# Evaluation of Secondary Numeracy Pilot Project 2005

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## Introduction

In 2005, the Ministry of Education offered New Zealand secondary schools an opportunity to improve the teaching and learning of number and algebraic concepts and skills through the Secondary Numeracy Pilot Project (SNP), a professional development programme for teachers.

The overall aim of the SNP is to develop teachers' knowledge of number and algebraic concepts, student strategies, and instructional practice in order to improve student achievement in year 9. A key part of the project is presenting teachers with a framework of broad stages describing students' numerical and algebraic thinking. Each stage is characterised by the range of strategies that students use to solve calculation problems. Teachers use a diagnostic interview to assess the stages of their students' thinking. Teachers are also introduced to number problem-solving strategies, activities, and equipment to use when working with students. There is a particular emphasis on ways of developing increasingly sophisticated strategies for solving number and algebra problems.

This report evaluates the impact of the 2005 SNP on 320 teachers across 11 regions: Northland, Auckland, Bay of Plenty, Wanganui, Manawatu, Hawke's Bay, Wellington, Nelson, Canterbury, Otago, and Southland. The report identifies changes in student achievement and teacher knowledge and practice that can be attributed to the professional development provided by the SNP.

The research addressed the following main questions:

***Impact on teachers***

1. Has the 2005 SNP pilot had an impact on teachers' professional knowledge? If so, what are the changes?
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 the subject, the pedagogical content, and learners' cognitions) have an impact on their classroom practices? If so, how?
4. What impact has the shift from staff member to in-school facilitator had on existing relationships within the school?

***Impact on facilitators***

1. What is the impact on external and in-school facilitators of developing teacher subject and pedagogical content knowledge at the year 9 level?
2. What knowledge have the in-school facilitators developed through their participation in the SNP?

3. What are the key qualities and skills required for effective in-school facilitation of the SNP at the year 9 level?

***In-school facilitation model***

1. What evidence is there that an in-school facilitation model is effective in building teacher capability?
2. What have been the benefits and drawbacks of in-school facilitation, according to different members of the school mathematics community?
3. Is there any evidence of enhanced collegial support within the mathematics department?

## *Key Findings*

***Impact on teachers***

- There was little change in the teachers' mathematical knowledge, as reported by the teachers or facilitators. Data from facilitators reported growth in teachers' knowledge of teaching mathematics. Data from teachers suggested more modest growth.
- Both teachers and facilitators reported an improvement in teachers' knowledge of how students learn mathematics across the duration of the year.
- Many teachers reported that achievement data gathered had influenced subsequent mathematics teaching by giving them a level at which to plan lessons and helping them to group students.
- The overwhelming view of teachers and in-school facilitators was that teachers' knowledge of number was the most important factor in teaching mathematics at year 9. This belief ran through responses to all questions, being strongest in the requirements for year 8 to bring to year 9 (99% of teachers and 33% of facilitators). It was seen as a key element by 49% of teachers in the initial survey and 77% in the final survey.
- Teachers saw time as the greatest limiting factor to teachers in fulfilling the SNP. Initially, 30% of facilitators and 39% of teachers saw it as an issue, and at the end of the year, 41% of facilitators and 33% of teachers saw it this way.

***Impact on facilitators***

- Most in-school facilitators felt that they had developed their knowledge of facilitation during the year. They generally felt more knowledgeable about the teaching of mathematics, how to prepare materials, and how to put their ideas across to teachers. They were more confident about running professional development sessions, although many would welcome more support on this in the initial stages of the project.
- People skills were seen as a very important quality for in-school facilitators to possess, for example, being approachable, having the ability to listen, and being able to communicate effectively. A belief in, and enthusiasm about, numeracy and the role of the facilitator were also important, as was the need to know mathematics.
- Many in-school facilitators noticed little impact in changing their role from being a staff member to being a facilitator. Many had been heads of department (HODs), so they knew teachers well and were used to discussing issues and working in a mentoring role. For others, the role provided opportunities to develop their work in mentoring staff.

### *In-school facilitation model*

- There is evidence to show that the in-school facilitation model is effective in building teacher capability in a significant way. Teachers were demonstrating an increased knowledge of how to teach calculation and were thinking more about what they were doing. The model had impacted on classroom practices, and teachers were more willing to try new things and take risks in areas such as group teaching and the creative use of materials.
- Having a facilitator in school was mostly seen as beneficial. For example, there was someone for teachers to take their problems to on a daily basis, which made dealing with problems arising in the context of specific schools easier and also made for better professional development and elevation of the status of mathematics in the school. Having a member of the school's mathematics department lead the programme gave the project credibility because that person was seen as being knowledgeable about the complexities of mathematics teaching and learning in their own school. In some schools, it took time to build trust so that colleagues were comfortable with in-class support. Workload was an issue for many in-school facilitators, particularly those with HOD responsibilities. Some teachers had problems seeing the facilitator in a different role.
- There is evidence that collegial support increased during the period of the SNP. Teachers were working together better with more discussion and were feeling more at ease within the school and with the facilitators.

### *Recommendation*

- SNP schools should be provided with ongoing support so that they can consolidate and extend the advances made in mathematics teaching.

## Background

The 2005 SNP pilot built on exploratory work carried out in secondary schools in 2001, 2002, and 2003 and on the introductory Numeracy Development Project (NDP) workshops provided throughout New Zealand in 2004. The evaluation investigated the impact of external and in-school facilitators on teachers' development of subject and pedagogical content knowledge at the year 9 level of schooling as well as considering the project's impact on the development of professional mathematics communities in the departments of participating schools.

The teacher development model for the 2005 pilot project was different from that used in all the other numeracy projects in its use of in-school facilitators supported regionally by an external facilitator. The in-school facilitator's role underpins the whole-school approach by involving all the members of the mathematics department who teach year 9 students, as well as having the goal of developing a professional mathematics community in the school. The in-school facilitator is typically a person holding a position of responsibility for mathematics (either the HOD or the management unit (MU) holder responsible for year 9 mathematics) and as such, should be better able to facilitate modifications to school systems as well as ensuring agreement across department staff for the timing of meetings and coaching and in-class modelling of effective mathematics teaching. The in-school facilitator is provided with training both nationally and regionally and is supported by the regional co-ordinator through regular meetings and visits to the school.

## *Rationale for the Project*

Recent evaluations of the exploratory numeracy projects in secondary settings found that student achievement at year 9 has been variable. The challenge of changing teachers' practice at the secondary level has also been noted by a number of commentators. In the evaluation of the Numeracy Exploratory Study in 2001, Irwin and Niederer (2002) noted the "unexpected weaknesses, especially in the understanding of fractions, the ability to find a fraction of a whole number, and the meaning of large numbers" (p. 97). While noting the possibility of a number of factors for this, one factor identified was the weak pedagogical content knowledge of teachers in the area of place value. In 2002 and 2003, students also performed weakly in the National Certificate of Educational Achievement (NCEA) algebra achievement standards, with about 50% of students being unable to solve straightforward algebraic equations at levels 1 and 2[1]. It is worth noting here that the standards were comprised of largely knowledge-based questions, with very few drawing on students' mathematical generalisations and strategy development.

## *Specific Aims of the Evaluation*

This evaluation investigated the impact of external and in-school facilitators on developing teacher subject and pedagogical content knowledge at the year 9 level of schooling through participation in the SNP Pilot 2005 and the extent to which professional mathematics communities have developed in each mathematics department.

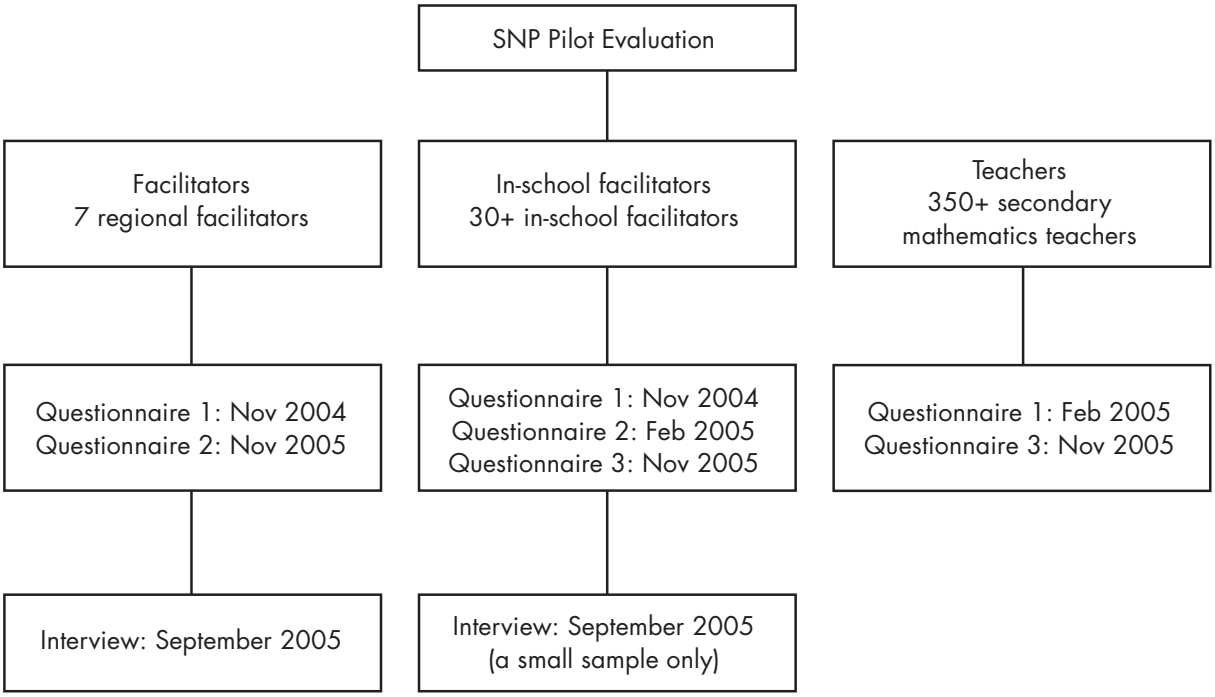


*Figure 1.* Overview of the evaluation of SNP Pilot 2005

[1] Level 1: Use straightforward algebraic methods and solve equations: Not achieved: 50.1%.
Level 2: Manipulate algebraic expressions and solve equations: Not achieved: 48.2%.

### *Design and Methodology*

The methodology took the form of an extended case study (Stake, 1998), involving about 30 teachers at selected schools nationally who were participating in the SNP Pilot 2005 as in-school facilitators and the 360–400 year 9 teachers with whom they were working. Feedback was sought from the external facilitators on the mentoring process used with these in-school facilitators.

