-used or used unnecessarily. In some cases this can waste teaching time.

Three percent of teachers challenged the need for the SNP in secondary schools:

> I feel that we should get primary teachers to teach this way and therefore by the time the students reach secondary school they will have a better understanding of maths.

Two percent challenged the way the SNP emphasises understanding:

> Too much emphasis on understanding the process can have a negative effect on students' ability to see what is happening. Simplicity, not complexity, of ideas remains a key factor in learning.

Other teachers mentioned changing their emphasis on aspects of their teaching, which could be seen as part of the normal bedding-in of change.

Main Changes to Teaching Year 9 Classes (ISFs' Responses)

The ISFs reported a wide range of changes to their teaching. The most frequent were differentiated teaching using groups at different levels (60%), using materials and diagrams before generalising (45%), and increased emphasis on strategies (20%).

Greater use of student contributions, teaching to student needs, and a greater focus on numeracy were each mentioned by 10% of ISFs. The ISFs commented that they intend to continue with the changes and, in fact, 90% of ISFs set themselves implementation goals for 2007 to challenge themselves to consolidate and continue their own professional journey.

Main Factors that Influenced Changes to Teaching (ISFs' Responses)

ISFs gave a range of responses to the question of the main factors that influenced their changes to the teaching:

> Student learning: I knew students were not learning/had gaps in knowledge/understanding and [I] was not catering for their needs. The SNP has enabled me to address this problem.
>
> Time to cater for students' needs and not just do coverage.
>
> Awareness of the "real" stage students are at. How they think, not just what they know.

ISFs were asked whether there were practices advocated by the SNP that they did not want to implement. Twenty percent of the ISFs commented that they had difficulties with aspects of group work and intended to reduce the emphasis on group teaching in future years:

> Separate teaching and resources for groups. This is a serious workload issue. There should be resource packages ready for adaptation at a secondary level of engagement.

One ISF did not want to continue assessing all students using the initial assessment, while other ISFs indicated that they would continue to streamline their use of resources and approaches.

Usefulness of Aspects of the Numeracy Professional Development

Teachers

Teachers were asked to rate six aspects in terms of their usefulness on influencing their teaching. Ratings were made on a scale of 1 to 5 (5 being extremely useful). The results are shown in Table 7 (see next page).

The majority of the teachers acknowledged the usefulness of the diagnostic assessment (mean ranking 3.9):

> Diagnostic interview was particularly eye opening.
>
> This [diagnostic interview] helped establish a rapport between the teacher and students, which helped as I started something new to me.

Although the mean rating for the numeracy booklets of 3.2 is favourable, the teachers gave mixed comments about the usefulness of these books. Favourable comments included:

> The numeracy booklets have great ideas to put into practice.
>
> Good reference for a later date.

Several teachers had suggestions for modifications for future editions of these books:

> Don't like the layout, the wordiness, the titles of each "concept" – hard to look things up or see a developmental flow of a topic, difficult to use. They felt as if written for non-mathematicians. Very frustrating.
>
> Referencing another book is annoying.
>
> Great content. An overall index would be useful.

The workshops were generally well received, with a mean rating of 3.6:

> The workshops enriched us with new ideas and gave teachers opportunity to share ideas/views, also advantages/disadvantages of using some techniques.

However, it is important to acknowledge the special issues experienced by teachers who have to travel to attend such workshops:

> Workshops were a bit overloaded – too much information all at once. Also when you are tired from teaching half a day, having to travel and then go late at night.

Ongoing support of the ISF received a mean rating of 3.4. There were few comments in this section, ranging from one critical comment of the ISF to three comments giving fulsome praise of the ISF. One teacher wrote of the need for ongoing ISF support to ensure that the professional development was sustained.

The resource material available from www.nzmaths.co.nz received a mean rating of 3.0. The few (9) comments specifically about this subject again covered the range from "not enough" to "this is an excellent website". One teacher asked for training in the use of these materials, and another reported that their lack of use was due to lack of time.

The 14% of participants who commented on the use of equipment again covered the full range of perspectives on the subject. One commented that the equipment was "irrelevant/non-existent", while at the other end of the spectrum there was a comment about being "overloaded with stuff".

There were more favourable than unfavourable responses to this topic:

> Resources are very important – the numeracy project would be impossible to implement without them.

Three teachers commented that they would like more training in the use of equipment:

> More demonstrations of using materials required – e.g., I have used the bead string really successfully after seeing it used by a visiting facilitator.

Table 7
Usefulness of Aspects of the Numeracy Professional Development as Rated by Teachers

Rate on a Scale 1–5 (1 little impact, 5 considerable impact)	1	2	3	4	5	mean
Teachers' rating of usefulness of the diagnostic assessment	6	3	21	28	41	3.9
Teachers' rating of usefulness of the numeracy booklets	11	14	30	29	16	3.2
Teachers' rating of usefulness of the workshops	9	7	26	27	31	3.6
Teachers' rating of usefulness of the ongoing support of the facilitator in own school	6	13	29	35	17	3.4
Teachers' rating of usefulness of www.nzmaths.co.nz	13	21	27	28	11	3.0
Teachers' rating of usefulness of the equipment introduced in the SNP	4	19	29	29	19	3.4

Note: One teacher did not rate the diagnostic assessment.

Facilitators

Table 8 shows the ISFs' rating of the usefulness of aspects of numeracy professional development. Sixty-eight percent of ISFs rated the diagnostic assessment as extremely useful:

> Very useful to hear how the student is thinking.

The ISFs' rating of the numeracy booklets was mixed, with 50% suggesting (or implying) ways of modifying the booklets:

> Aimed mainly at primary school. Secondary booklets are needed.

> One activity per page or each page or each activity started on a new page would be a more useful format.

> Too time consuming for teachers to get into the books. Needed them last year so they could read them in the summer holidays.

Eighteen percent of ISFs rated the booklets as extremely useful:

> Have read these a lot, especially booklets 5–8, to review what was in the workshops.

The equipment introduced through the SNP received mixed reviews:

> Have not had enough time or experience to really know all the equipment. Some have been great, others have been a flop.
>
> Only useful if I had seen a demonstration.

ISFs recognised the support and mentoring that they had received from the RFs in introducing equipment:

> We are lucky to have this [support material] provided to us in such a professional manner.

One ISF wrote this comment regarding the equipment introduced through the SNP:

> There was a tendency to be overwhelmed by the amount of material in the booklets, website and equipment. It was difficult particularly for us secondary teachers who move/share classrooms to cope with/share resources. We fine-tuned this to each teacher contributing a couple of useful activities that they had tried.

Table 8
Usefulness of Aspects of the Numeracy Professional Development as Rated by ISFs (%)

Rate on a scale 1–5 (1 little impact, 5 considerable impact)	1	2	3	4	5	mean
ISFs' rating of usefulness of the diagnostic assessment	0	0	18	14	68	4.5
ISFs' rating of usefulness of the numeracy booklets	5	5	64	9	18	3.3
ISFs' rating of usefulness of nzmaths website	14	5	32	32	18	3.4
ISFs' rating of usefulness of the equipment introduced in the SNP	9	9	41	27	14	3.3

Note: Percentages may not total to 100 due to rounding.

Discussion

The range of responses to the aspects of support provided through the SNP may in part be attributed to the range of situations in which teachers work and to the stages that individuals are at in their own development. The teachers involved in the SNP ranged from mathematics teaching specialists with many years' experience to those who were new to the profession and included teachers with specialist teaching interest in other areas who teach mathematics on a part-time basis (see the demographic data in tables 1 and 2).

The willingness and ability to implement changes will be influenced by teachers' experience, beliefs, and their teaching context. While some individuals may find making many changes to their pedagogical signature professionally energising, others will need to make changes in a more gradual way to fit this aspect of teaching in with their other professional duties.

The SNP works with teachers in many different circumstances and as such has to be able to promote change at the appropriate rate for each individual. The results indicate that a proportion of teachers believe that they need more guidance in implementing the changes in the classrooms.

While the SNP continues to provide a wide range of support to be picked up by those ready for widespread change, it may be useful to identify the most powerful examples for secondary classroom implementation and give greater emphasis to these in the written materials, workshops, and videos demonstrating the use of equipment and pedagogical practices in secondary classrooms.

This backbone of solid support is likely to make the transition of teaching style even more comfortable for a larger percentage of secondary mathematics teachers.

Use of Assessment Data

Use of Assessment Data to Inform Teaching (Teachers' Comments)

Ninety percent of teachers wrote comments about how they used assessment data to inform their teaching. Twenty-two percent of teachers described using this data to focus their lessons on material appropriate to the class, and an additional 4% of teachers described using such data to review their teaching.

The majority of responses described using the data in ways that allowed teachers to differentiate their teaching; 22% of responses mentioned grouping, and 23% described differentiation of their teaching in some manner, including identifying individual needs (13%), underachievers (1%), and students who would benefit from extension (3%):

> Very much more inclined now to begin teaching from where the student actually is, rather than where they "should be" by their age.
>
> More individualised learning as different students are at different levels.
>
> It allowed me to group the students with like ability and challenge them accordingly.

Only 2% of teachers wrote that they did not use the assessment data to inform teaching. Eight percent of teachers specifically mentioned the NumPA assessment conducted at the beginning of the year. All but two were very positive about the value of the information gained through this assessment:

> The interviews in particular revealed in-depth clues to students' understanding of maths concepts.

