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.

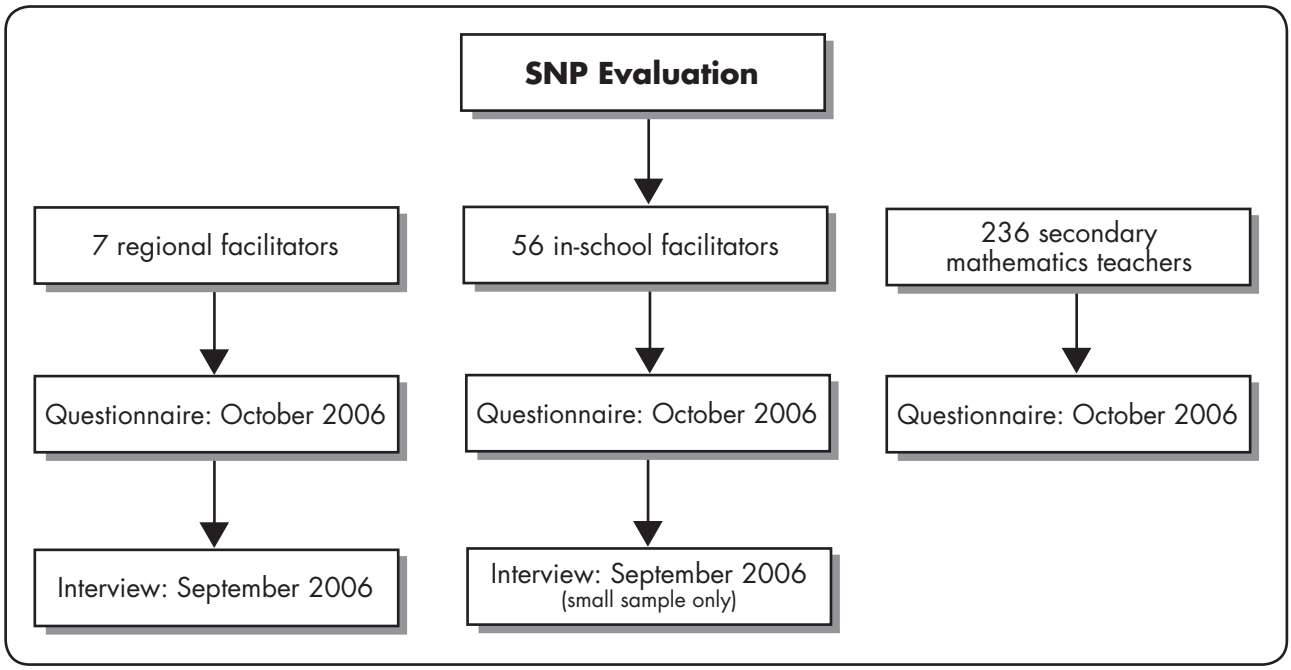

Figure 1: Overview of the evaluation of 2006 SNP

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

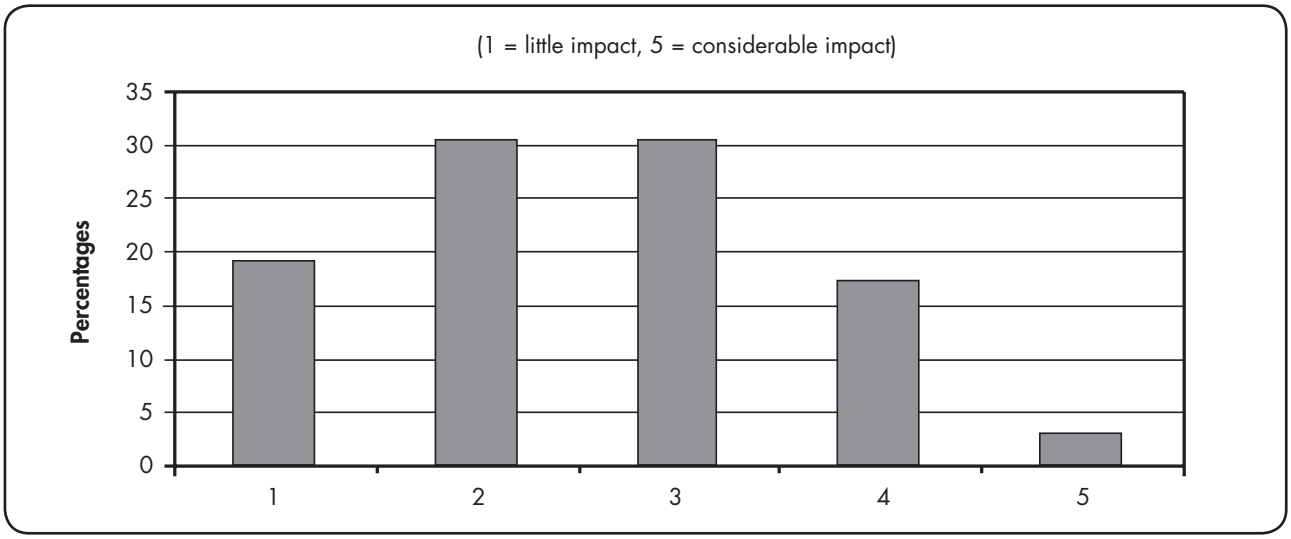

Figure 2: Impact of SNP on teachers' mathematical knowledge