To determine whether changes to teacher knowledge and practices have occurred as a result of their involvement in the SNP Pilot 2005, data from two research tools was used: semi-structured interviews and concept mapping. The concept mapping approach was used to examine the impact of these resources on the professional knowledge of teachers in New South Wales (Bobis, 1999). More recently, this approach has been used to evaluate the pilots of the Early and Advanced Numeracy Projects (Thomas & Ward, 2001; Higgins, 2001).

The research involved the collection of base-line data from the 30 in-school facilitators in November 2004. The data included:

- biographical details (number of years of teaching; qualifications in mathematics);
- beliefs about year 9 mathematics in terms of what should be taught;
- beliefs about what year 8 students bring to year 9;
- beliefs about how mathematics should be taught at year 9;
- knowledge and views of facilitation, including the skills they already have and the skills they need to develop.

At the first national training for in-school facilitators (November 2004), the participants were asked to draw a concept map entitled "Key elements of effective professional development" as a starting point for revealing their beliefs about the focus of the professional development to be facilitated with the teachers in their school. They were invited to redraw their concept map at the end of the first year in the project (November 2005) as a means of identifying changes they had made to their beliefs and knowledge about teaching mathematics at year 9. A small number of the in-school facilitators were also interviewed to gather more in-depth comments.

The analysis was informed by the teacher-centred model of professional development outlined in the 2001 evaluation of the Advanced Numeracy Project (Higgins, 2002).

## *Overview of Participants*

### *Demographic data of the schools involved in the project*

A total of 43 schools over 11 regions of New Zealand were involved in the project. The schools involved ranged in size from 201 students in the smallest school to 2247 students in the largest school. The schools ranged in decile from 1 to 10.

Table 1
*Demographic Data of Schools*

| Category | Details | Number of schools | Percentage (N = 43) |
|---|---|---|---|
| Region | Northland | 2 | 5 |
| | Auckland | 9 | 21 |
| | Bay of Plenty | 8 | 19 |
| | Manawatu–Wanganui | 4 | 9 |
| | Hawke's Bay | 2 | 5 |
| | Wellington | 4 | 9 |
| | Nelson | 1 | 2 |
| | Canterbury | 6 | 14 |
| | Otago | 6 | 14 |
| | Southland | 1 | 2 |
| Size of school (number of pupils) | 101–500 | 10 | 23 |
| | 501–1000 | 13 | 30 |
| | 1001–2000 | 18 | 42 |
| | 2001+ | 2 | 5 |
| Decile of school | 1–3 | 10 | 23 |
| | 4–7 | 16 | 37 |
| | 8–10 | 17 | 40 |

### *Demographic data of teacher respondents*

Of the 319 questionnaires sent out to teachers, 177 were returned, resulting in a 55% response rate. Of these 177, two arrived too late for inclusion. The following analysis is based on the remaining 175.

Table 2
*Demographic Data of Teacher Respondents*

| Category | Details | Number of Teachers | Percentage (N = 175) |
|---|---|---|---|
| Years of teaching experience* | 1–5 | 37 | 21 |
| | 6–10 | 18 | 10 |
| | 11–15 | 25 | 14 |
| | 16–20 | 17 | 10 |
| | 21–30 | 34 | 19 |
| | 31+ | 16 | 9 |
| | No response | 28 | 16 |
| Highest mathematics qualification* | Secondary school | 18 | 10 |
| | University stage 1 | 15 | 9 |
| | University stage 2 | 30 | 17 |
| | University stage 3/Bachelor's degree | 62 | 35 |
| | Postgraduate level 1 (including Masters, PhD) | 22 | 13 |
| | No response | 28 | 16 |

*Not all respondents completed this question.

## Impact on Teachers

### *Teachers' Mathematical Knowledge*

Pre and post-comparisons are useful for assessing the impact of a programme of professional development. Teachers were asked to rate their mathematical knowledge at the beginning and end of the year, using a likert scale where 1 was strong and 5 was weak. As illustrated in Figure 2, teachers reported little change in their own knowledge of mathematics as a result of their involvement in the SNP. This is not surprising, given that, as specialist mathematics teachers, they would start with a high level of mathematical knowledge anyway.

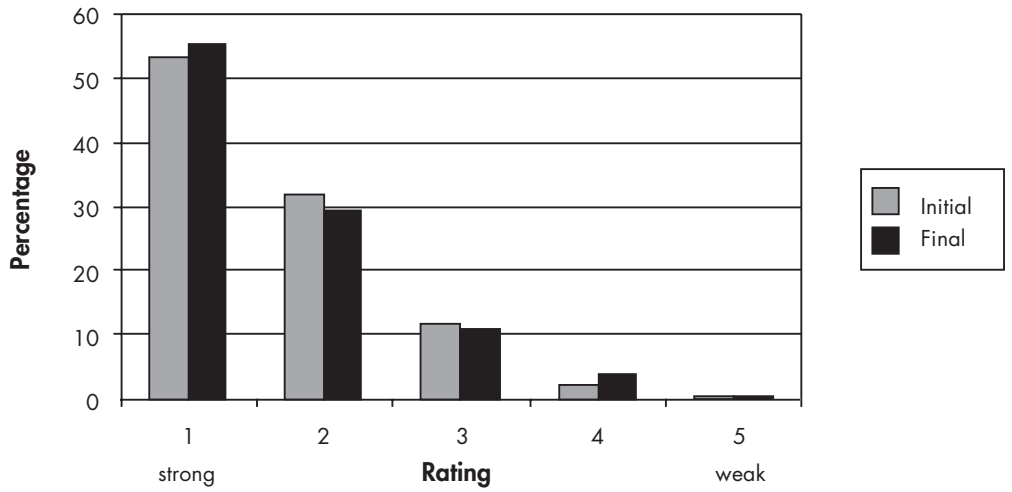


*Figure 1.* Teachers' self-rating mathematical knowledge

Facilitators were also asked to rate teachers' mathematical knowledge at the beginning and end of the year. Their rating of teacher knowledge was slightly lower than that of teachers' rating of themselves. The facilitators reported little change in teachers' mathematical knowledge over the year.

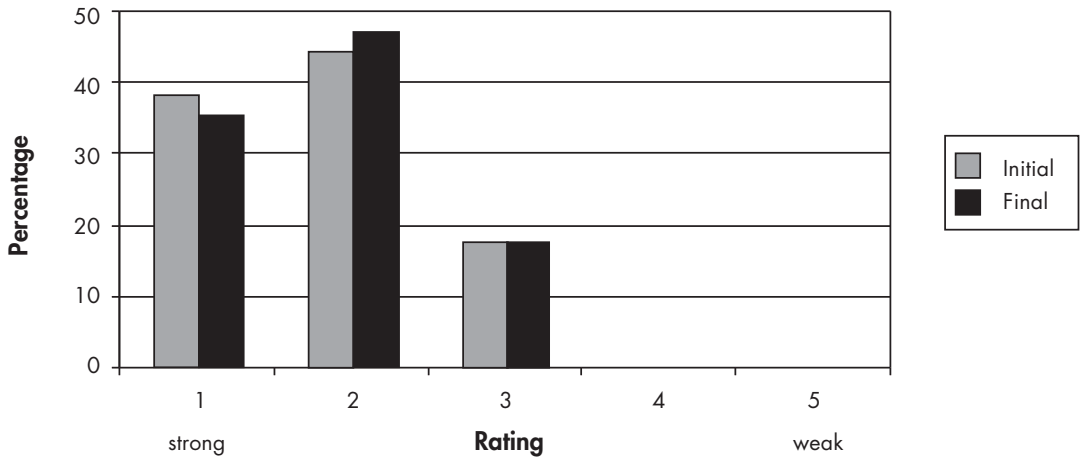


*Figure 2.* Facilitators' rating of teachers' mathematical knowledge

## *Teachers' Mathematical Practice*

Similarly, teachers were asked to rate their mathematical teaching practice at the beginning and end of the year. The pattern that emerged here was different from that of knowledge. Initially, teachers rated their teaching practice more highly than they did at the end of the year (see Figure 3). This may have been because they shifted from instruction based on textbooks to instruction based on discussion and thinking.

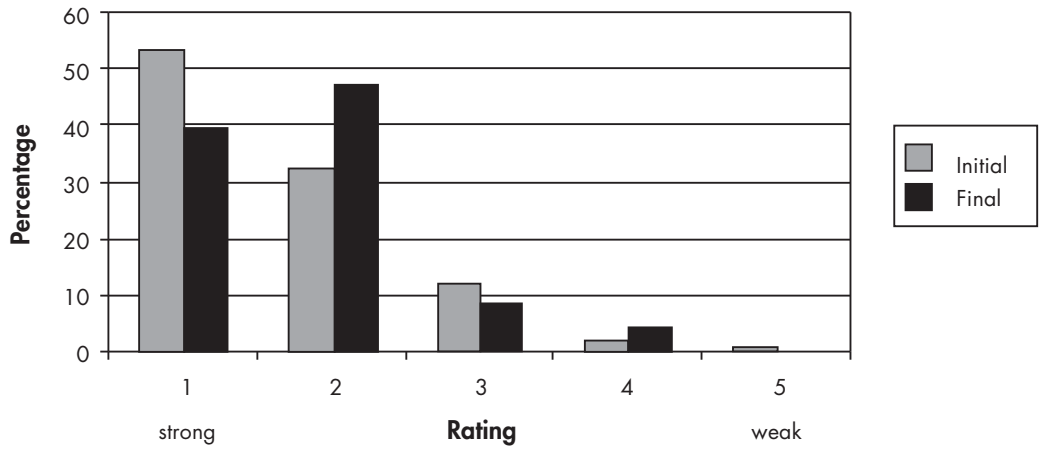


*Figure 3.* Teachers' self-rating of mathematics teaching practice

Facilitators were also asked to rate teachers' knowledge of teaching mathematics. The facilitators regarded teachers' knowledge of teaching mathematics as being not as strong as teachers rated themselves. However, an improved rating over the year is evident.