Despite the positive impression given in the feedback on the use of assessment data, many teachers still have reservations about the extent to which they are able to alter their teaching on the basis of this data. A quarter of the teachers identified time and workload as limiting their ability to make full use of this data. Six percent of the teachers had concerns about the reliability of the assessment data as a basis for teaching, and 7% raised specific concerns related to the implementation of the NDP:

> Not all had been in "numeracy project schools" – had efficient strategies but different.
>
> Some students who have been exposed to NP in primary and intermediate and who think they "can do" certain strategies and knowledge but haven't really mastered them yet – resistance!

Use of Assessment Data to Inform Teaching (ISFs' Comments)

Forty percent of ISFs described using assessment data to differentiate the learning for different groups of students. Thirty percent described using the data to focus their teaching; in some cases for work with the whole class, at other times with individuals or groups of students. Forty percent of ISFs found that time considerations limited their use of assessment data:

> Time to usefully analyse, contemplate and then consider initiating a change.

Other factors mentioned by participant ISFs included pressure to cover the curriculum and the perceived lack of congruence between the numeracy knowledge test and the secondary maths curriculum (10%), difficulties with managing groups within the class, class size (15%), and new students arriving through the year (10%).

Main Messages Arising from the SNP

Teachers were asked what they thought their main message would be to a secondary school mathematics department that was considering participating in the SNP. This question was asked in order to get an overall response about the professional development. The question was not answered by 5% of teachers. Eight percent of teachers recommended not becoming involved or counselled caution:

> Don't do it until materials appropriate for secondary students are available.

Nineteen percent of teachers advised participating but with some reservations, often citing the time taken as a disadvantage:

> More useful for the middle and lower stream classes. [It will] take up a lot of teaching time and [you] can't complete the curriculum for that year.
>
> Scale it down. Only work with mid–low form 3 classes. Reduce the amount of time spent on it by 50%. Pick out the most useful aspects and do those only. Far too much to assimilate in the present form.

The remaining 68% of teachers endorsed participation in the SNP and, of these, 32% gave very strong endorsement:

> Adds an extra dimension for all teaching. Adds a critically important dimension for lower ability learners.
>
> Go for it. It is hard work but is very meaningful. It is exciting to see better student learning even if it is the first year.
>
> I think it has made me a better teacher, not only of year 9 classes (that I teach numeracy to) but senior classes as well.

ISFs were also asked what they thought their main message would be to a secondary school department that was considering participating in the SNP. Ninety percent of ISFs recommended becoming involved in the SNP, with 20% being very enthusiastic in their endorsement. Drawing on their experience of a year of facilitating the SNP in their schools, ISFs expressed a wide range of ways that schools could fine-tune their implementation of the SNP.

The main recommendations were: to ensure that all members of the mathematics team are committed to implementing the project (35%); to see the professional development as a long-term project that would take several years to fully implement (30%); to ensure that the range of ability is effectively catered for (10%); and to set aside considerable blocks of time in the classroom programme for implementing numeracy ideas (10%). Each of the following ideas were suggested by an ISF: use a buddy school that is already involved with the SNP, let two teachers from each large department participate in the ISF training, meet regularly as a team, and modify material from the SNP to suit individual schools' needs.

In-school Facilitation

The teachers taking on the role of ISF varied considerably in terms of background and previous experience in leadership of teachers. This, together with the varying structures within schools, has meant that the growth and challenges of leadership and facilitation skills reported by ISFs are extremely wide ranging.

Most of the first-year ISFs mentioned more than one area of growth. Seven responses related to aspects of people skills, in some cases indicating that working with staff had been a considerable challenge:

> Teaching colleagues is harder than teaching students.
>
> How to deal with different personalities and needs.
>
> Interact more confidently with colleagues.

Ten ISFs mentioned the development of skills at running workshops, with one commenting that the skills developed would be useful in other positions of leadership.

Other aspects that were mentioned more than once included: organisation (three ISFs); consolidating understanding of the project (two ISFs); overseeing development of resources (two ISFs); and observing teaching practices and giving feedback to colleagues (two ISFs).

Most ISFs mentioned the challenges they had experienced in carrying out their role. The most common challenge mentioned was resistance from members of the mathematics department (10 ISFs). Four ISFs regarded lack of sufficient time to do all that is involved in the SNP as an issue, with an additional two suggesting that it was extremely hard to condense what they had learnt in a one-day training session into a two-hour workshop for staff. There was little time left for reflection and consolidation between the ISFs being trained and then passing that learning on to their department. Two ISFs reported that the lack of opportunity to trial ideas before training others made it harder for them to "own" the strategies. A particular issue for ISFs working in a cluster of remote rural schools is the travel time involved in moving between schools, resulting in long days during workshops and making it very difficult to schedule classroom observation.

The ISFs were given the opportunity to recommend additional support that would benefit future ISFs. Four participants made a strong case for commencing ISFs' training earlier in the previous year; associated with this recommendation was the requirement for ISFs to have time to plan the workshops on each topic well before delivering the workshop to the teachers. Two participants suggested that some ISFs were not aware of the full extent of their role before entering the SNP, and they asked for fuller briefings of the requirements as well as for suggestions of ways to deal with pressures.

Three ISFS wanted to see more examples of implementation in the classroom. Suggestions included RFs taking demonstration lessons that show how three-group rotation can work and RFs preparing DVDs, showing the use of strategies and modelling teaching, for use in the workshops. Two ISFs suggested that there needs to be greater emphasis on trialling materials in the regional teams before ISFs start working with their own staff. Three ISFs wanted to maintain a similar level of interaction with RFs and peers from within their cluster.

ISFs in schools in the second year of the SNP gave a wide range of suggestions for areas of growth. Common themes included running more effective workshops with staff (28%), enhancing observations of peers teaching (21%), and encouraging and supporting staff (43%). Challenges for these facilitators included changing teacher practice (43%) and timetable clashes preventing visits to peers' classrooms (14%).

Key Qualities and Skills Required for Effective In-school Facilitation of the SNP

ISFs from both the first and second year of the SNP were asked for their perspective on the qualities and skills required for effective facilitation of the SNP. Each participant made comments covering a range of points.

The first-year ISFs focused on people skills including listening, diplomacy, patience, and developing a non-threatening approach (35%). However, participants also described the requirement for the ISF to be thick skinned (10%), and to have good organisational skills (25%), leadership skills (10%), the ability to work with the team (10%), and sound mathematics knowledge and teaching skills (30%).

An additional 15% suggested that a commitment to the SNP was important. One participant focused on the need to overcome barriers to getting into classrooms to support teaching.

The pattern of the responses from ISFs in schools in the second year of the SNP was similar to those from the first-year ISFs. People skills mentioned included organisational skills (36%), the ability to work with the team (21%), and sound mathematics knowledge and teaching skills (50%). Twenty-one percent mentioned a commitment to the SNP. The following skills were each mentioned once by 7% of participants: creativity, critical thinking skills, open mindedness, and a sense of humour.

The two sets of responses suggest that the skills required in the first year and second year of the project are similar.

The ISFs from the second year of the SNP were also asked for their perspective on whether different skills were required in the second year of the SNP. Of 14 responses, seven gave an unqualified no and two more noted that while in general the skills required were the same, there was a difference in emphasis between the years. Of the five ISFs who noted that there is a difference in the skills required, three noted that the first year of the SNP has an element of trial to it, while in the second year, the ISF has to put pressure on staff to make real changes. The other two ISFs noted that the requirement to be in classrooms critiquing lessons made the second year more demanding.

RFs' views of the ISF role in the second year of the SNP as compared to the first year varied widely. One RF had not observed any appreciable change in role, the majority saw a change in emphasis in role, and one RF described these as two different jobs. Those who suggested that the roles were different described the first year as developing an overview of the SNP, seeing the need for change in teaching, introducing changes to aspects of teaching, and managing resources. They felt that the role in the second year of facilitation was to develop a learning community to alter the pedagogical approach to teaching mathematics used in the school.

Enhanced Collegial Support within the Mathematics Department

Teachers were asked whether there was any evidence of enhanced collegial support within their mathematics department. Specifically, teachers were asked "In what ways has the SNP impacted on discussions with colleagues on mathematics teaching?" Of the 88% of teachers who responded to this question, 60% felt the SNP had a positive impact. The main themes from their comments on this question included increased discussion (12%), positive impact on the functioning of the department (16%), and greater sharing of ideas and resources (20%).

Six percent of teachers responded that there had been very little change in discussion within departments, and 7% of teachers expressed dissatisfaction with the SNP or the nature of discussion between colleagues:

> Added stress as we coped with yet another change.
>
> There has been a lot of negative talk about SNP. A lot of teachers don't want to do it.
>
> We have talked about how it is an unstructured mishmash of ideas, which is very irritating for those of us who like to be organised and plan ahead.

These responses are countered by many more showing a very positive impact:

> Enormous impact. It dominated workroom discussions as staff shared activities and what worked and what didn't.
>
> Brought the department together.
>
> We are a lot more motivated to do a better job. Fractions and algebra are two topics that as math teachers we really want to do better in.

Some of the more neutral responses reflect the feeling that the SNP has required a very considerable change in pedagogy:

> Animated discussions about the demands of SNP versus traditional methods and needs of the curriculum. No clear conclusions, but some positives taken from both sides.
>
> This is a major change in pedagogy. After overcoming the initial shock, everyone is beginning to feel the positive impact.