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

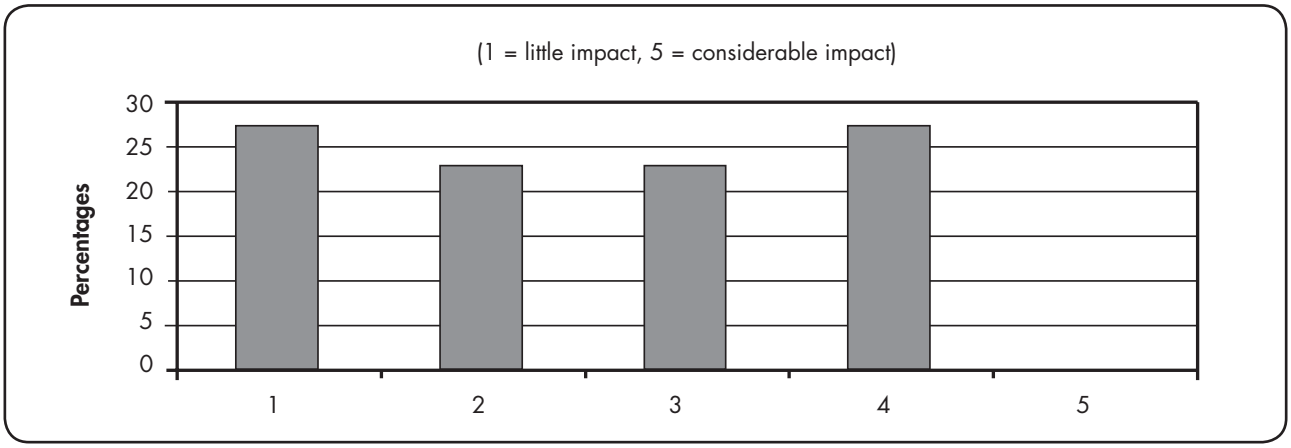

Figure 3: Impact of SNP on ISFs' mathematical knowledge

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

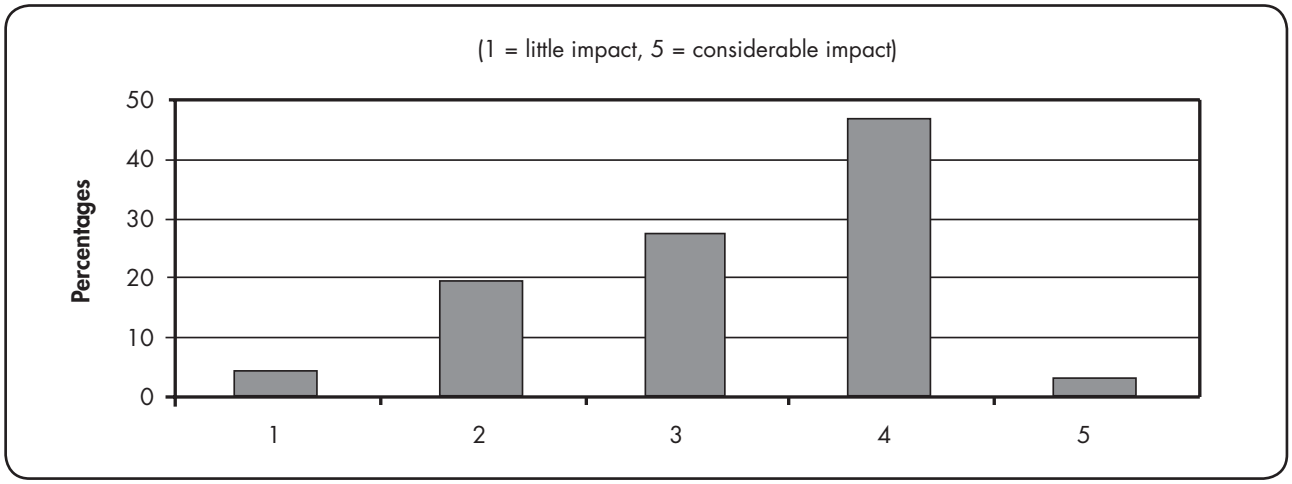

Figure 4: Impact of the SNP on teachers' knowledge of teaching mathematics