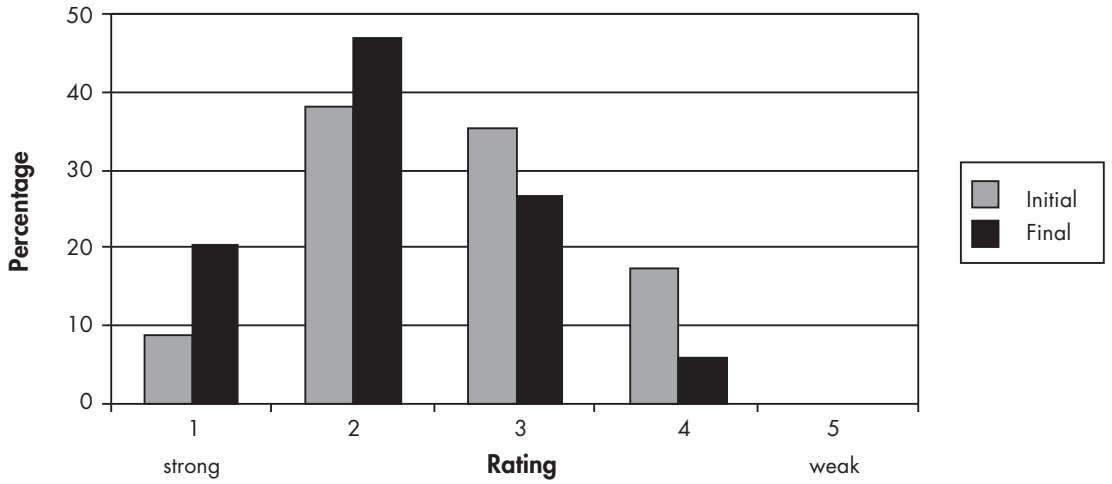


*Figure 4.* Facilitators' rating of teachers' knowledge of teaching mathematics

Teachers self-rated their knowledge of how students learn mathematics before and at the completion of the professional development. They did not rate this knowledge as highly as they rated their own knowledge of mathematics. However, an improvement over the year is noted.

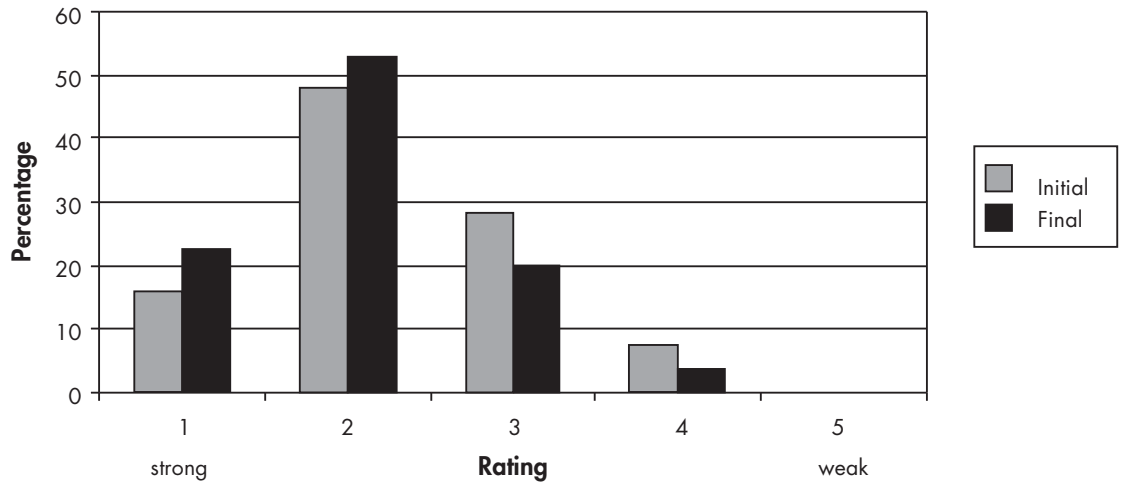


*Figure 5.* Teachers' self-rating of how students learn mathematics

Facilitators were also asked to rate teachers' knowledge of how students learn mathematics. Over the course of the year, they indicated that this aspect of teacher knowledge improved.

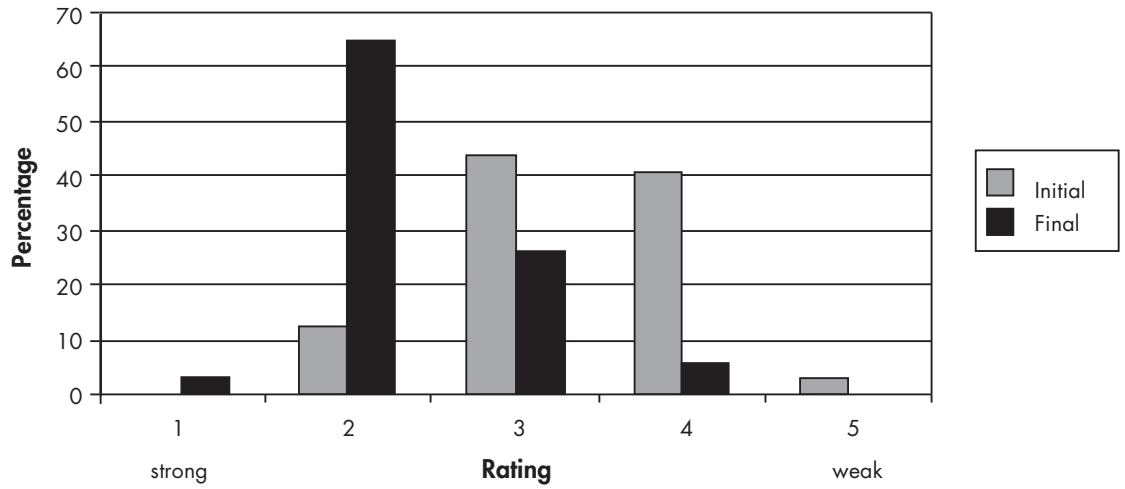


*Figure 6.* Facilitators' rating of teachers' knowledge of how students learn mathematics

## *Year 9 Mathematics Programme*

One way of gauging the impact of professional development on classroom practice is to investigate teachers' views of the key elements of teaching and assessing of a mathematics programme in the first year of secondary schooling.

Initial responses to the question "What were the key elements of a year 9 mathematics programme?" were wide-ranging and varied, with most teachers listing several elements they felt were important. By far the largest number of responses included number/numeracy as a key element (49%). Typical comments were:

> The programme should also consolidate and build number skills, the basis of most other strands.
>
> Emphasis on number skills, a feel for number. Little else can be taught in mathematics without an understanding of number.
>
> Numeracy, as it is the foundation – needs to be the basic number one key element.

Many teachers mentioned algebra, often in connection with number (26%). Some saw algebra as being important to future mathematics learning. Typical comments were:

> Algebra. Students struggle in algebra even when they move to higher classes. The problem is that the topic becomes more difficult during year 12 and they have less time to practise and grasp the concept of algebra.
>
> Algebra – the cornerstone of so much subsequent maths learning.
>
> Transition from mainly about numeracy to looking at what algebra is and how it's useful.

Strands that were also rated by larger groups of respondents were geometry (12%) and measurement (10%). Comments about geometry included:

> Geometry ... should be emphasised more.
>
> Geometry – shapes, angle types, no theoretical work like corresponding angles.
>
> Geometry – the ability to visualise spatially in 2D/3D is a powerful tool.

Comments about measurement included:

> Thorough understanding of ... measurement
>
> Measurement (units, perimeter, area, and volume)

Statistics were mentioned by 6% and fractions by 3%. A further 16% talked about the basics (skills, facts). Comments on these areas included:

> Making sure they have the basics and moving them on from there in all areas of mathematics.
>
> Proceeding until students have a solid grounding in the basics.
>
> Consolidating all basic work and building towards future mathematical learning.

The fact that students should be able to use strategies they had learned to solve problems was seen as a key element by 20% of teachers. Typical comments were:

> The programme should enable students to acquire knowledge and to use their knowledge to solve problems.
>
> Skills! Students need to know why to do things, not how to do them. If they know why, then how comes naturally.
>
> Problem solving – need to design own methods, strategies, etc.

Many other topics were mentioned by small numbers of teachers: student understanding (9%); the curriculum – including one response about cross-curricular activities (5%); patterns and prior knowledge (both 4%); calculators, student enjoyment, and variety (3% each); time, learning styles, and levels, *Mathematics in the New Zealand Curriculum* (*MiNZC*), NCEA, and group work (2% each); basic building blocks, monitoring, year 8, 9, and 10 students, exploration, and testing (1% each); and concepts, computers, listening skills, resources, feedback, and streamed classes (just under 1% each).

There was no response from 11% of teachers, with a further 2% of answers saying nothing relevant.

Final responses by teachers to the question "Have you changed your views of what the key elements of a year 9 mathematics programme should be?" are listed below. Of the teachers who

responded to this question, the same number of outright "yes" and "no" answers were received (26%). Almost as many responses (23%) gave no comment on any view change but rather offered general explanations. Comments included:

> Key elements should be more basic knowledge rather than rushing through the curriculum.
>
> The key elements change, depending on my group – some numeracy, specifically decimals, percentages, fractions, has to be included (not always the case in the past) as skills – they don't always have the level expected at year 9.
>
> Number knowledge and strategies are the key to a successful programme. The other strands give context to numbers.

Comments from 13% of teachers indicated that there was no change to their view of the key elements, because they already put a high value on numeracy. Examples of these comments are:

> I have always felt that basic numeracy is essential for ultimate success with mathematics, and I'm pleased to see the emphasis returning to this.
>
> Not really – number work or place value has always been high.
>
> I still believe the key elements should be a strong grounding in the basics and number.

A small group (8%) did not address this question, and 4% of teachers were unsure or saw a slight change.

The subject of numeracy rated highest in the explanations of all answer groups. Of the "yes" answers (51%), the "no" answers (26%), and the remainder, 31% mentioned numeracy, using the terms "numeracy", "number", "numerical", and "numerate". Typical comments from the "yes" group were:

> Yes, I have recognised the importance of number manipulation for all students.
>
> Yes, numerical knowledge underpins all mathematics ...
>
> Yes. More numerate. Students are getting more knowledge of basic mathematical principles.

From the "no" group, the comments included:

> No, but maybe the emphasis has changed – greater time spent on numeracy.
>
> No. I have always believed number skills and processes to be the key to learning in maths but believed, and still do, that the other areas of the curriculum enhance student number skills.

From the remainder, the comments included:

> The basic skills/knowledge of numeracy are fundamental to all other areas of maths. If a class is weak in maths in general, number should be the area of concentration.
>
> Not really – still a need to ensure that basic calculation/number skills underpin everything we teach.
>
> It is important to teach the number components of the programme at the right level.