All ISFs were asked the same question. Of the 20 responses from those in their first year of the SNP, only one ISF suggested that participation in the SNP had resulted in "minimal" change. Two cited increased discussions but had concerns about the SNP's impact on student learning and teacher workload. The remaining 17 ISFs reported a positive impact on the nature and quality of departmental dialogue:

> Great for discussion of teaching practice. More dialogue, more opportunity to debate.
>
> Much more discussion about the teaching of maths – more discussion about maths full stop.

Of the ISFs in the second year of the SNP, one participant indicated that their mathematics department already had a culture of reflective practice and ongoing professional discussion and the other 13 participants (93%) all indicated that there was now more discussion about the teaching of mathematics. In several schools, the discussions focused on fine tuning the implementation of the numeracy ideas into classrooms in their schools.

Impact of the Shift from Staff Member to ISF on Existing Relationships within the School

First-year ISFs were asked what impact the shift from the role of staff member to ISF had on their existing relationships within the school. Twenty ISFs responded to this question. Eleven reported minimal or no change and in some cases supported this by saying that the numeracy facilitation was just an additional role in their mathematics department leadership position.

Two ISFs felt more distanced from their peers:

> Feel more isolated from departmental colleagues, having to "justify" the SNP.

Two ISFs felt that their leadership was not initially accepted:

> For some teachers it took a while to accept the shift as I had not taught for nearly as long as they have. But all came round, and it has been a team effort.

Four of the ISFs felt that they were now recognised for their expertise, with two in particular feeling "groomed" into management:

> Senior management and staff assume I have a management unit and give me duties accordingly.
>
> I am approached to apply for more senior roles.

Benefits and Drawbacks of In-school Facilitation According to Different Members of the School Community

In general, those involved in the SNP viewed the ISF model favourably. The ISF being a member of the department was the key factor in many of these considerations. This membership of the department gave knowledge of the particular culture of the school and department, knowledge of the strengths of members of the team so that these strengths could be used, and credibility with peers as someone who was learning at the same time and teaching in the environment of the school. Being someone from the school enabled the ISF to maintain ongoing support for the team and individuals on both a formal and informal needs basis. Locating and growing expertise in the school maintains a day-to-day visibility of the SNP within the school and increases the likelihood that the SNP will be sustained over time.

Potential disadvantages of the ISF model include the time pressures on ISFs to begin mentoring their peers soon after being introduced to new practices and the workload conflicts with Head of Department and other roles within the school. Some ISFs expressed doubt about whether they were sufficiently knowledgeable to lead all aspects of the development, and one RF felt that the dilution of messages as they went through several layers of communication was a potential weakness.

The responses suggest that it is crucial that schools select appropriate people to act as ISFs – people who have credibility within their team and the drive and ability to become leaders of the initiative.

The variant model used for small-school clusters working with one ISF could see teachers in the non-host schools losing some of the day-to-day contact with the ISF. This would be exacerbated in situations where the schools are a considerable distance apart physically.

Concluding Comments

The SNP has made a notable impact on teachers' and ISFs' professional knowledge. The impact has been greatest in the domains of knowledge of how students learn mathematics and knowledge of teaching mathematics. In both of these domains, the ISFs reported a greater impact than the teachers. This may be explained by the ISFs' deeper involvement in the SNP.

Teachers generally had a favourable view of the materials and support provided through the SNP, with the diagnostic assessment being rated as especially powerful.

The SNP works with teachers in a wide range of contexts. By identifying and emphasising the most powerful examples of practices for classroom implementation through written materials and video, the SNP may be more effective in supporting those teachers who are finding implementation demanding.

The majority of participants recommend that mathematics departments at other schools become involved in the SNP, with one-third of teachers giving the SNP very strong endorsement.

The majority of participants recognised that the SNP had enhanced the purpose and functioning of their mathematics department and reported greater collegial support within the team as a result of participation in the SNP.

The role of ISF provides an opportunity for professional growth. While ISFs can find it challenging to build staff capacity at the same time as they are introducing new ideas, the ISF model of delivery provides effective professional development and grows expertise within schools.

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Performance of SNP Students on the Number Framework

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Introduction

One of the aims of the Secondary Numeracy Project (SNP) is to improve students' learning in mathematics, particularly in number and algebra, so a key aspect in evaluating the project is to quantify any improvement. This chapter aims to address the following research questions:

- What progress have SNP students made on the Number Framework in 2006?
- How does this progress compare with that made in 2005?
- What is the numeracy profile of year 10 students in schools that are in their second year in the SNP?
- What demographic factors impact on the progress and performance of SNP students?

This chapter first describes the participating students and the methods used to analyse student results. The findings are then discussed in three sections. The first section describes the performance and progress of year 9 SNP students in 2006 and compares this with the performance of year 9 SNP students in 2005. The second section compares the end-of-year performance of year 10 SNP students in 2006 with the end-of-year performance of year 9 SNP students in 2006. The final section analyses the impacts of demographic factors (gender, decile, and ethnicity) on the performance and progress of students.

Sample

The results reported in this chapter were obtained by downloading from the online numeracy database on 1 February 2007 all the data from schools participating in the SNP. Students were only included in the subsequent analysis if complete data had been entered for them. For year 9 students, this meant both initial and final data on the three strategy domains and the four knowledge domains of the Number Framework, while year 10 students only required final data on the seven domains. Complete results were available for 5807 year 9 and 2324 year 10 students from 55 schools. Of the 5807 year 9 students, 4189 were from schools participating in the SNP for the first time in 2006 and 1618 were from schools that had also participated in 2005.

Table 1 comprises a breakdown of the students by year, gender, and ethnicity. Sixty-five percent of the students were of New Zealand European origin, 18% identified as Māori, and approximately 8% identified as Pasifika. There were more male students than female (52% compared with 48%). The overall percentages of students in New Zealand schools by ethnicity are provided for comparison (Education Counts, n.d.). The ethnic breakdown of the SNP sample is not dissimilar to that of the general population.

Table 1
Profile of 2006 SNP Students by Ethnicity and Gender

	Year 9		Year 10		National (all domestic school students)
Ethnicity	Male	Female	Male	Female	
NZ European	64%	63%	69%	64%	59%
Māori	19%	18%	18%	19%	22%
Pasifika	8%	11%	4%	6%	9%
Asian	4%	3%	3%	3%	8%
Other	5%	5%	6%	8%	2%
N =	2878	2929	1328	996	751 044

Analysis

A t-test was used to compare the means of variables with only two categories (gender and year level), while an ANOVA test was used to compare the means of variables with three or more categories (decile band and ethnicity). Where statistically significant differences are described between groups, a difference has been verified to at least the 99% confidence level, either by the t-test or by a post-hoc analysis using Tukey's honestly significant difference test. In addition, differences of less than 5% in percentages of students at particular levels of each domain and differences in mean stages of less than 0.2 are not reported. It also needs to be noted that in some instances significantly different mean gains and effect sizes may be smaller than other gains and effect sizes shown that are not statistically significant due to differences in sample size.

In all tables, rounded percentages are presented. Percentages less than 0.5% are therefore shown as 0%, and where there are no students represented, the cell is left blank. Due to rounding, percentages in some tables may not total to 100.

Effect sizes, where used, have been calculated by dividing the average difference between two groups by the pooled standard deviation of the two groups. Effect sizes of 0.2 are considered "small", effect sizes of 0.5 are "medium", and effect sizes of 0.8 or higher are "large" (Cohen, cited in Coe, 2002). For the purposes of this chapter, effect sizes of 0.2 or less are described as small, effect sizes between 0.2 and 0.8 are described as medium, and effect sizes of 0.8 or higher are described as large.

Performance of Year 9 SNP Students

The annual Numeracy Development Projects (NDP) research reports have consistently shown that many students move to higher stages on the Framework between the start of the project and their final assessment (Young-Loveridge, 2006). Table 2 shows the initial and final percentages of year 9 students in 2006 at each stage of the three strategy domains.

Table 2
Initial and Final Strategy Stages of 2006 Year 9 SNP Students

	Additive		Multiplicative		Proportional	
Stage	Initial	Final	Initial	Final	Initial	Final
0–3: Counting from one	1%	0%	2%	0%	1%	0%
4: Advanced counting	14%	5%	14%	5%	17%	6%
5: Early additive	44%	29%	28%	16%	31%	24%
6: Advanced additive	33%	44%	32%	35%	17%	19%
7: Advanced multiplicative	8%	22%	18%	29%	30%	38%
8: Advanced proportional	n/a	n/a	6%	14%	4%	12%
N =	5807	5807	5807	5807	5807	5807

Year 9 students in SNP schools in 2006 made progress on all three strategy domains, with the percentage of students rated as at least advanced multiplicative (stage 7) increasing from 8% to 22% on the additive domain, from 24% to 43% on the multiplicative domain, and from 34% to 50% on the proportional domain between the initial and final assessments. Correspondingly, the percentages of students still rated as using counting strategies (stage 4 or below) decreased from 15% to 5%, from 16% to 5%, and from 18% to 6%, on the additive, multiplicative, and proportional domains respectively.

Table 3 compares the final results of year 9 students in 2006 with the final results of year 9 students in 2005, showing that the performance of students was similar across all three domains.