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

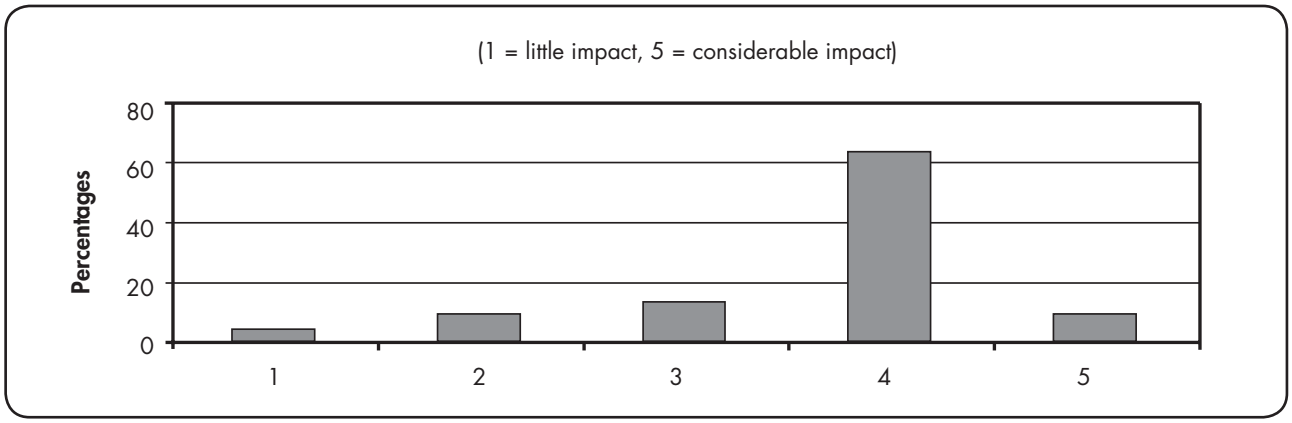

Figure 5: Impact of the SNP on ISFs' knowledge of teaching mathematics

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

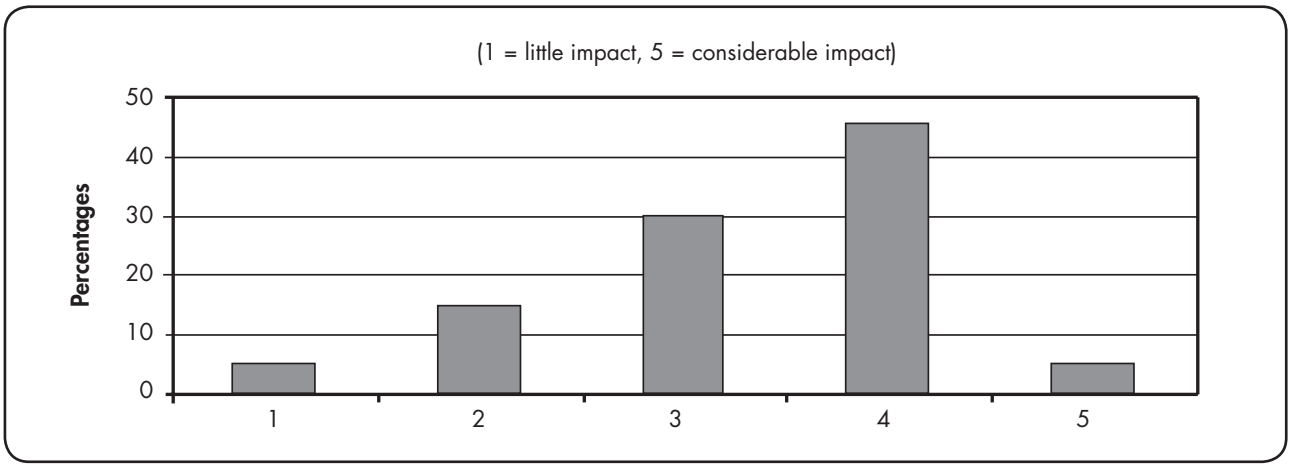