Several other points were raised in a minor way in teachers' explanations. Taken as a percentage of the total number of respondents, these comments included: the learning of basic skills (10%); students' prior knowledge and understanding (each at 9%); the use of calculators (7%); fractions and decimals (6%); tables and mental arithmetic (5%); and geometry and algebra (7%).

### *Teaching Year 9 Mathematics*

When teachers were asked about how they thought year 9 mathematics should be taught, initially they offered a wide range of opinions, with only three opinions being voiced by more than 10%

of the teachers. These three options were: groups and group work (20%), a variety or mix of teaching methods and learning experiences (18%), and hands-on or practical experiences (11%). Many answers included several points. Comments relating to groups and group work included:

> Groups (ability grouping), so that I can help like-minded students to progress on to the next step.
>
> In small groups, as the Numeracy Project is trying to do.
>
> Ideally, students should be grouped according to the stages they are at. Each group should receive instruction at the appropriate level for their development.

Views on variety or mix of teaching methods and learning experiences included:

> With a variety of activities – practical, written, investigations, textbook, fun activities, plenty of practice at basic skills, using equipment where necessary.
>
> A mix of teacher-directed and student-directed teaching should be employed. Lessons need to be a mix of textbook, investigations, co-operative learning activities, games, and fun.
>
> Using a variety of skills and approaches, from problem solving, investigating, through to formal "up front" teaching.

Typical responses about hands-on or practical experiences were:

> Students should have as much hands-on experience as possible.
>
> In well-equipped classrooms, using as much hands-on material as possible.
>
> I feel that year 9 maths should be hands-on problem solving ...

The large range of other points raised in response to this question included: exploration and experimentation, teaching at students' level, number and basic skills, real contexts, and reinforcement and repetition (7% each); individually based work (6%); calculators, prior knowledge, whole-class teaching, and problem solving (4% each); resources (3%); use of technology, interactive teaching, traditional teaching, structure, the curriculum, class size, time, and the use of trained maths teachers (2% each); teacher and student enjoyment, explanation, assessment/testing, discussion, and concepts (1% each). Year 9 as an introduction to secondary maths, the syllabus, individual needs, questioning, and thinking all fell below the 1% mark.

Only 5% of teachers offered answers of a more general nature, and 10% of teachers did not respond to this question.

At the end of the year, teachers were asked if their views about how to teach mathematics had changed. More teachers gave outright "yes" responses (27%) than "no" (23%) to this question. In 28% of cases, the teachers gave no outright "yes" or "no" responses but offered an explanation of what the teacher was doing or thought needed doing or described the difficulties the teacher was experiencing. For example:

> Greater use of concrete equipment would help some students. I like the idea of allowing students to work out their own ways of getting to the answer and being able to explain it. In the past, it tended to be "do it my way".
>
> We have to find out the numeracy level of our students and work from there. Hopefully, as the programme makes a difference in the primary and intermediate schools, we will change our emphasis to teaching the levels that the students are meant to be at.
>
> It is my belief that primary and intermediate mathematics should follow the Numeracy Project guidelines. I have to admit that I found it difficult to change my teaching practice/methods. I feel that my teaching was more effective last year.
>
> The Numeracy Project has provided material to use more group work, and the students have enjoyed this. (I have too.)

Some 7% of teachers felt that their views had changed to a degree. A smaller number of responses (4%) indicated no change to the teachers' views. Only 2% of respondents were unsure, and 8% did not address the question of change to their views.

The comments from all groups in response to this question were varied. In the "yes" group, numeracy was once again the highest area of change (25%). Comments from this group included:

> Yes. A large emphasis needs to be placed on raising the strategy levels for numeracy for each student, so a greater emphasis on the number topics is needed. I used to assume the students arrived from year 8 knowing more than they do!!!
>
> Yes. The way I now teach algebra has changed. Now I teach it based a lot more on number. Students take to it better this way and have better understanding.
>
> Yes. Across the board I believe that placing greater emphasis on numeracy skills will be beneficial, although in years to come I hope many of these skills will be coming in [with the students].

However, in the "no" group, numeracy didn't feature. In this group, 35% of responses had no explanation at all. Of the remaining responses, 16% talked about numeracy. Comments included:

> Reinforcing number strategies and key knowledge is necessary.
>
> The very significant improvement in their numeracy made me think there was a lot in the curriculum already that reinforced those skills.
>
> Ensure sound number strategies are in place before other topics are introduced, especially algebra.

Other comments, taken as a percentage of the total number of respondents, included these topics: students' prior knowledge and understanding, activities, learning experiences, and resources (9% each); basic knowledge (8%); equipment and materials (both 7%); and use of calculators, teaching strategies, group work, and comments about year 9 (all under 5%).

### *The Use of Assessment Data in Mathematics Teaching*

Teachers were asked to describe how information about individual student achievement (for example, observations, interactions, and test scores) informed their subsequent mathematics teaching. Many responses to this question contained a variety of points about how achievement information had informed teaching. The main focus was the use of achievement data to help in planning subsequent lessons (43%). Typical responses were:

> Feedback is essential to decide at what level to pitch the next lesson. All factors are considered.
>
> It helps me plan lessons to meet the needs of individual students. Without these assessments, my lessons would perhaps have been generic and in fact a total waste of the students' time.
>
> All used to aid the planning of each lesson, to help with the differentiated work of each group.

Some of these responses (6%) indicated that the information was also used to alter the level and pace of teaching according to "the way the students interact and their body language". Although these responses explicitly mentioned changes to planning and/or delivery, the nature of the change was seldom made clear.

Another way in which information was used by teachers (12%) was in giving instructions and setting of tasks at different levels for individuals and groups within the class. For example:

> A guide to how far I need to extend the difficulty level each way, to accommodate students of different abilities.
>
> Helps in deciding group formation.
>
> It helps me to group children according to their needs – and so address them individually.

Another way information was used by 8% of teachers was to help group students for instruction. A few respondents (6%) said that the information enabled them to set their teaching levels to give an appropriate variety of work for students. Re-teaching was the prime use suggested by 5% of teachers, with an additional 1% listing both re-teaching and varying the programme. Under 1% of teachers talked about student misconceptions and feedback. The fact that data on individual achievement was not used in any significant way was indicated by 6% of respondents. Some answers (18%) were ambiguous.

When asked at the end of the year if the project had changed the way in which information about individual student achievement (for example, observation, interactions, and test scores) informed their subsequent mathematics teaching, the number of teachers answering "yes" (29%) was markedly more than the teachers answering "no" (16%). Comments that indicated the teachers had noticed a change in their mathematics teaching, without saying "yes", stood at 16%. Comments included:

> Observations and the interview(s) help with individuals. Test scores themselves are a more coarse tool. Both can be used to form groups as well as select resources.
>
> I am beginning to use individual information as I become confident with teaching the subject.
>
> I found it very interesting in the interviews to find out which strategies students use to solve problems and do numerical calculations. This affected the way I taught as I tried to mention several strategies, rather than just teaching one method.

A smaller group of teachers indicated no change in their teaching (10%) and made comments such as:

> Not greatly. Having ascertained where students are at, one is still required to move through the curriculum, covering certain requirements. I have also worked to take students from where they are at and move them on as far as possible.
>
> Not really. Have still had a real need for traditional testing.
>
> Not really, as I have always used information about students and watched class reactions to monitor my teaching.

A further 15% made no comment about any change but gave general statements. For example:

> Potential for more detail in this method.
>
> We need to teach to where they are at – start from what they know and go from there.
>
> A complete picture is built up using all the different assessments. The numeracy testing demonstrates how students solve problems. However, it is difficult to get the time at the start of the year and at the end of the year because secondary teachers have 3–4 other classes to teach.

There was no response to this question from 9% of the teachers, and 5% saw some change or had their views confirmed.

The explanations given by all the above groups were numerous and varied. In the "yes" group, by far the greatest number of teachers (28%) commented on a change to teaching to students' needs and levels. Typical comments were:

> Yes, to a point at least. It has forced me to teach students in ability groups and aim appropriate work at their level.
>
> Yes – I have seen the need to teach groups of students with same stage level together.
>
> Definitely – as far as grouping according to their level of ability – has definitely been a huge factor and definitely assisted my teaching and the students' learning.
>
> Yes. It was easy to identify the students' strength/weakness and then plan the lessons to address those issues.

An equal percentage of teachers (11% in each case) felt that they had made changes in their understanding of how students process knowledge and approach problems and in their use of testing and of interviews. Comments here included:

> Yes, more information about how students approach a problem from interview.
>
> Yes. Pre-test of sections of the syllabus used to determine subsequent teaching.
>
> Yes. In a way, testing highlights the numeracy issues to a much greater extent.
>
> Yes. The interview process was particularly useful in determining how my students arrive at the answers.

The remainder of the "yes" respondents covered a range of topics, including information acquired, checking/rechecking, and assessment (4% each); and teaching aids (2%).

In the "no" group, the biggest number of comments was once again in the area of teaching to students' needs and levels (12%), although these comments were not always favourable. They included:

> No. The project has given me a better idea about pupils' needs, but practical/logistical issues prevent us from adjusting our teaching methods, for example, large numbers, discipline, resources, planning ahead.
>
> No. The data collected initially in my view gave some indication of students' ability and prior knowledge, but the assessing technique, timing, scoring, etc., I think, introduced in many cases meaningless data.

The remaining comments from this group of respondents (8%) related to gaps, with testing, assessment, and the provision of more information at 4% each. Acquiring more information rated highest in the remaining responses (13%), with comments such as:

> Project gave us much more information about their achievement (the area where they do well and do not do well).
>
> I feel I know much more about what each student can do. It has been a very useful part of the programme, helps me to target the teaching.

Other comments in this remaining group mentioned testing (9%), improvement for/of students, and interviews (6% each); grouping (2%); and planning (1%).

In-school facilitators were asked to comment at the end of the year on whether or not the project had changed the way in which teachers in their school used information gathered about individual student achievement. As with teacher responses, the "yes" answers (23%) were higher than the "no" (14%). Positive comments that included the word "more" sat at 14%. Facilitators who gave no view but offered an explanation numbered 18%. Nearly one-quarter (23%) of facilitators saw some change or were unsure, compared with 5% of teachers.

As with teacher responses, facilitator answers included a range of topics. However, by far the largest group discussed teaching to students' needs – this fell into the group of answers that mentioned knowledge and understanding (14%). Comments included:

> Yes, teachers understand and know about individual student achievement ... modified the schemes and used them to teach to the needs of different classes.
>
> More in-depth information about student knowledge and understanding.
>
> We are more aware of the vast array of ways students misunderstand maths!