Table 3
Final Strategy Stages of Year 9 SNP Students in 2005 and 2006

	Additive		Multiplicative		Proportional	
Stage	2005	2006	2005	2006	2005	2006
0–3: Counting from one	1%	0%	0%	0%	1%	0%
4: Advanced counting	5%	5%	6%	5%	6%	6%
5: Early additive	26%	29%	16%	16%	23%	24%
6: Advanced additive	46%	44%	32%	35%	17%	19%
7: Advanced multiplicative	23%	22%	30%	29%	41%	38%
8: Advanced proportional	n/a	n/a	16%	14%	12%	12%
N =	3975	5807	3975	5807	3975	5807

Table 4 gives the initial and final percentages of year 9 students in 2006 at each stage of the four knowledge domains and shows a similar pattern to Table 2, with students making progress across all domains.

Table 4
Performance of 2006 Year 9 SNP Students on the Knowledge Domains

	FNWS		Fractions		Place Value		Basic Facts	
Stage	Initial	Final	Initial	Final	Initial	Final	Initial	Final
0–3	2%	0%	4%	1%	3%	1%	2%	1%
4	4%	2%	12%	6%	11%	3%	6%	2%
5	40%	25%	41%	29%	45%	30%	20%	12%
6	54%	72%	22%	25%	21%	27%	49%	43%
7	n/a	n/a	16%	28%	12%	20%	23%	42%
8	n/a	n/a	4%	11%	8%	19%	n/a	n/a
N =	5807	5807	5807	5807	5807	5807	5807	5807

While the proportions of students at the higher stages of all seven domains increased and the proportions of students at the lower stages decreased, it is important to note that on each domain between 2% and 7% of students finished year 9 still rated at stage 4 or below. The recently released draft curriculum (Ministry of Education, 2006) includes objectives in the Number strand linked closely to the Framework. Students in year 9 are expected to be working at levels 4 or 5 of the curriculum, which are equivalent to stages 7 and 8 of the Framework. Expectations provided on the nzmaths website (Maths Technology Ltd, n.d.) identify year 8 students still rated at stage 5 or below as "at risk". While there are no expectations provided for year 9 students, comparisons of the expectations for year 8 students with the final results of year 9 students on the strategy domains indicate that between 21% and 34% of students are "sufficiently below norm expectations that their future learning in mathematics is in jeopardy" (ibid).

Figures 1–3 show the percentages of year 9 students gaining stages on each of the three strategy domains in 2005 and 2006, broken down by initial stage. Over half of all year 9 students not initially rated at the top stage of the domain made progress on the additive and multiplicative domains, with higher proportions of students making progress from the lower stages of the domains. A slightly lower proportion of students made progress on the proportional domain (45% in 2005 and 47% in 2006).

On the proportional domain, while students initially at the lower stages tended to be more likely to make progress, a slightly higher proportion of students initially rated at stage 6 made progress (56% in 2005 and 58% in 2006) than did students initially rated at stage 5 (50% in both years). Previous research has shown generally that the stages of the Framework are not equal in size (Thomas, Tagg, & Ward, 2003; Young-Loveridge, 2004). The finding that a higher proportion of students made the transition from stage 6 to stage 7 suggests that stage 6 is smaller than both stage 5 and stage 7 on the proportional domain, and hence easier to make progress from. This is further supported by the fact that around half of those students initially rated at stage 5 who made gains moved up more than one stage.

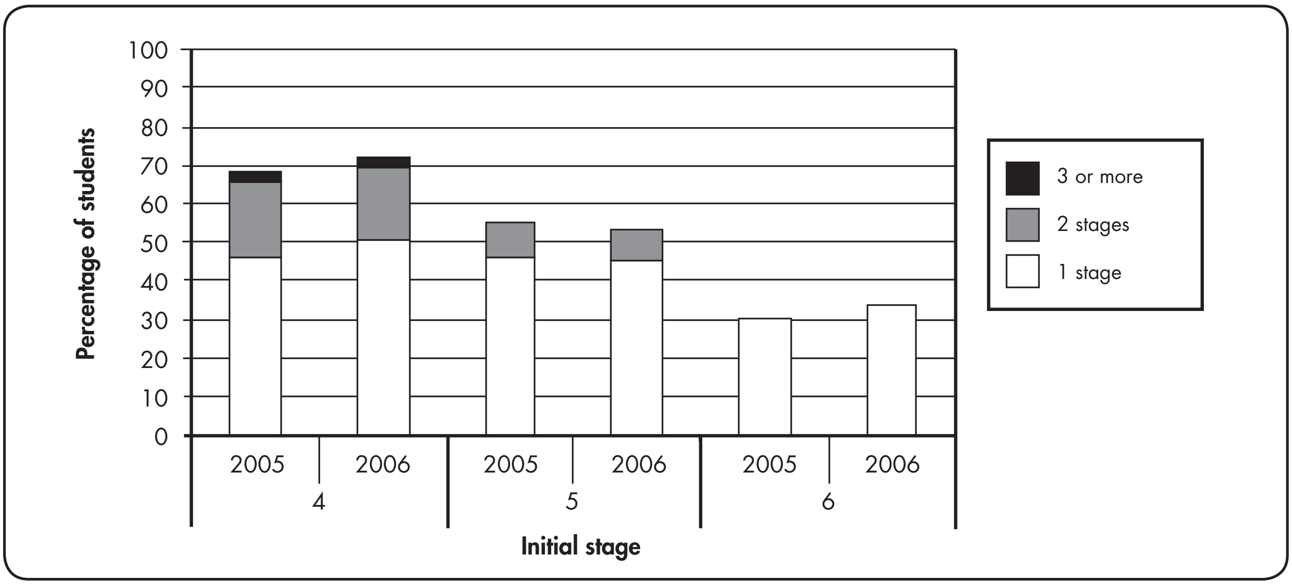

Figure 1: Number of stages gained by initial additive stage for year 9 SNP students in 2005 and 2006

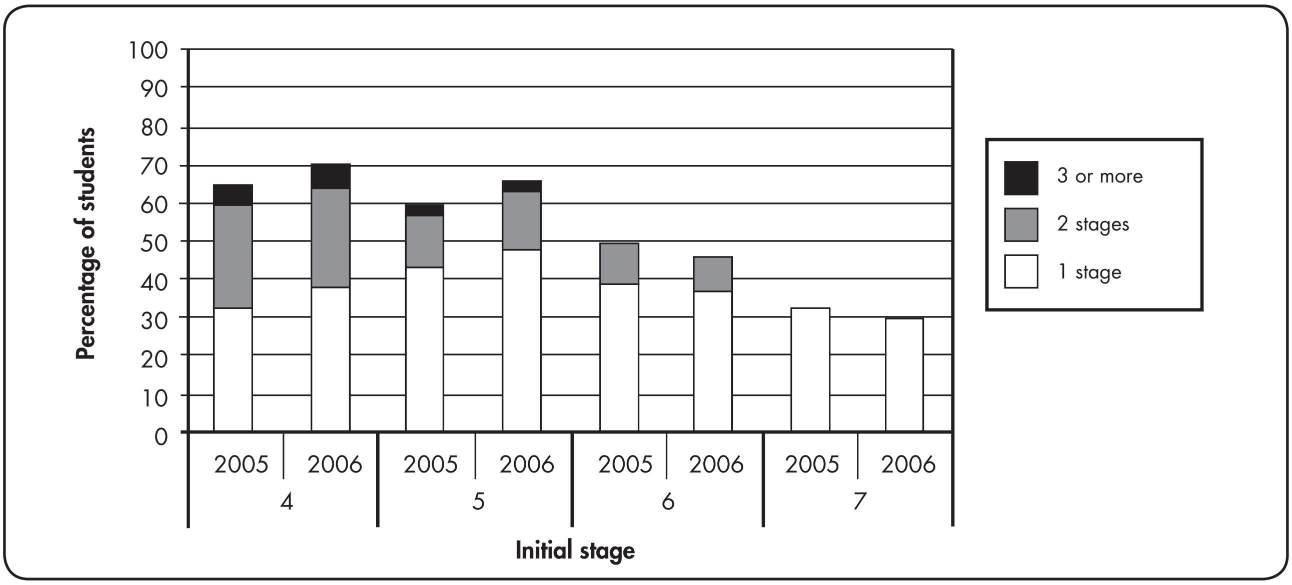

Figure 2: Number of stages gained by initial multiplicative stage for year 9 SNP students in 2005 and 2006