Figure 6: Impact of the SNP on teachers' knowledge of how students learn mathematics

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

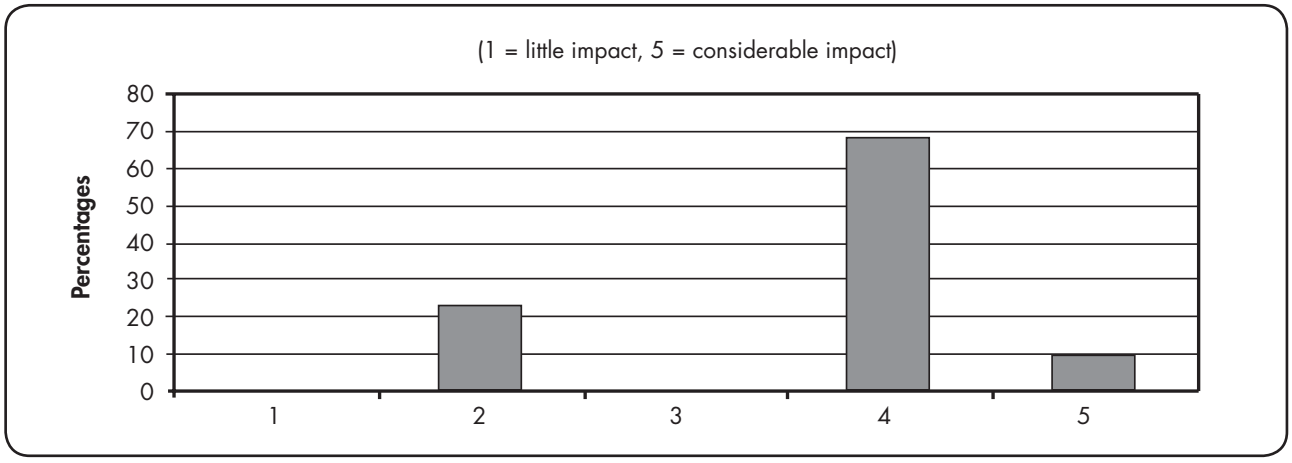

Figure 7: Impact of the SNP on ISFs' knowledge of how students learn mathematics

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)