The largest group of responses from facilitators was about testing/assessing (27%). Comments included:

> No, but I think it will as they have the knowledge that multi-assessment is a better reflection of a student ...
>
> Yes, in conjunction with asTTle [Assessment Tools for Teaching and Learning] assessments, pre- and post-testing is now dominating.
>
> No. The initial testing was very informative.
>
> Yes, feedback from other teachers on the programme has led us to trial asTTle for diagnostic purposes. Diagnostic strategy testing is used to broadly group year 9.

Two other larger groups of responses (14%) were about school reports and the Numeracy Project Assessment diagnostic tool (NumPA). Comments about school reports included:

> We include the results in the school reports.
>
> We used the numeracy testing (second time) to do our reports this year.
>
> Used results in school reports to inform parents of student progress.

Likewise, comments about NumPA included:

> Most of the teachers have used NumPA data to help with their teaching.
>
> We had begun to use NumPA to assess needs of students ...
>
> Teachers made use of NumPA results.

The remainder of the explanations were spread over the following topics: interviews, class teaching, asTTle, and grouping (each 9%), and time and ways to fix shortcomings (both 4.5%).

## *Addressing Teachers' Needs*

Meeting the needs of participating teachers is an important aspect of any professional development. The shifts in classroom practice being suggested have been of a more fundamental nature the higher up the school the project has moved. The needs that teachers and in-school facilitators expressed must be seen in the context of wider issues in secondary schooling.

Initially, teachers were asked to explain what they saw as their greatest needs as a mathematics teacher. Two major areas were mentioned – time (39%) and resources (35%). Some teachers talked about both. Many of the time responses just had the word "time", but some examples of longer explanations were:

> More contact time with my classes. To see the students on a daily basis.
>
> Time to discover the skills level of individual students and the time to work with small groups or even individuals in the classroom.
>
> Time – for planning, resource preparation, reading/assessing student work – for reading/researching current issues in maths and maths education – for searching for suitable materials for students.

Comments about resources included:

> Interesting and stimulating resources. I simply do not have the time to put together the resources I would like to use.
>
> Resources that target specific areas of a topic besides workbooks and homework books. Too much of these are geared towards "reading" about how to do a problem, rather than doing a multitude of problems ...
>
> Meaningful resources. In order to define your classroom as interactive, you need to have something other than books. Therefore if a student has a weakness in number banding, I require strategies (topic plans) and resources to hit this objective.

One issue discussed by 12% of teachers was class size; they wanted smaller numbers and a smaller range in ability. Streaming was favoured by 1%. Comments included:

> Smaller classes – just can't give them the one to one time they need.
>
> Class of smaller ability range so you could teach to one level.
>
> Smaller classes. With 32–35 students in a class, it's almost impossible to teach properly.

Comments about more personal needs were made by 11% of teachers. Comments included:

> To provide consistency and continuity of learning and not to be giving the students sudden spurts of irrelevant skills and techniques.
>
> Being organised to best target each student and knowing that the students are engaged enough to gain something out of the activity.
>
> As this is my first year teaching maths, I could use help to set quality targets for student achievement. Developing strategies to teach.

Other topics that were mentioned by smaller groups of respondents were professional development and a range of difficulties with students (7%); strategies and ideas for teachers (6%); support from the school (4%); use of computers and calculators (3%); use of technology and variability (both 2%); number, prior knowledge, the curriculum, and understanding of student learning (1% each); and classroom help, attendance, content, audio visual, change, and trained teachers, each 1%. A few (3%) gave no specific answer to the question, and 2% did not answer the question at all.

At the end of the year, teachers were asked to comment on how the project had addressed some/all of their needs. The responses looked at here all refer to the part of the question regarding some needs, as no teacher said that all their needs were met. Of the total number of answers, 13% responded with a definite "yes" and 22% with a definite "no", using statements such as:

> Yes. The Framework gives confidence that when a student presents with a range of abilities you have the necessary information to find the baseline to start progress from.
>
> No, my greatest need is to teach year 9s four days a week instead of three.

Of the responses that did not say "yes", 28% were positive. For example:

> The project has given me the opportunity to refine my delivery more specifically to students' needs and provided resource material that can be trialled and adapted.
>
> Given me different ways of looking at number, and thus it is easier to be on the same wavelength as kids.
>
> It has addressed needs and provided valuable professional development. My greatest need is more time with my classes – 3.5 periods a week at years 9 and 10 is not enough.
>
> It has addressed a need to provide basic numeracy skills and has provided useful resources to do so.

Responses that were more negative were given by 6% of teachers. These responses were often about lack of time and resources.

A small group of teachers (13%) said they saw some of their needs addressed:

> It has addressed some needs – the ability of how, what, where the students do/learn maths – but teaching numeracy is taxing and very difficult, but we will persevere.
>
> Some – I am a better teacher of arithmetic. I had always assumed it was taught at primary school and students would have more feeling for number by secondary level.
>
> Some. Time spent working with other maths teachers is invaluable.

Unanswered questions made up 9% of the total. There were a small number of answers that indicated no change, lack of certainty, or neutrality (3% each).

There were three major ways in which teachers saw the project addressing their needs, these being the provision of resources and activities (14%); a better understanding of students (9%); and the improvement in number strategies (9%). Comments from the resources and activities group included:

> The introduction of equipment to year 9 classes has been a real need. Games to make maths more fun are also a plus. But there's always room for more tips, ideas, etc., and the preparation of resources would be beneficial.
>
> I used some activities presented at workshops, which I couldn't find in a maths textbook. It was helpful.
>
> It has provided me with a range of teaching material that is stimulating and fun for the students.
>
> The resources and suggested activities have been a great asset.

Minor ways in which the project addressed needs were revitalisation and teaching strategies (both 4%); groups, testing, calculators, and professional development (2% each); and resourcing and pedagogy (both 1%).

Other more negative comments remarked on the heavy workload and lack of time (12%). For example:

> No. It has caused me endless hours of planning and preparation and tripled my normal workload at this year level. With other classes and responsibilities this year, the load has been unsustainable.
>
> The need for time to deliver a content-heavy curriculum – even more time with a "numeracy" based approach.
>
> The project created a lot more work for me ...

A very small number of teachers criticised the lack of resources (6%), the project (2%), class size, and lack of support (both 1%).

Both in-school and regional facilitators were asked at the beginning of the year what they anticipated would be the greatest needs of the teachers in the project.

The majority of in-school facilitators mentioned several needs in their response to this question. Time was the need most mentioned (30%), with a range of explanations given. For example:

> Time to think about and complete the changes. Time to reflect, assess, and self-appraise what they are doing.
>
> Time to think about the information the pre-testing shows them and then to plan effective teaching strategies to develop the students' understanding.
>
> Time – will there be enough time to teach the rest of the syllabus?
>
> Time: to understand the procedures/reasons for the work they need to do, to implement, to network.

Three needs that were seen as being an issue by 24% of in-school facilitators were teacher understanding/knowledge, resources, and support for teachers. Comments about teacher understanding/knowledge included:

> To understand how students form their ideas in number and to be able to help them advance their understanding.
>
> The knowledge of what is required in the project ...
>
> Build an understanding of the Number Framework and how to transition students from one stage to the next.

Comments about resources included:

> Resources to present to students.
>
> Materials with which to work and feel confident using.
>
> Resources to use to develop hands-on activities in the classroom.

Comments about teacher support included:

> Guidance with programme planning to help them let go of what is traditionally done.
>
> Encouragement to use new/different strategies.
>
> Support from both regional and in-school facilitators.
>
> Help with evaluation process (support will be needed).

The only other need mentioned in a significant number of responses was the need for confidence (15%). Typical comments were:

> Confidence in looking at the teaching of numeracy in a different manner.
>
> Confidence to use the resources.
>
> That they are confident in what they have to do ...

Other anticipated needs were planning, risk taking, and group work (9% each); programme implementation, strategies, teaching skills, professional development, and the need to focus (6% each); and class control and modelling (both 3%).

All the regional facilitators responded to this question. Likewise, the biggest anticipated need they saw teachers requiring was time (43%). Comments included:

> Time to discuss, make sense of ideas, experiment.
>
> Time – there is a huge amount to absorb ...
>
> Time to reflect, discuss, think, plan ...

Another 29% mentioned the need for resources. A range of other needs was mentioned by 14%, including the need for a paradigm shift, management issues, assessment, focusing on maths education, support/reassurance, group work, use of materials, and mental strategies.

In-school facilitators were asked two questions about needs in the final round of questioning: how the project had addressed teacher needs and what they anticipated would be ongoing needs.

Almost half (45%) of those who responded to the first question on addressing teacher needs used language that indicated there had been some anticipated needs met. Comments included:

> Partly, in terms of resources and workshops ...
>
> Too early to say, but there has been a slight change in the teaching practice of a large number of teachers.
>
> It may have given teachers more options for starters or ways to introduce topics.
>
> To some extent. However, I simply did not have the time to do the project justice.

Only one of the respondents in this group used the word "yes". The remainder of responses (50%) gave general explanations about the project and staff involvement. Typical comments were:

> The project highlighted the fact that everyone works towards problems in different ways.
>
> Running a numeracy classroom requires a major shift for teachers, and the workshops and support we gave each other was invaluable.
>
> Practical help and advice to learn a new style of teaching.

One respondent to the questionnaire did not answer this question.

A large group (55%) commented on how teachers have responded to the project. Comments included:

> The project is not fully accepted by all staff, although one or two would not be prepared to admit that it has [been worthwhile].
>
> However, there has been an overwhelming (at times) amount of information and material for them to process, use, etc., so while they have been positive about the PD sessions, there has always been more to do.
>
> For new teachers, I think it has made them aware of the importance of number in all aspects of maths. For staff who have taught maths for many years, some have taken to it enthusiastically, others have been reluctant.
>
> Some have been prepared to try new activities. Others have reverted to their traditional teaching style. Most have tried something new.

Resources and materials were talked about by 32%. Comments included:

> Yes, good materials.
>
> There was enough material towards the end, although initially we were preparing our own.
>
> There were plenty of paper resources – almost too many to sort through.

An increased awareness of students' thinking/knowledge was commented on by 27%. For example:

> There is an awareness and use of children's thinking at different stages ...
>
> Staff are not only aware of problem areas of pupil knowledge but now have a way of addressing it.
>
> It has given a framework or stages at which children learn numeracy (number/mathematics) and how they can be moved on to the next stage.

Other anticipated needs that were addressed were time, the ongoing nature of the project, and number (9% each); and workshops, starters, support, observation, and pedagogy (each 4.5%).