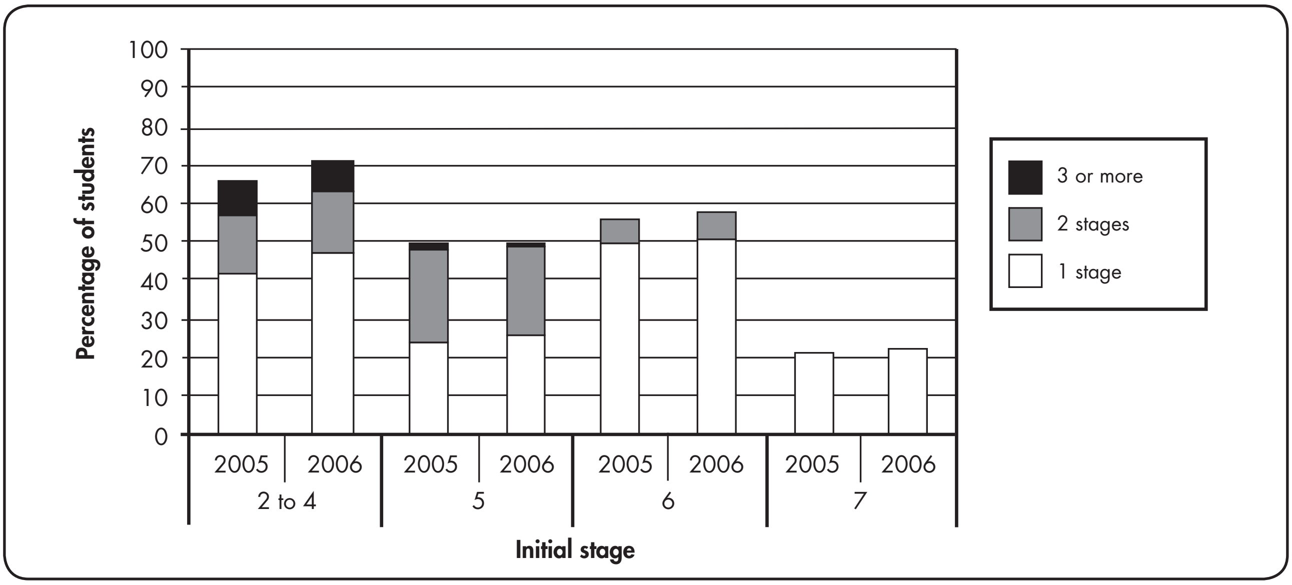

Figure 3: Number of stages gained by initial proportional stage for year 9 SNP students in 2005 and 2006

Effect sizes were calculated to examine the magnitude of the impact of the SNP on year 9 students. Table 5 presents the mean stages and effect sizes for the seven domains.

Table 5
Effect Sizes for Comparisons of Initial and Final Scores of Year 9 SNP Students

Domain	Mean Score		Difference	Effect Size
	Initial	Final		
Additive	5.31	5.81	0.50	0.58
Multiplicative	5.69	6.30	0.61	0.54
Proportional	5.54	6.20	0.66	0.47
FNWS	5.45	5.69	0.24	0.38
Fractions	5.44	6.05	0.62	0.52
Place value	5.51	6.19	0.68	0.57
Basic facts	5.83	6.23	0.40	0.45

Mean gains of at least half a stage were made on all domains apart from FNWS (0.24) and basic facts (0.40). The apparent lack of progress on the FNWS domain can be explained by a ceiling effect; over half of the year 9 students were rated at the top stage of this domain (stage 6) at the initial assessment and 94% of students were rated as at least stage 5, restricting their potential to move to higher stages.

With the SNP now in its second year of implementation, it is possible to compare the performance of year 9 students in first-year SNP schools with those in second-year SNP schools. The results of t-tests showed that the mean scores of the students in 2005 were significantly higher ($p < 0.01$) for both assessments in all domains except for the final assessment on the additive domain. The means and effect sizes for the strategy domains are shown in Table 6 below. These results represent 4189 students in schools participating in the SNP for the first time in 2006 and 1618 students in schools in their second year of implementation. The shaded cell represents the comparison where the difference was not statistically significant at the 99% confidence level.

Table 6
Comparisons of Performance of Year 9 Students in First-year and Second-year SNP Schools

Domain	Assessment	Mean Score		Difference	Effect Size
		2nd yr	1st yr		
Additive	Initial	5.38	5.28	0.09	0.10
	Final	5.82	5.81	0.01	0.02
Multiplicative	Initial	5.82	5.63	0.18	0.16
	Final	6.37	6.27	0.10	0.09
Proportional	Initial	5.75	5.46	0.29	0.19
	Final	6.30	6.16	0.14	0.11

While the differences between the two groups on the multiplicative and proportional domains were statistically significant, the effect sizes for the differences between the two cohorts were small (less than 0.2) in all cases. Practically, this indicates that the mean strategy stages of the two groups are very similar. At both the initial and final assessment, students from schools in their second year of implementation had higher mean stages on all three domains. However, the gains made on all three domains were greater for students from schools in their first year of implementation. Correspondingly, the effect sizes for the differences between the cohorts were smaller for the final assessments than for the initial assessments, indicating that over the 2006 teaching year the differences between the two groups of students reduced.

Comparison of 2006 Year 9 and Year 10 Results

Table 7 shows the percentages of year 9 and year 10 SNP students in 2006 at each stage of the three strategy domains at the final assessment.

Table 7

Performance of Year 9 and 10 SNP Students in 2006 on the Strategy Domains

	Additive		Multiplicative		Proportional	
Stage	Yr 9	Yr 10	Yr 9	Yr 10	Yr 9	Yr 10
0–3: Counting from one	0%	0%	0%	1%	0%	1%
4: Advanced counting	5%	7%	5%	5%	6%	8%
5: Early additive	29%	21%	16%	16%	24%	21%
6: Advanced additive	44%	42%	35%	30%	19%	20%
7: Advanced multiplicative	22%	29%	29%	32%	38%	33%
8: Advanced proportional	n/a	n/a	14%	17%	12%	17%
N =	5807	2324	5807	2324	5807	2324

Slightly higher percentages of year 10 students than year 9 students reached the top two stages of the additive domain (71% compared with 66%) and of the multiplicative domain (49% compared with 43%). On the proportional domain, while 5% more year 10 students (17%) than year 9 students (12%) reached stage 8, the same proportion of students from each year level (50%) reached at least stage 7. At the lower stages, the difference between the percentages of students remaining at stage 4 or below was 3% or less on each domain. A t-test and analysis of effect sizes indicates that the difference between the two groups is not statistically significant ($p < 0.01$) on the proportional domain, and that on all three domains, the effect size is small (less than 0.2). In fact, the effect sizes for the difference between year 9 and year 10 students on the three domains were 0.13, 0.07, and 0.00 respectively. It is a cause for concern that year 10 students who should have had two years of teaching in schools that are implementing the SNP perform so similarly to year 9 students with one year of exposure to the SNP.

Table 8 shows the percentages of year 9 and year 10 students at each stage of the four knowledge domains at the final assessment.

Table 8
Performance of Year 9 and 10 SNP Students in 2006 on the Knowledge Domains

	FNWS		Fractions		Place Value		Basic Facts	
Stage	Yr 9	Yr 10	Yr 9	Yr 10	Yr 9	Yr 10	Yr 9	Yr 10
0–3	0%	0%	1%	1%	1%	0%	1%	1%
4	2%	1%	6%	6%	3%	3%	2%	3%
5	25%	21%	29%	23%	30%	25%	12%	12%
6	72%	78%	25%	24%	27%	29%	43%	40%
7	n/a	n/a	28%	31%	20%	18%	42%	45%
8	n/a	n/a	11%	16%	19%	25%	n/a	n/a
N =	5807	2324	5807	2324	5807	2324	5807	2324

The pattern of performance on the knowledge domains is similar to that of performance on the strategy domains, with similar or very slightly higher proportions of year 10 students reaching the higher stages of each domain. The proportions of students still rated at stage 4 or below were similar for the two year groups on all four domains. Between 15% and 36% of year 9 students and between 16% and 32% of year 10 students obtained a final rating of stage 5 or below on the knowledge domains. This is a real concern given that the acquisition of this knowledge base is a requirement for future success in mathematics.

Impacts of Demographic Factors

The results from the SNP in 2005 (Tagg & Thomas, 2006) indicated that the comparative performances of demographic subgroups of students in the SNP were similar to those found in previous NDP research (Young-Loveridge, 2006). Appendices E and F (pp. 50–56) provide a detailed breakdown of the percentages of students in 2006 from each demographic subgroup rated at each stage of the seven domains of the Framework. These results follow a similar pattern to previous findings.

This section compares the 2006 results of demographic subgroups on the multiplicative and basic facts domains, which are representative of the other strategy and knowledge domains. Table 9 shows the mean initial and final stages of demographic subgroups of year 9 students on the multiplicative domain as well as the mean final stages of year 10 students.

Table 9
Mean Multiplicative Stages of Demographic Subgroups

	Year 9 Initial	Year 9 Final	Year 10 Final
Male	5.81	6.41	6.43
Female	5.56	6.19	6.31
Low decile	5.15	5.91	5.92
Medium decile	5.67	6.26	6.38
High decile	5.97	6.57	6.52
NZ European	5.83	6.41	6.52
Māori	5.51	6.11	5.92
Pasifika	4.97	5.83	6.06
Total	5.69	6.30	6.38

In general, the pattern of performance of year 9 SNP students reflects that found in 2005. The mean stage of male students was higher than that of females, the mean stage of New Zealand European students was higher than that of Māori and Pasifika students, and the mean stage of students from high-decile schools was higher than that of those from medium-decile schools, with both higher than that of students from low-decile schools. The mean final stages of year 9 students ranged from 5.83 for Pasifika students to 6.57 for students from high-decile schools. In year 10, Māori students and students from low-decile schools shared the lowest mean stage (5.92), while New Zealand European students and students from high-decile schools shared the highest mean stage (6.52). All the subgroups of year 9 students made mean gains on the multiplicative domain of at least half a stage, with the smallest gains made by New Zealand European students (0.58) and the largest made by Pasifika students (0.86). The mean final multiplicative stages of year 9 and year 10 students were similar, with Pasifika students being the only subgroup for which the mean final stage of year 10 students was more than 0.2 of a stage higher than the mean final stage for year 9 students.