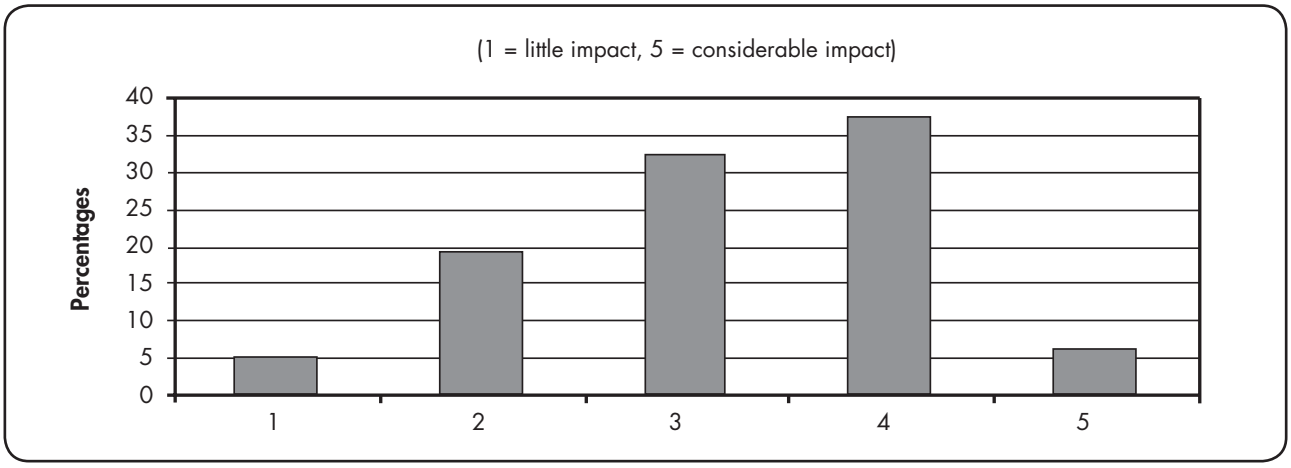

Figure 8: Impact of the SNP on teaching in teachers' classrooms

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)

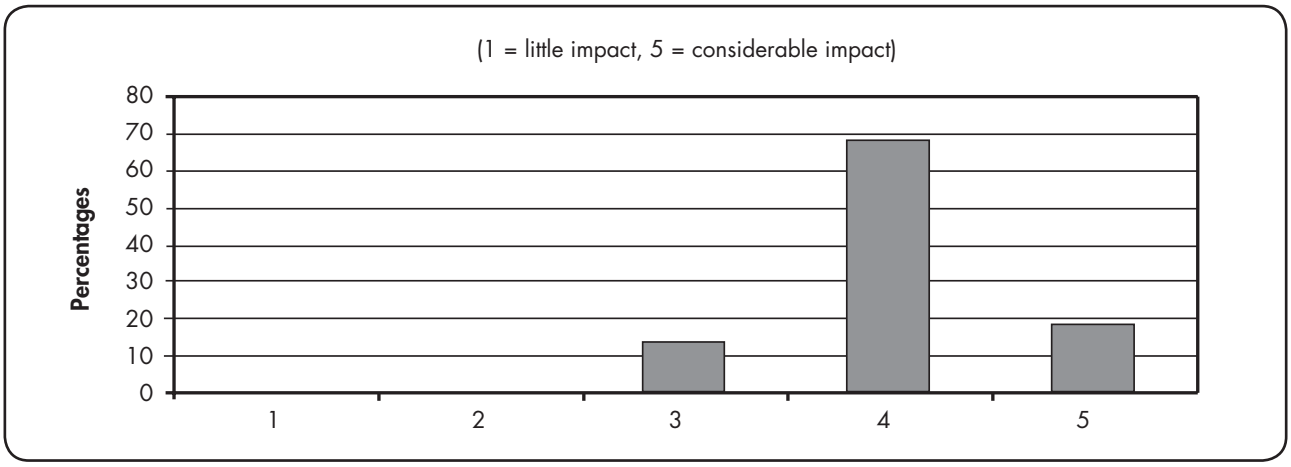

Figure 9: Impact of the SNP on teaching in ISFs' classrooms

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)