All of the in-school facilitators answered the question about anticipated ongoing needs. Once again, most answers contained many points, and five of them were mentioned by several facilitators – resources (50%), time and support/guidance (both 23%), observation and the facilitator themselves (both 18%). Comments about resources included:

> Help in resource building.
>
> Resources ... materials, practice worksheets – and a scheme that includes the "numeracy" strands and stages relevant to our clientele.
>
> More resources (that they don't have to create or look for).
>
> Materials support, use of materials, and also material for use in classroom (worksheets, etc.).

Comments about time included:

> Time! To reflect on different activities, etc.
>
> Time for planning, preparation, and review.
>
> Time to do assessing. If this is not provided, it will not be possible to continue strategy assessment.

Comments about support/guidance included:

> Support in introducing new ideas/methods.
>
> Ongoing ... support to develop skills in this area (formerly done by primary teachers).
>
> More in-class support. (My own timetable has been changed next year to be able to provide this.)

Comments about observation included:

> Need exposure to some excellent examples of teaching (for example, video) both whole-class and in groups (some teachers don't have the confidence to try things cold).
>
> More help in observing "good" numeracy classrooms.
>
> In-class support/observations.

Comments about the facilitator's own role included:

> I am trying to organise this for 2006 [observation in classrooms].
>
> More support from the regional facilitator (I'll do what I can).
>
> My own timetable has been changed next year to be able to provide this [in-class support].

Other areas that in-school facilitators saw as being ongoing needs for teachers included pedagogical knowledge, discussion/reflection, and professional development (9% each) and workshops and class size (both 4.5%).

## Impact on Facilitators

### *Introduction*

Facilitators' knowledge of mathematics, mathematics teaching and learning, and facilitation underpins any professional development initiative.

### *Key Elements of a Year 9 Mathematics Programme*

Both in-school and regional facilitators were asked what they thought were the key elements of a year 9 mathematics programme. Initially, many responses from in-school facilitators to this question gave several key elements. Answers were varied and covered a range of topics. Number was the most emphasised (15%), then number together with algebra (9%), followed by these two plus measurement and number with statistics (3%). Comments about number included:

> Students without basic number understanding don't like maths, so do not progress. Before abstract concepts are covered in later years, it is essential that they have a good grasp of what a number is and how numbers interrelate.
>
> Students should be able to be confident about understanding if any answer is feasible or not, for example, simple adding, subtracting, multiplying things together.
>
> Number and algebra are the most important elements as these two are very important for all the other maths strands.

Mathematics processes/concepts and curriculum strands were mentioned by 9% of in-school facilitators:

> The focus should be on students understanding concepts and learning through solving problems that are meaningful to them. Other curriculum strands should incorporate understanding and efficient use of number/algebraic thought.

Some other elements mentioned by one or two respondents included NCEA, group work, a two-year programme, transition from primary to secondary school, building on previous knowledge, and maintaining enthusiasm.

All regional facilitators answered this question, offering a variety of key elements and all listing several in the one answer. Number was most commonly mentioned (71%), with algebra next (57%), and comments about the strands, problem solving, and developing/extending students each rating 43%. Comments covering these elements included:

> Experimenting and learning about effective teaching of algebra driven by the number strand.

> Problem-solving experience.
>
> Developmental – move them from where they are at.
>
> Consolidate students' number understanding – extend their familiarity with fractions, decimals, percentages, integers. Extend their facility with symbol representation.
>
> Problem solving – across strands. Coverage of other strands.

Meeting/understanding students' needs and diagnosing student ability were seen as a key element by 29% of regional facilitators. A further 14% saw the following elements as important: enjoyment, materials, geometry, stage 7, mental strategies, and effective teaching.

When asked at the end of the year if they had changed their views on the key elements, in-school facilitators' answers ranged from one word to large paragraphs containing many ideas. The majority (68%) responded with "yes" answers (included in this group were answers that used language such as "more", "now", and "I did not realise", indicating an affirmative response); 14% responded with "no" answers or an explanation implying "no"; and 4.5% or were unsure.

Explanations for in-school facilitators' viewpoints were wide ranging and varied. As with the teachers, numeracy was the subject mentioned most (27%). Comments included:

> One thing we do know is that the pupils should be coming in with a better numeracy base.
>
> Yes, I see the need for number in all strands.
>
> Yes. The emphasis needs to be on number knowledge and strategies with a view to moving on to algebra. The other strands can be taught as usual, but the number concepts need to be emphasised all the time.
>
> I'm more focused on incorporating number skills and strategies into every strand. Kids can't do the strands if they can't do the number work.

The other main explanation concerned the teaching of strategies (23%). Comments included:

> Strategies to equip them to tackle problems with a clear understanding of what they are doing rather than just memorising an algorithm.
>
> Yes, strategy techniques especially mental should be part of all year 9 programmes.
>
> Much of what we previously assumed that students knew, we are now aware that they do not know always. Therefore we have gone back a step to teaching strategies for dealing with number that they need for further progress.

Other explanations discussed algebra, fractions, decimals, percentages, basic knowledge, and the way in which students construct knowledge/learn (9% each) and equations, geometry, measurement, statistics, prior knowledge, use of materials, group work, diagnostic information, and worksheets (4.5% each).

### *Teaching Year 9 Mathematics*

When asked initially to explain how they thought year 9 mathematics should be taught, in-school facilitators mentioned a range of ways. Just over half (52%) gave variety (choice, mixture) as a way to teach mathematics. Comments on this included:

> Variety of approaches – activities to promote appreciation of relationships, etc.
>
> Using a variety of techniques that will enthuse all types of students, for example, co-operative learning strategies.
>
> In a variety of ways, depending somewhat on the personality of the teacher. A variety in styles of delivery is important to meet different learning styles and keep interest.
>
> I think there needs to be a mix of teaching strategies.

Group work, including groups based on ability, was mentioned by 39% of in-school facilitators. Typical comments included:

> Group work where students get time to discuss problems.
>
> Should be taught in groups of similar ability with classes that are not too large.
>
> Grouped with similar levels of ability.
>
> Group work – opportunity for discussion/co-operative learning.

Students' needs, involving/understanding students, numeracy, and a hands-on approach were mentioned by 18%. Comments about student needs included:

> Will vary, I think, to suit the students' needs – academically and socially.
>
> Appropriate to the needs of the pupils.
>
> By measuring current stage and appropriate teaching to needs.

Comments about involving/understanding students included:

> Delivery of the knowledge is probably best achieved by involving the pupils in the lessons as much as possible – get them thinking.
>
> To encourage understanding and find relationships with what students presently understand and then build on this.
>
> Asking good questions of students, challenging their thinking and giving them a chance to explain their thinking.

Comments about numeracy included:

> By topic, but with numeracy skills incorporated into each lesson by way of (1) starter questions, (2) games, (3) competitions.
>
> Many students who have gaps with numeracy need to have this addressed, incorporated into the current programme or focus on numeracy.
>
> I like the numeracy approach of materials – image – properties.

Comments about a hands-on approach included:

> Main focus on number/algebra units with hands-on manipulatives.
>
> Hands on – greater use of equipment.
>
> Hands-on activities. Some teaching of basic skills leading to problem-solving structures to develop these.

A further 15% of in-school facilitators talked about activities/materials and assessment. Comments included:

> Lots of discovery – activities to promote appreciation of relationships, etc.
>
> So we should spend more time playing in the materials (for example, physical manipulations, diagrams).
>
> Assess where individual students are in a group.
>
> Formative assessment (for example, asTTle and NumPA) and each objective within the strands checked for student understanding of concept.

Some of the in-school facilitators also mentioned a range of other ways that year 9 should be taught mathematics. These alternatives included textbooks, problem solving, and enjoyment (9% each); topic based teaching, context, and teachers (6% each); and mental skills, NCEA, individual teaching, whole-class teaching, curriculum strands, rote learning, practice, and class size (3% each).

The majority of regional facilitators (57%) also discussed multiple ideas, while 29% stated "in a variety of ways" and 14% did not respond. Of those who listed several points, the most mentioned idea was teaching to students' levels and needs (57%). Some comments were:

> Start where children are at.
>
> Appropriate teaching to needs.
>
> To encourage understanding and find relationships with what students presently understand and then build on this.

Three other points were raised by 29% of regional facilitators – diagnostic testing, use of materials, and practice. A further 14% saw group work, assessment strategies, morning classes, and daily classes as ways year 9 mathematics should be taught.

At the end of the year, all in-school facilitators responded to the question asking if they had changed the way in which they thought year 9 mathematics should be taught. The number of "yes" responses was the highest at 46%. "No" responses (which included "not really") were given by 18%, and 36% gave only an explanation.

Once again, explanations were varied, but all the in-school facilitators supplied them, often covering several points. At 27%, number, lessons/teaching, and materials were the most mentioned topics. Comments on number included:

> There is a real potential for parts of number to be integrated into other strands or in a thematic approach.
>
> No, it has, however, validated the need to explore number, develop number sense, etc.
>
> Yes, after this year – rearrange school scheme to push "numeracy" to the front of year 9 and 10 – for slower kids, it is dominating the year.
>
> Yes, for about 40% of students who are not multiplicative, numeracy is the priority and needs to be emphasised when covering the other strands.

Comments on lessons/teaching included:

> No, a mixture of traditional lessons, textbook lessons, activity lessons, and numeracy/discussion type lessons.
>
> The structure of a lesson needs to be planned more carefully to include knowledge, strategy, and practice.
>
> Teach more to the ability of the class, rather than teaching something because "it is in the scheme".
>
> A bit more creativity in the classroom, less "drill and kill".

Comments on materials included:

> Yes, I place much more emphasis on mental strategies and connections to concrete materials.
>
> Need for more "building work" done through pictures, graphs, diagrams, materials, etc.
>
> Yes, year 9 programme should be taught by using appropriate materials to introduce the concept, imaging, and bridging until abstraction has been achieved.

Group work and grouping was mentioned by 14%. For example:

> I think there is some room for group work.
>
> Where possible, different levels of understanding should be targeted, using group work of various types.
>
> The programme can be taught in a traditional way, although the use of groupings (not necessarily groups) assists with management.

Other comments included discussion about: basics and knowledge/understanding (9% each) and mental strategies, levels, processes, calculators, streaming, and discussion (5% each).

## *Key Qualities and Skills of Facilitation*

At the start of the year, regional facilitators were asked to rate their own knowledge of mentoring other professionals. Figure 7 shows that most rated their knowledge of mentoring others as strong to very strong.