To further investigate the significance of the impact of demographic factors on students' performance on the Framework, effect sizes were calculated for comparisons between males and females; New Zealand European, Māori, and Pasifika students; and students from low-, medium-, and high-decile schools. The results of this analysis for all seven domains are shown in full in Appendix G, pg. 57.

Table 10 shows the effect sizes for demographic factors on the multiplicative domain. The shaded cells represent comparisons where the difference was not statistically significant at the 99% confidence level.

Table 10
Effect Sizes for Comparisons between Demographic Subgroups on the Multiplicative Domain

	Year 9 Initial	Year 9 Final	Year 10 Final
Male/Female	0.21	0.21	0.10
High/Medium decile	0.27	0.30	0.12
High/Low decile	0.70	0.59	0.53
Medium/Low decile	0.45	0.32	0.40
NZE/Māori	0.28	0.27	0.55
NZE/Pasifika	0.76	0.54	0.42
Māori/Pasifika	0.50	0.27	–0.13

Table 10 shows that the effect sizes for comparisons of final results for individual year levels varied from 0.10 for the difference between year 10 male and female students and –0.13 between year 10 Māori and Pasifika students to 0.59 for the difference between year 9 students from high- and low-decile schools. The difference between the final results of year 9 and year 10 students on this domain, while statistically significant, had a very small effect size (0.06).

Effect sizes were also calculated for the differences between the initial and final stages of year 9 students to compare the impact of the SNP on the demographic subgroups. The results of this analysis for all seven domains are shown in full in Appendix G, pg. 57.

Table 11 shows the mean gains and effect sizes for the impact of the SNP on year 9 students on the multiplicative domain.

Table 11
Effect Sizes for Gains Made on the Multiplicative Domain by Demographic Subgroups of Year 9 SNP Students

	Mean Initial Stage	Mean Final Stage	Gain	Effect Size
Male	5.81	6.41	0.60	0.51
Female	5.56	6.19	0.63	0.59
Low decile	5.15	5.91	0.76	0.62
Medium decile	5.67	6.26	0.59	0.54
High decile	5.97	6.57	0.60	0.54
NZ European	5.83	6.41	0.57	0.52
Māori	5.51	6.11	0.60	0.54
Pasifika	4.97	5.83	0.86	0.83
Total	5.69	6.30	0.61	0.54

The overall effect size for the impact of the SNP on year 9 students' performance on the multiplicative domain was 0.54. While all demographic subgroups made mean gains of over half a stage, the greatest mean gain (0.86) and, correspondingly, the highest effect size (0.83) were for Pasifika students. It is interesting to note that for all demographic factors, the subgroups for which the impact was greatest tended to be those whose mean starting stage was lowest. This further supports previous findings that students make greater progress on the Framework from the lower stages (Thomas, Tagg, & Ward, 2003).

Table 12 shows the effect sizes for demographic factors on the basic facts domain. The effect sizes on this domain tended to be smaller than those on the other six domains. The shaded cells represent comparisons where the difference was not statistically significant at the 99% confidence level.

Table 12
Effect Sizes for Comparisons of Demographic Subgroups on the Basic Facts Domain

	Year 9 Initial	Year 9 Final	Year 10 Final
Male/Female	0.04	0.06	–0.09
High/Medium decile	0.11	0.18	–0.09
High/Low decile	0.46	0.33	0.27
Medium/Low decile	0.35	0.18	0.36
NZ European/Māori	0.14	0.13	0.27
NZ European/Pasifika	0.47	0.30	0.07
Māori/Pasifika	0.30	0.15	–0.18

The largest effect size calculated on this domain was 0.47, for the difference between the initial stages of year 9 New Zealand European and Pasifika students. The largest effect size calculated for final assessment results was 0.33, for the difference between year 9 students in high- and low-decile schools. The fact that the effect sizes for the differences in final results tended to be smaller than those for initial results would seem to indicate that the differences between subgroups are reduced over the course of the SNP. The difference between the final results of year 9 and year 10 students on this domain was not statistically significant.

Concluding Comment and Key Findings

Generally, year 9 students in schools participating in the SNP made progress on all domains of the Number Framework. Although year 10 students performed better than year 9 students on all domains apart from the proportional domain, the effect sizes of the difference between year levels were small, suggesting that a second year of implementation of the SNP has had little impact on student performance. Consistent with previous results from the NDP, demographic factors were shown to have impacted on the performance of students.

Among the findings were:

- The percentages of year 9 students rated in the top two stages of the additive, multiplicative, and proportional domains increased from 41% to 66%, 24% to 43%, and 34% to 50% respectively.
- The percentages of year 9 students still rated stage 5 or lower on the additive, multiplicative, and proportional domains decreased from 59% to 34%, 44% to 21%, and 49% to 30% respectively.
- By the final assessment, the percentage of students at the top two stages of the knowledge domains had increased from 20% to 39% for fractions, from 20% to 39% for place value, and from 23% to 42% for basic facts.
- Between 15% and 36% of year 9 students and between 16% and 32% of year 10 students remained at stage 5 or below on the knowledge domains at the end of the year.
- New Zealand European students performed better than Māori or Pasifika students, male students generally performed slightly better than female students, and students from high-decile schools performed better than students from medium- and low-decile schools.

While the SNP has had a positive impact on the performance of year 9 students on the Framework, the proportions of students in both year 9 and year 10 with final ratings of stage 5 or below on the Framework are a cause for concern. Given that students' progress on the strategy domains is dependent on their number knowledge, it is important that efforts are made to address the significant proportions of year 9 and 10 students remaining at the lower stages of the knowledge domains.

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Appendix A (Evaluation of the 2006 Secondary Numeracy Project)

Questionnaire for Teachers

1. What do you regard as the **main messages** from the Secondary Numeracy Project?

2. How has participation in the project impacted on your **mathematical content knowledge**?

1 2 3 4 5

Little impact Considerable Impact

Please comment:

3. How has participation in the project impacted on your **knowledge of teaching mathematics**?

1 2 3 4 5

Little impact Considerable Impact

Please comment:

4. How has participation in the project impacted on your **knowledge of how students learn mathematics**?

1 2 3 4 5

Little impact Considerable Impact

Please comment:

5. Please rate the impact of the numeracy professional development **in your classroom** on:

Teaching

1	2	3	4	5
Little impact				Considerable Impact

Please comment:

Student learning

1	2	3	4	5
Little impact				Considerable Impact

Please comment:

6a. What are the **main changes** you have made to your teaching of year 9 classes?

b. Which of these changes will you continue with?

c. What other changes would you like to make?

7. What are the **main factors** that have influenced changes that you have already made to your teaching?

8. Are there **practices** introduced by the SNP that you do not wish to implement? If so, what practices?

9. Describe how **information** about individual student achievement (observations, interactions, test scores, etc) informs your subsequent mathematics teaching.

10. Describe any **factors that limit** your use of assessment data.

11. Please rate, using a scale of 1 to 5 (5 being extremely useful), the following terms for their usefulness in influencing your teaching.

☐ Diagnostic interview

☐ Numeracy booklets

☐ Workshops

☐ Ongoing support of the facilitator in your school

☐ Support material from www.nzmaths.co.nz

☐ Equipment introduced in the project

Please comment:

12. In what ways has SNP impacted on discussions with colleagues on mathematics teaching?

13. What would your main message be to a secondary school mathematics department who are considering participating in the SNP?

14. Are there any other comments you would like to make about the project?

BIOGRAPHICAL DATA

Qualification:

Qualification in mathematics:

Years teaching mathematics:

Years teaching mathematics in secondary school:

Hours per week timetabled for teaching mathematics this year:

Thank you for your assistance.

Appendix B (Evaluation of the 2006 Secondary Numeracy Project)

Questionnaire for Small Sample of First-year In-school Facilitators (ISFs)

1. What knowledge and skills of facilitation/teacher development have you developed through the project?

2. What are the key skills and qualities needed by the facilitator for in-school facilitation to be effective?

3. Has the in-school model of teacher development been effective in building teacher capability in your school(s)?

4. Has the in-school model of teacher development been effective in raising student achievement in your school(s)?

5. What are your thoughts about the in-school facilitator model of professional development:
   - Advantages?
   - Disadvantages?
   - Other points of interest?

6. How have your relationships with staff been affected by your change of role (to in-school facilitator)?

Appendix C (Evaluation of the 2006 Secondary Numeracy Project)

Questionnaire for Facilitators Involved with the Project for Two Years

1. How has participation **this year** in the project impacted on the **mathematical content knowledge of teachers in your department**?

1	2	3	4	5
Little impact				Considerable Impact

Please comment:

2. How has participation **this year** in the project impacted on the **knowledge of teaching mathematics of teachers in your department**?

1	2	3	4	5
Little impact				Considerable Impact

Please comment:

3. How has participation **this year** in the project impacted on **knowledge of how students learn mathematics of teachers in your department**?

1	2	3	4	5
Little impact				Considerable Impact

Please comment:

4. Please rate the impact this year of the numeracy professional development **in classrooms in your school**.

Teaching

1	2	3	4	5
Little impact				Considerable Impact

Please comment:

Student learning

1	2	3	4	5
Little impact				Considerable Impact

Please comment:

Explain the main changes.

5. In what ways has SNP this year impacted on discussions with colleagues on mathematics teaching?

6. What knowledge and skills in facilitation have you developed in your role as in-school facilitator?

7. Describe the challenges to effective facilitation that you have experienced in your role as in-school facilitator.

8. What are the key qualities and skills required for effective facilitation of the Secondary Numeracy Project?

9. Are the facilitation skills required for the second year of the project different to those required for the first year of the project facilitation?