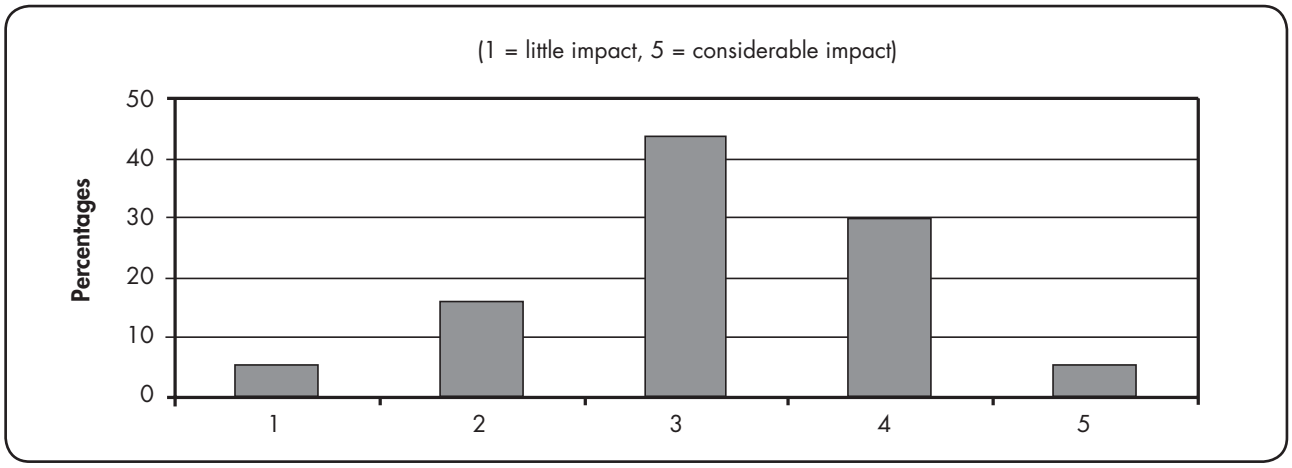

Figure 10: Impact of the SNP on learning in teachers' classrooms

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)

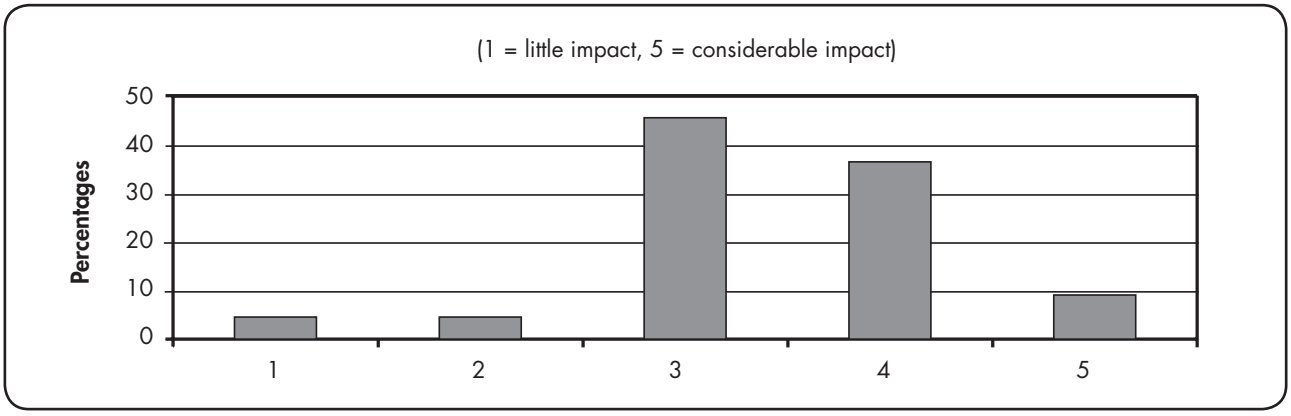

Figure 11: Impact of the SNP on learning in ISFs' classrooms

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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Acknowledgments

Grateful thanks to the teachers, in-school facilitators, and regional facilitators for participating in the SNP evaluation.

Special thanks to Susan Kaiser and Lynne Jackson for their help with the evaluation.