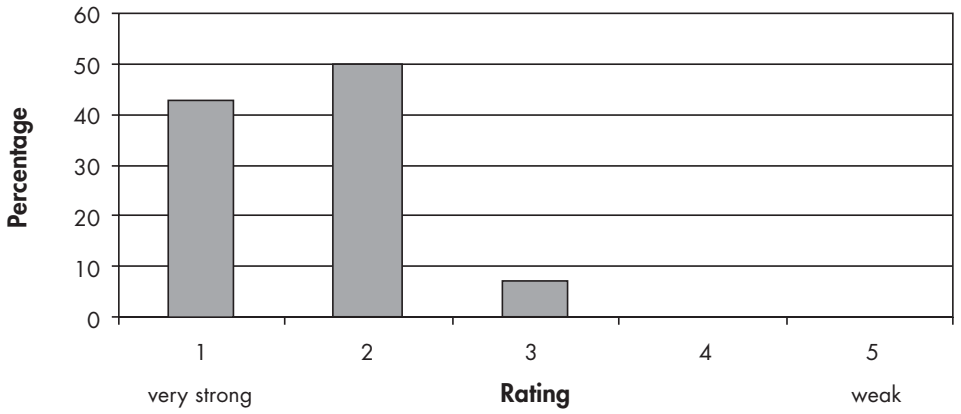


*Figure 7.* Regional facilitators' knowledge of mentoring other professionals

In-school facilitators were asked at the beginning of the year how they would rate their own knowledge of facilitation. The results can be seen in Figure 8, in which fewer in-school facilitators rated their knowledge as being very strong.

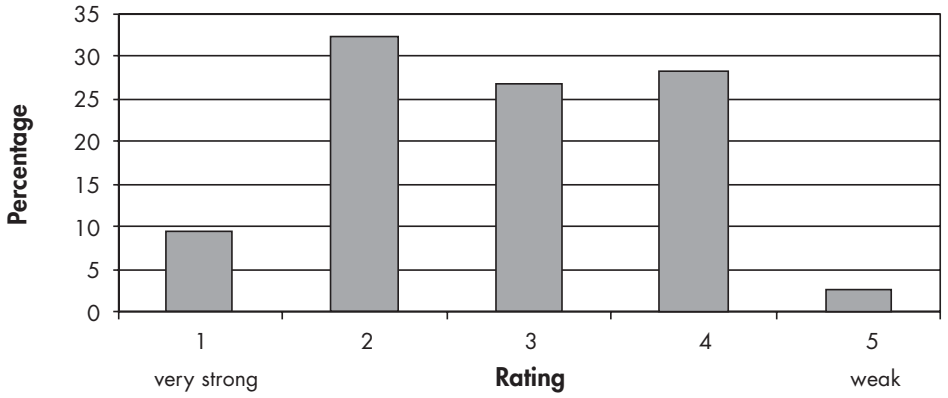


*Figure 8.* In-school facilitators' rating of their own knowledge at the beginning of the year

When asked what skills they already possessed, in-school facilitators gave a range of skills that they thought would be useful in their SNP role, many giving more than one. People skills were mentioned the most (27%). Typical comments were:

> Ability to develop good rapport with colleagues.
>
> Good relationships with the members of my present maths department.
>
> I have good communication skills and interpersonal skills.
>
> Ability to get ideas across to others.

Previous facilitation work was mentioned by 21%, some from NCEA experience (9%) and some from other areas (12%). Comments from this group included:

> NCEA facilitator for 101 [students in levels] 1–3.
>
> Facilitation of groups on NCEA training day.
>
> In-school facilitation of Maths/ICT [Information and Communications Technology] of staff in an area school and a large high school.

A further 21% cited skills in leadership and management as useful experience, some as HODs (15%) and the remainder in other roles. Their comments included:

> As an HOD, I am able to run effective meetings and encourage others to contribute and participate.
>
> In my work as HOD, I have been involved in working with teachers to develop their classroom teaching skills.
>
> Leading large faculty. Chairing meetings.
>
> Co-running a large department.

Knowledge and understanding of numeracy and number were cited by 18%. Comments included:

> Detailed understanding of number sense ... Some understanding of the Number Framework. Sound subject knowledge – passionate about the subject and strong interest.
>
> An insight into the project. I have helped to implement numeracy skills to year 9 for two terms.

Previous work with less academic learners and pupils who lacked confidence was seen as a useful skill by 12%. Their comments included:

> Spent many years working and developing programmes within our school for "slow learners" ... Have an affinity with students who struggle with maths and their own confidence.
>
> The needs of students who often struggle.

A range of other skills was mentioned by smaller numbers of in-school facilitators. These skills included mentoring and maths projects/programmes (9% each); group work, presentation, professional development, and the willingness to try new things (6% each); and problem solving, teaching adults, employee relations, and timetabling (3% each).

In-school facilitators were also asked to state what skills they thought they needed to develop. The range of skills given was fewer than those the facilitators felt they already had. Some respondents were unsure (6%) or made comments that did not relate directly to the question (6%). The skill that they felt most needed to be developed was confidence (18%). Comments included:

> I need to feel confident about the Numeracy Project so I can facilitate.
>
> Confidence to talk to larger groups.
>
> Sometimes can be not quite so confident – when unfamiliar with material.
>
> Confidence with my own ability to convert others to the value of the Numeracy Project.

Three skills were mentioned by 15% – knowledge of the project, testing/assessing, and motivating teachers. Typical comments on knowledge of the project included:

> In-depth knowledge of this project.
>
> Knowledge of Numeracy Project and how students learn.
>
> To improve my own picture of the aims and objectives of a particular project, that is, become more of an expert before embarking.

Comments on testing/assessing included:

> Practice at diagnostic testing to evaluate/recognise strategy and knowledge levels.
>
> Using the diagnostic test to group students.
>
> Finding ways of assessing the progression the students make.

Comments on motivating teachers included:

> The salesman side of facilitation – the need to sell this project to a large department that will contain several new teachers next year, especially in the face of all other changes taking place at school.
>
> Putting across what must be done in a way that will enthuse and educate.
>
> Ways to transfer own knowledge and teaching strategies to other teachers who are not comfortable with group work or with very limited students.

A further 12% felt that it was important to develop communication/presentation skills. Comments included:

> Communicate clearly.
>
> Presentation – use of tools available, sequential delivery.
>
> Presentation skills – selecting and delivering appropriate strategies to deliver numeracy strategies to team members.

Other skills named by 3% respectively were computer, facilitation, observation, modelling, concept maps, organisation, examples, and programmes.

Regional facilitators were also asked at the beginning of the year how they rated their own knowledge of facilitation, and they all answered this question. Figure 9 demonstrates on a scale of 1–5 (with 1 being the strongest and 5 the weakest) regional facilitators' rating of their own knowledge at the beginning of the year.

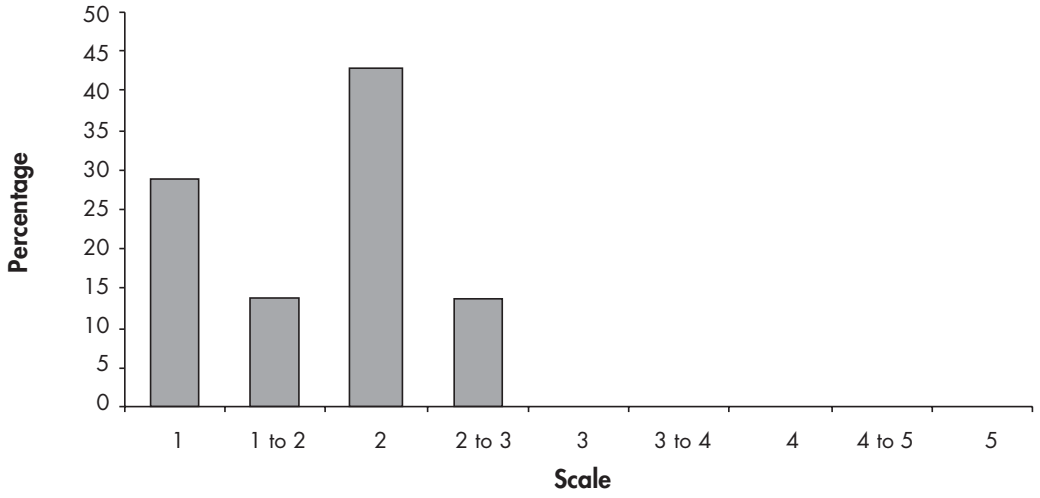


*Figure 9.* Regional facilitators' rating of their own knowledge at the beginning of the year

When asked what skill they thought they already had, 86% gave a range of skills, with the remaining 14% giving no answer. NCEA was mentioned by 43%, with experience as a mathematics adviser being given by 29%. Some comments about these skills included:

> Several years of NCEA training.
>
> NCEA facilitator.

> A year as maths adviser.
>
> Maths adviser for two years.

A wide-ranging number of skills were given by 14% of respondents. These skills included professional development co-ordinator, INP (Intermediate Numeracy Project)/SNP experience, teaching/communicating, research, NumPA, ability to listen, understand, and encourage, and knowledge of materials. There was no response from 14%.

A range of skills were seen as needing to be developed by 43%. For example:

> Always can develop improved ways to encourage teachers' engagement, develop independent-based strategies for sustainability, feedback.
>
> More of everything. In-class modelling, better organisation, presentation skills. More reading of research papers.
>
> All of the same continue to need development [talking about skills already listed].

A further 14% saw ICT skills and conflict handling as areas needing improvement. There was no response to this question from 29%.

At the end of the year, in-school facilitators were once again asked to rate their own knowledge of facilitation. All the facilitators answered this question. Figure 10 demonstrates on a rating of 1–5 (with 1 being the strongest and 5 the weakest) these results.