☐ Yes ☐ No

Please comment:

10. What are your thoughts about the in-school facilitator model of professional development?

- Advantages:
- Disadvantages:
- Other points of interest:

11. Are there any other comments you would like to make about the project?

BIOGRAPHICAL DATA

Hours per week timetabled for teaching mathematics this year:

Thank you for your assistance.

Appendix D (Evaluation of the 2006 Secondary Numeracy Project)

Questionnaire for Regional Facilitators (RFs)

1. Describe the main impact of the second year of the project for those schools which started the project in 2005.

2. What knowledge and skills of facilitation/teacher development have the facilitators in your region developed through the project?

3. Describe any development of facilitation skills this year for those involved as facilitators for their second year of the project?

4. What are the key skills and qualities needed by the facilitator for in-school facilitation to be effective?

5. Are different qualities required for facilitation of the project in the second year of a school's involvement in the project to the qualities required for the facilitation of the project in a school's first year of the project?

   Please describe:

6. Has the in-school model of teacher development been effective in building teacher capability in the schools you work in?

7. Has the in-school model of teacher development been effective in raising student achievement in the schools you work in?

8. What are your thoughts about the in-school facilitator model of professional development:

   - Advantages?

   - Disadvantages?

   - Other points of interest?

Appendix E (Performance of SNP students on the Number Framework)

Performance on the Strategy Domains in 2006

Table 13

Performance of SNP Students on the Additive Domain

	Ethnicity			Decile Group			Gender		
	NZE	**Māori**	**Pasifika**	**Low**	**Med.**	**High**	**Male**	**Female**	**Total**
Year 9 initial									
0–3: Counting from one	1%	1%	3%	4%	1%	1%	2%	1%	1%
4: Advanced counting	11%	18%	27%	23%	14%	9%	11%	17%	14%
5: Early additive	42%	47%	49%	47%	45%	41%	40%	48%	44%
6: Advanced additive	37%	30%	19%	23%	33%	38%	37%	29%	33%
7: Advanced multiplicative	9%	4%	1%	2%	7%	12%	11%	5%	8%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 9 final									
0–3: Counting from one	0%	1%	0%	2%	0%	0%	0%	0%	0%
4: Advanced counting	4%	6%	11%	11%	5%	3%	4%	6%	5%
5: Early additive	26%	32%	40%	31%	31%	23%	25%	33%	29%
6: Advanced additive	46%	44%	38%	42%	45%	42%	45%	43%	44%
7: Advanced multiplicative	24%	16%	10%	15%	19%	31%	25%	18%	22%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 10 final									
0–3: Counting from one	0%	1%	0%	1%	0%	1%	0%	0%	0%
4: Advanced counting	5%	14%	16%	16%	8%	4%	8%	6%	7%
5: Early additive	18%	30%	24%	25%	20%	21%	19%	23%	21%
6: Advanced additive	43%	42%	41%	47%	45%	39%	43%	42%	42%
7: Advanced multiplicative	33%	14%	19%	12%	28%	36%	29%	29%	29%
N =	1551	422	113	321	1037	966	1328	996	2324

Table 14

Performance of SNP Students on the Multiplicative Domain

	Ethnicity			Decile Group			Gender		
	NZE	**Māori**	**Pasifika**	**Low**	**Med.**	**High**	**Male**	**Female**	**Total**
Year 9 initial									
0–3: Counting from one	1%	2%	3%	5%	1%	1%	2%	1%	2%
4: Advanced counting	11%	17%	31%	27%	14%	8%	13%	14%	14%
5: Early additive	26%	31%	38%	30%	30%	23%	24%	32%	28%
6: Advanced additive	34%	33%	21%	26%	32%	35%	31%	33%	32%
7: Advanced multiplicative	21%	15%	7%	11%	17%	24%	21%	15%	18%
8: Advanced proportional	7%	3%	1%	2%	6%	9%	8%	4%	6%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 9 final									
0–3: Counting from one	0%	1%	0%	2%	0%	1%	1%	0%	0%
4: Advanced counting	4%	6%	9%	11%	5%	3%	5%	5%	5%
5: Early additive	14%	17%	29%	23%	18%	10%	14%	19%	16%
6: Advanced additive	33%	40%	35%	32%	37%	32%	31%	38%	35%
7: Advanced multiplicative	31%	26%	23%	22%	28%	35%	32%	27%	29%
8: Advanced proportional	16%	9%	4%	10%	12%	20%	18%	11%	14%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 10 final									
0–3: Counting from one	1%	1%	0%	1%	0%	1%	1%	1%	1%
4: Advanced counting	3%	8%	7%	11%	5%	2%	5%	4%	5%
5: Early additive	14%	25%	19%	25%	16%	13%	16%	17%	16%
6: Advanced additive	28%	35%	41%	29%	31%	28%	27%	33%	30%
7: Advanced multiplicative	35%	24%	26%	23%	30%	37%	31%	33%	32%
8: Advanced proportional	20%	7%	7%	10%	18%	18%	21%	12%	17%
N =	1551	422	113	321	1037	966	1328	996	2324

Table 15

Performance of SNP Students on the Proportional Domain

	Ethnicity			Decile Group			Gender		
	NZE	**Māori**	**Pasifika**	**Low**	**Med.**	**High**	**Male**	**Female**	**Total**
Year 9 initial									
0–1: Unequal sharing	0%	1%	2%	2%	1%	0%	1%	1%	1%
2–4: Equal sharing	13%	20%	37%	34%	17%	9%	15%	19%	17%
5: Early additive	28%	39%	36%	29%	33%	27%	28%	34%	31%
6: Advanced additive	18%	16%	12%	15%	17%	18%	17%	17%	17%
7: Advanced multiplicative	35%	21%	13%	18%	28%	39%	33%	27%	30%
8: Advanced proportional	5%	2%	0%	1%	4%	7%	6%	3%	4%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 9 final									
0–1: Unequal sharing	0%	0%	0%	0%	0%	0%	0%	0%	0%
2–4: Equal sharing	5%	8%	11%	14%	6%	3%	6%	6%	6%
5: Early additive	20%	33%	40%	29%	27%	16%	20%	28%	24%
6: Advanced additive	18%	20%	21%	22%	19%	16%	18%	19%	19%
7: Advanced multiplicative	43%	32%	23%	26%	37%	46%	40%	36%	38%
8: Advanced proportional	14%	7%	4%	9%	10%	18%	15%	10%	12%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 10 final									
0–1: Unequal sharing	1%	1%	2%	5%	0%	0%	1%	1%	1%
2–4: Equal sharing	6%	13%	13%	13%	9%	6%	9%	7%	8%
5: Early additive	17%	33%	25%	31%	22%	16%	18%	24%	21%
6: Advanced additive	18%	21%	32%	19%	22%	17%	20%	20%	20%
7: Advanced multiplicative	37%	27%	24%	24%	32%	38%	34%	32%	33%
8: Advanced proportional	21%	7%	4%	8%	15%	23%	18%	17%	17%
N =	1551	422	113	321	1037	966	1328	996	2324

Appendix F (Performance of SNP students on the Number Framework)

Performance on the Knowledge Domains in 2006

Table 16

Performance of SNP Students on the FNWS Domain

	Ethnicity			Decile Group			Gender		
	NZE	**Māori**	**Pasifika**	**Low**	**Med.**	**High**	**Male**	**Female**	**Total**
Year 9 initial									
0–3: To 20	1%	3%	7%	7%	2%	1%	2%	2%	2%
4: To 100	3%	5%	10%	10%	4%	3%	4%	5%	4%
5: To 1000	36%	43%	55%	47%	39%	38%	35%	45%	40%
6: To 1 000 000	60%	48%	27%	37%	56%	58%	59%	49%	54%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 9 final									
0–3: To 20	0%	0%	2%	2%	0%	0%	0%	1%	0%
4: To 100	1%	2%	6%	6%	1%	1%	2%	2%	2%
5: To 1000	21%	30%	44%	32%	26%	21%	20%	31%	25%
6: To 1 000 000	77%	67%	48%	60%	73%	77%	78%	67%	72%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 10 final									
0–3: To 20	0%	0%	0%	0%	0%	0%	0%	0%	0%
4: To 100	1%	2%	1%	2%	1%	0%	1%	1%	1%
5: To 1000	17%	30%	32%	30%	19%	20%	19%	24%	21%
6: To 1 000 000	82%	68%	67%	67%	80%	80%	80%	75%	78%
N =	1551	422	113	321	1037	966	1328	996	2324