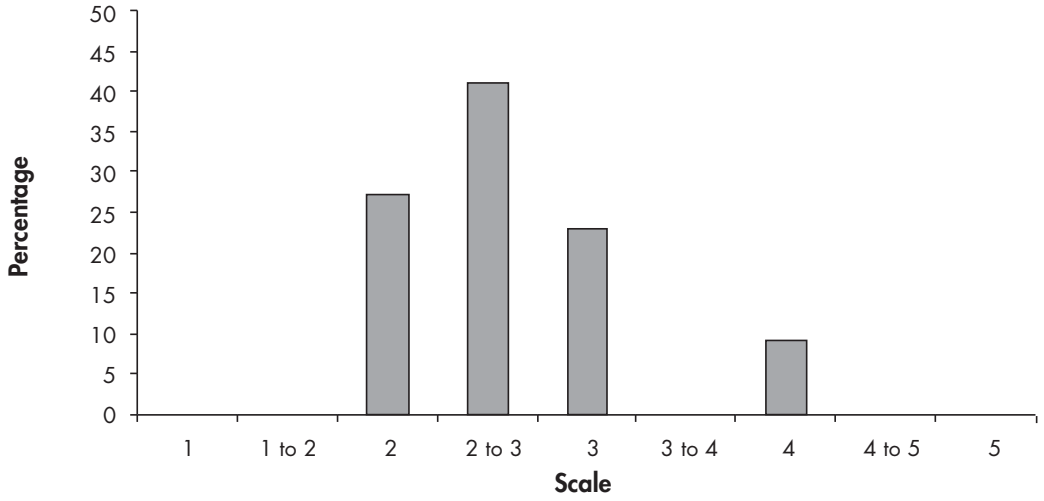


*Figure 10.* In-school facilitators' rating of their own knowledge – end of the year

Once again, in-school facilitators were asked to describe the skills they felt they still needed to develop. One facilitator did not respond to this question. The remaining facilitators offered a wide range of varied comments, with almost all facilitators talking about more than one issue. Things that affected facilitators on a more personal level featured in a large number of answers (37%). Typical comments from this area were:

> Organising and putting into practice what I have learnt this year. Not confident enough in first year to teach/facilitate effectively.
>
> Time management, setting realistic goals for change.
>
> Dealing with doubters. ... Confidence that I am doing the right thing. I am being harsh on myself.

The next most mentioned skill was the need to give good feedback (18%). Comments included:

> Constructive feedback.
>
> I need to develop my reporting back to teachers after observations.
>
> Effective observation/feedback.

Addressing issues with staff, involving and enthusing others, and modelling were represented equally in the range of skills listed as needing developing (14%). Typical comments about addressing issues with staff were:

> More help with techniques to encourage reluctant "older" staff to try new strategies.
>
> Dealing with those who want to be given the resources and not create their own, or to make their own choices.
>
> Addressing issues with teachers.

Comments about involving and enthusing others included:

> Probably would like to involve others more in the running of in-service courses.
>
> Better at delegating our tasks.
>
> To try and enthuse the rest of the Y9 group.

Comments about modelling included:

> I will need to do more work on ... modelling lessons.
>
> Need to develop more confidence at "modelling" the teaching.
>
> In-class modelling.

Other skills that 9% of in-school facilitators mentioned included leadership, in-service, pedagogy, and in-class support, while 4.5% commented on coaching, reflective process, levels, group work, and resources.

### *In-school Facilitation Model*

On the whole, both teachers' and in-school facilitators' comments about the in-school facilitation model were favourable. Initially, many in-school facilitators (43%) were excited about and looking forward to being involved in the project. They saw it as an opportunity to provide better professional development and student outcomes in mathematics. Comments included:

> It is an exciting project to be involved in and will open doors for us and gives us the chance to provide our students with a more valuable learning experience.
>
> Looking forward to it. My own personal development as well as better student outcomes in mathematics.

Quite a large group of in-school facilitators (36%) had concerns about some aspects of facilitation. For example:

> I would like there to be provision for me to visit primary/intermediate schools where the project is running successfully.
>
> I am also aware of the stress being faced by my colleagues at present and hope we introduce the project slowly and with time to allow them to investigate how the project will work best for them.

One regional facilitator commented:

> Facilitators coming in fresh from a busy secondary school need TIME to do it properly – DO LESS BETTER.

By the end of the year, most of the in-school facilitators were still enthusiastic about the project, saying such things as:

> I feel it has been invaluable ... Very worthwhile!!!
>
> Eureka moments.
>
> Overall, the Numeracy Project is excellent.

Some in-school facilitators (36%) felt that, for one reason or another, they could have done a better job. For example:

> Circumstances make me feel that I could have done a much better job of facilitation and will do in 2006. I will be much more proactive.
>
> On the whole, the teachers have been positive but needed more leadership from me. The expectation of weekly meetings is unrealistic, and the team meetings were too far apart. A balance needs to be found there.
>
> Attempted too much this year. Trying to learn new information and have confidence to impart it to others.

## *The Professional Community*

An important aspect of sustaining change is building a professional community. One indicator of whether this has been successful is the degree to which departmental practice includes and supports professional dialogue and student learning.

The graph below shows how teachers estimated the amount of time spent on administration, assessment/reporting, professional and curriculum support, and other topics in department meetings. They estimated that more time was spent on administration than on other topics. However, the estimated amount of time on professional and curriculum support increased by the end of the professional development programme.

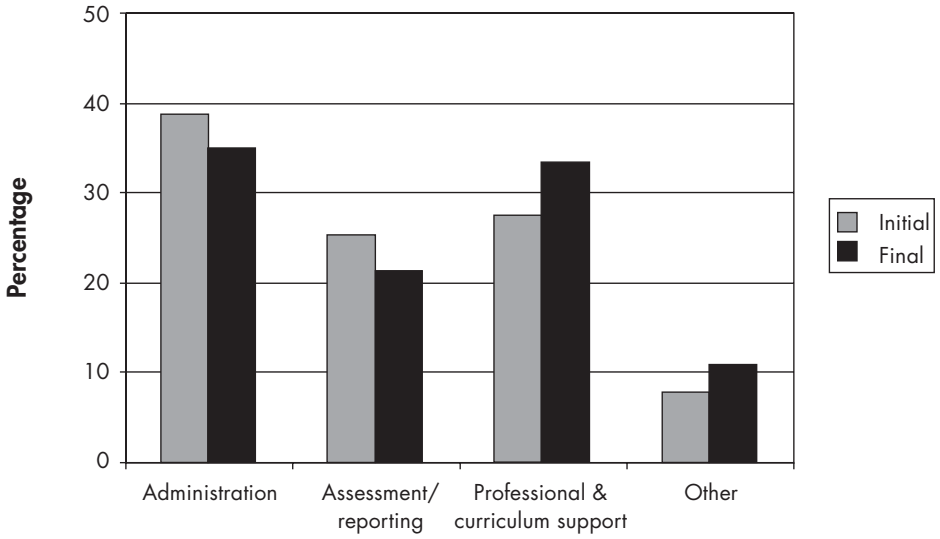


*Figure 11.* Teacher estimates of time spent at departmental meetings

In-school facilitators were also asked to estimate the amount of time spent on different activities at department meetings. Their estimates were similar to those of teachers. However, in contrast to teachers, they thought that there was an increase rather than a reduction of time spent on administration-type activities, and they did not estimate that the professional and curriculum support increased over the year.

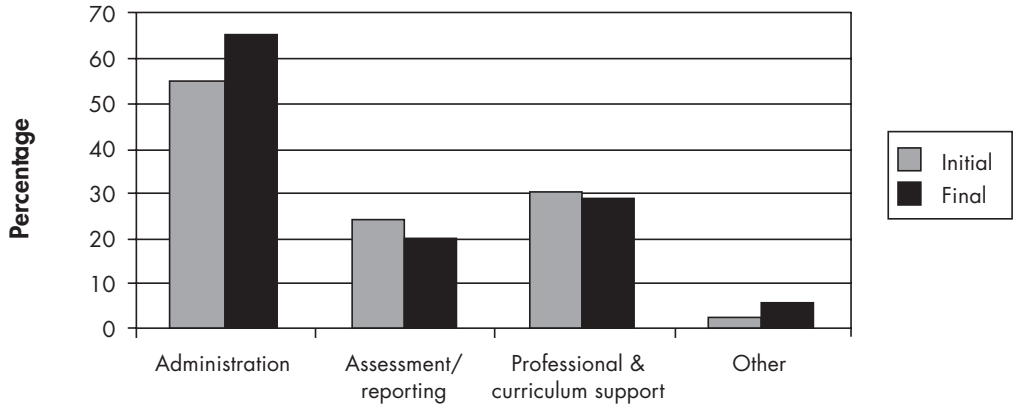


*Figure 12.* In-school facilitators' estimates of time spent at departmental meetings

Additional evidence that was gathered suggested that dialogue about the way that mathematics is taught and learned is taking place in schools. The following comments were made by regional facilitators:

> I think the biggest success that I see is that the departments are talking about teaching and learning ...
>
> The success ... the atmosphere in the department work area, the fact that they're talking together.
>
> It's the engagement and professional discussions about teaching mathematics that they all comment on.
>
> I think the successes have been the talk.

Comments from in-school facilitators and teachers were less direct but indicated that professional dialogue was taking place. In-school facilitators talked about using results from testing in school reports:

> We used the numeracy testing (second time) to do our reports this year. Very effective too!
>
> Used results in school reports to inform parents of student progress.

Teachers used the words "us" and "our", which indicate that dialogue had taken place:

> It has broadened our knowledge – this is stored on our database for future use.
>
> Numeracy testing during the project helped us monitor progress and refocus at times.

It may be that teachers were making a distinction between department meetings at which organisational matters were sorted out and separate numeracy meetings at which professional matters were discussed.

## Concluding Comments

Most teachers taking part in the SNP saw number/numeracy as a critical component of the year 9 programme. There was a wide range of ways in which teachers felt that year 9 mathematics should be taught. Many teachers saw a need for an increased emphasis on number/numeracy as a result of the project. Many teachers used achievement data to support planning of subsequent lessons. Nearly one-third of teachers reported making greater use of assessment data as a result of the project. The NumPA interview gave many participating teachers greater knowledge of their students. However, pressures of time/work limited some teachers' use of achievement data. Time generally was identified as a pressure on teachers both at the start and at the end of the project.

The SNP gave some teachers ways to address the numeracy skills for individual students. Although the resources supplied were found to be useful, there is an ongoing demand for continued development of resources specifically for secondary school students.

Regional facilitators reported an increase of professional dialogue within mathematics departments. Qualities regarded as important for in-school facilitators included being enthusiastic, supportive, energetic, organised, realistic, and willing to take risks. To be successful, in-school facilitators felt that they needed to have good knowledge of mathematics and the project, be prepared to lead staff, and able to give effective feedback.

In general, the model of in-school facilitation was seen as successful. In part, this was due to the fact that the in-school facilitators were intimately aware of the context of the particular schools and were able to modify the programme to meet local circumstances. Their availability for ongoing dialogue assisted the project's implementation.

Overall, many participants in the SNP saw the first year of the project as successful in the way that it impacted on teachers' and in-school facilitators' knowledge, skills, and practice.

## Acknowledgments

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