Table 17
Performance of SNP Students on the Fractions Domain

	Ethnicity			Decile Group			Gender		
	NZE	**Māori**	**Pasifika**	**Low**	**Med.**	**High**	**Male**	**Female**	**Total**
Year 9 initial									
0–3: Non-fractions	3%	6%	10%	10%	4%	2%	5%	4%	4%
4: Assigned unit fractions	10%	18%	20%	17%	13%	8%	10%	14%	12%
5: Ordered unit fractions	40%	43%	46%	47%	42%	35%	38%	43%	41%
6: Co-ordinated num./denom.	23%	19%	17%	17%	21%	27%	21%	23%	22%
7: Equivalent fractions	18%	12%	7%	8%	15%	22%	18%	14%	16%
8: Orders fractions	5%	2%	1%	1%	4%	6%	7%	2%	4%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 9 final									
0–3: Non-fractions	0%	1%	2%	2%	1%	1%	1%	1%	1%
4: Assigned unit fractions	4%	10%	11%	10%	7%	3%	6%	6%	6%
5: Ordered unit fractions	27%	34%	38%	33%	33%	19%	26%	32%	29%
6: Co-ordinated num./denom.	25%	25%	29%	27%	24%	26%	24%	26%	25%
7: Equivalent fractions	30%	24%	18%	20%	27%	34%	28%	28%	28%
8: Orders fractions	13%	8%	3%	7%	9%	17%	15%	7%	11%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 10 final									
0–3: Non-fractions	1%	2%	0%	3%	1%	1%	2%	1%	1%
4: Assigned unit fractions	4%	9%	8%	11%	6%	4%	6%	5%	6%
5: Ordered unit fractions	21%	32%	23%	31%	22%	21%	22%	23%	23%
6: Co-ordinated num./denom.	22%	26%	41%	21%	26%	22%	21%	27%	24%
7: Equivalent fractions	33%	24%	20%	25%	30%	34%	30%	32%	31%
8: Orders fractions	19%	7%	8%	9%	15%	19%	19%	12%	16%
N =	1551	422	113	321	1037	966	1328	996	2324

Table 18
Performance of SNP Students on the Place Value Domain

	Ethnicity			Decile Group			Gender		
	NZE	**Māori**	**Pasifika**	**Low**	**Med.**	**High**	**Male**	**Female**	**Total**
Year 9 initial									
0–3: Counts in fives and ones	2%	3%	7%	8%	2%	2%	3%	2%	3%
4: 10s to 100, orders to 1000	9%	11%	21%	17%	11%	8%	9%	13%	11%
5: 10s to 1000, orders to 10 000	42%	51%	55%	49%	45%	43%	40%	50%	45%
6: 10s, 100s, 1000s, orders whole numbers	23%	20%	12%	16%	22%	20%	21%	21%	21%
7: Tenths in and orders decimals	14%	11%	4%	7%	12%	16%	15%	10%	12%
8: Tenths, hundredths, and thousandths	9%	5%	1%	3%	7%	11%	11%	4%	8%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 9 final									
0–3: Counts in fives and ones	0%	1%	2%	2%	0%	1%	1%	1%	1%
4: 10s to 100, orders to 1000	3%	4%	6%	6%	3%	2%	3%	3%	3%
5: 10s to 1000, orders to 10 000	26%	33%	48%	37%	30%	25%	26%	33%	30%
6: 10s, 100s, 1000s, orders whole numbers	27%	32%	26%	26%	28%	25%	26%	28%	27%
7: Tenths in and orders decimals	23%	19%	11%	18%	20%	22%	21%	20%	20%
8: Tenths, hundredths, and thousandths	22%	12%	6%	11%	17%	26%	23%	14%	19%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 10 final									
0–3: Counts in fives and ones	0%	1%	0%	2%	0%	0%	1%	0%	0%
4: 10s to 100, orders to 1000	2%	6%	4%	5%	3%	3%	3%	4%	3%
5: 10s to 1000, orders to 10 000	23%	33%	27%	33%	24%	24%	25%	26%	25%
6: 10s, 100s, 1000s, orders whole numbers	25%	36%	44%	35%	32%	23%	27%	30%	29%
7: Tenths in and orders decimals	19%	13%	16%	15%	18%	18%	17%	19%	18%
8: Tenths, hundredths, and thousandths	30%	11%	9%	11%	23%	32%	27%	22%	25%
N =	1551	422	113	321	1037	966	1328	996	2324

Table 19
Performance of SNP Students on the Basic Facts Domain

	Ethnicity			Decile Group			Gender		
	NZE	**Māori**	**Pasifika**	**Low**	**Med.**	**High**	**Male**	**Female**	**Total**
Year 9 initial									
0–3: Facts to 10	2%	3%	5%	6%	2%	1%	4%	1%	2%
4: Within 10, doubles, and teens	5%	7%	10%	9%	6%	3%	5%	6%	6%
5: Addition, multiplication for 2, 5, 10	19%	23%	25%	24%	20%	18%	19%	21%	20%
6: Subtraction and multiplication	50%	45%	51%	47%	48%	53%	45%	54%	49%
7: Division	25%	23%	9%	14%	24%	25%	28%	18%	23%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 9 final									
0–3: Facts to 10	1%	1%	1%	2%	0%	1%	1%	0%	1%
4: Within 10, doubles, and teens	2%	2%	2%	4%	2%	1%	3%	2%	2%
5: Addition, multiplication for 2, 5, 10	11%	15%	16%	16%	13%	9%	12%	12%	12%
6: Subtraction and multiplication	42%	43%	53%	41%	45%	41%	38%	48%	43%
7: Division	44%	39%	28%	38%	40%	49%	46%	38%	42%
N =	3700	1061	546	708	3546	1553	2878	2929	5807
Year 10 final									
0–3: Facts to 10	1%	2%	2%	3%	1%	1%	2%	0%	1%
4: Within 10, doubles, and teens	3%	4%	2%	3%	2%	3%	3%	2%	3%
5: Addition, multiplication for 2, 5, 10	11%	14%	12%	17%	12%	10%	11%	12%	12%
6: Subtraction and multiplication	38%	47%	41%	45%	36%	42%	40%	40%	40%
7: Division	47%	33%	43%	33%	50%	43%	44%	46%	45%
N =	1551	422	113	321	1037	966	1328	996	2324

Appendix G (Performance of SNP students on the Number Framework)

Effect Sizes for Performance of SNP Students

Table 20
Effect Sizes for Differences between Demographic Subgroups of SNP Students

		Add	Mult	Prop	FNWS	Fract	PV	BF
Male/Female	Yr 9 initial	0.26	0.21	0.20	0.15	0.17	0.28	0.04
	Yr 9 final	0.20	0.21	0.17	0.21	0.18	0.22	0.06
	Yr 10 final	0.02	0.10	0.04	0.11	0.03	0.08	–0.09
High/Medium	Yr 9 initial	0.23	0.27	0.32	0.08	0.28	0.17	0.11
	Yr 9 final	0.26	0.30	0.35	0.09	0.37	0.22	0.18
	Yr 10 final	0.15	0.12	0.26	0.02	0.13	0.16	–0.09
High/Low	Yr 9 initial	0.63	0.70	0.81	0.58	0.72	0.57	0.46
	Yr 9 final	0.49	0.59	0.66	0.46	0.56	0.50	0.33
	Yr 10 final	0.61	0.53	0.73	0.31	0.50	0.53	0.27
Medium/Low	Yr 9 initial	0.41	0.45	0.48	0.53	0.44	0.44	0.35
	Yr 9 final	0.26	0.32	0.32	0.41	0.20	0.29	0.18
	Yr 10 final	0.45	0.40	0.47	0.30	0.38	0.40	0.36
NZE/Māori	Yr 9 initial	0.27	0.28	0.38	0.30	0.37	0.25	0.14
	Yr 9 final	0.24	0.27	0.39	0.25	0.30	0.30	0.13
	Yr 10 final	0.58	0.55	0.53	0.37	0.48	0.53	0.27
NZE/Pasifika	Yr 9 initial	0.63	0.76	0.83	0.84	0.63	0.73	0.47
	Yr 9 final	0.50	0.54	0.66	0.77	0.55	0.67	0.30
	Yr 10 final	0.47	0.42	0.58	0.37	0.36	0.43	0.07
Māori/Pasifika	Yr 9 initial	0.37	0.50	0.45	0.44	0.25	0.53	0.30
	Yr 9 final	0.25	0.27	0.25	0.41	0.24	0.38	0.15
	Yr 10 final	–0.10	–0.13	0.05	–0.02	–0.13	–0.11	–0.18
Year 10/Year 9	Final	0.13	0.07	0.00	0.15	0.17	0.13	0.00
Initial/Final	Yr 9	0.58	0.54	0.47	0.38	0.52	0.57	0.45

(Shaded cells represent differences that are not statistically significant ($p < 0.01$).)

Table 21
Effect Sizes for Impact of Project on Demographic Subgroups of SNP Students

	Add	Mult	Prop	FNWS	Fract	PV	BF	N =
NZE	0.57	0.52	0.45	0.38	0.51	0.57	0.44	3700
Māori	0.60	0.54	0.48	0.40	0.57	0.55	0.42	1061
Pasifika	0.73	0.83	0.70	0.44	0.60	0.72	0.61	546
Low	0.67	0.62	0.60	0.43	0.69	0.67	0.53	708
Medium	0.58	0.54	0.46	0.38	0.48	0.56	0.42	3546
High	0.58	0.54	0.47	0.39	0.56	0.58	0.48	1553
Male	0.54	0.51	0.44	0.39	0.49	0.51	0.41	2878
Female	0.63	0.59	0.51	0.37	0.55	0.65	0.49	2929
Total	0.58	0.54	0.47	0.38	0.52	0.57	0.45	5807

MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

EXPLORING ISSUES IN MATHEMATICS EDUCATION

Evaluations of the 2006 Secondary Numeracy Project

R. Harvey, J. Higgins, A. Tagg, G. Thomas

Evaluations of the 2006 Secondary Numeracy Project

SNP contracted researchers

R. Harvey, J. Higgins, A. Tagg, G. Thomas

Foreword

K. Hannah

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