Senior Secondary Numeracy Practices in Successful Schools

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The Secondary Numeracy Project (SNP) focuses on developing numeracy teaching practice at years 9 and 10. Previous evaluations showed that teachers involved in the SNP professional development reported growth in their pedagogical content knowledge and mathematics teaching practice. The study reported on in this paper explored effects of the SNP on mathematics teaching at the senior secondary school level. The study sample comprised the mathematics teachers from four schools with effective numeracy teaching practices and six regional professional development facilitators. Data was collected using questionnaires and semi-structured interviews. Results indicate that the SNP has positively influenced teachers' practice in the senior school. Specific examples of changes in practice and departmental contextual factors that appear to have enhanced the impact of the SNP professional development are identified. The study findings indicate that, when certain contextual factors exist, the benefits of the SNP professional development extend beyond the target year levels.

Background

The Secondary Numeracy Project (SNP) is in its fourth year of implementation in New Zealand schools. Its overarching aim is to enhance mathematics teaching practices in secondary school classrooms. While the main focus of the SNP is on mathematics pedagogy for year 9 and 10 classrooms, the project has the potential to alter mathematics teaching at all levels in the secondary school. Schools regarded by regional numeracy facilitators as "successful numeracy schools" are the focus of the research reported in this paper, which aimed is to identify and share practices that the teachers in these schools believe to be transferable from the teaching of their junior classes to their senior classes and advantageous to students' learning.

Schools choosing to join the SNP receive professional development for mathematics department members for two consecutive years. In the first year of participation, teachers focus on developing their year 9 mathematics teaching practices. In the following year, they consolidate their year 9 teaching practices and adapt their teaching of year 10 classes. Schools receive funding to release one member of the mathematics team from 20% of their usual teaching load for the two years of the professional development, to allow them to take on an additional role as the school's in-school facilitator (ISF). The ISFs are inducted at a national hui in the year before their school first participates in the SNP and are mentored and supported within their region by their regional facilitator. Within each school, the ISF has a key role in their department's professional development. The ISF's responsibilities include: conducting workshops to introduce new approaches to teaching particular mathematics topics in years 9 and 10 within their department; supporting individual teachers in their development by observing lessons and providing feedback; and maintaining the impetus of professional development for numeracy teaching within their department. Smaller schools are clustered so that a teacher from one school acts as the ISF for two or more schools.

Previous evaluations of the SNP have shown that the majority of participating teachers have reported growth in their pedagogical content knowledge and mathematics teaching practices in years 9 and 10 (Harvey & Higgins, 2006, 2007). The 2007 investigation (Harvey & Smith, 2008) found that there was considerable variation in the degree to which teachers believed the SNP had impacted on their

teaching practice with year 11 classes and that the teachers working with year 11 unit standards[1] classes reported a greater impact on their teaching practice than their colleagues teaching year 11 achievement standards classes.

Analysis of student attainment in two National Certificate of Educational Achievement (NCEA) Level 1 mathematics achievement standards in 2007 alerted researchers to the strong correlation between the decile[2] rating of schools and the performance of students in examinations (Harvey, 2008). Assisting teachers in low- and mid-decile schools to improve students' mathematics achievement is a way to address issues identified in that study.

Features that are generally present in effective mathematics professional development include: a specific pedagogical focus on mathematics teaching, with the development of the teacher's understanding of students' thinking; an extended time frame; and consistency between the development and the working context of the teachers (Timperley, Wilson, Barrar, & Fung, 2007). The SNP professional development extends over two years, has a specific focus on finding out what students do to solve mathematics problems, and involves all teachers from each school's mathematics department in addressing students' teaching and learning in their own school.

Some evidence exists that students involved in the Numeracy Development Projects (NDP) at the primary school level value explaining their own mathematical thinking and knowing others' mathematical strategies (Young-Loveridge, Taylor, & Hāwera, 2005). This paper discusses the ways in which secondary teachers were able to develop their skills in accessing student thinking.

A shared whole-school professional development focus was a noted characteristic of primary NDP schools that were creating strong achievement gains for Māori students (Te Maro, Higgins, & Averill, 2008). The current study explored the impact of whole-school professional development on how mathematics departments worked as teams to foster growth of professional expertise.

The study reported in this paper builds on the previous SNP evaluation studies by investigating the practices of teachers working at year 11 in successful numeracy schools. Consistent with the recommendation regarding decile level (Harvey, 2008), the study sample included only low- and mid-decile schools. The research questions were:

- Which SNP teaching practices are used in the year 11 classrooms of successful numeracy schools?
- How has the SNP impacted on practice in year 11 mathematics classrooms in successful numeracy schools?

Method

The research participants included the year 11 mathematics teachers, the mathematics head of department (HoD), and the ISF of four schools, as well as the regional numeracy facilitators. Participant schools were identified using recommendations by the regional numeracy facilitators and others. Initially, the regional facilitators were asked to suggest schools they deemed to be successful numeracy schools, which were broadly defined as schools where the implementation of the SNP has positively impacted on the teaching practice of the mathematics team. In order to help ensure a geographic

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1 In year 11, most New Zealand secondary schools offer two different mathematics courses. The course that has a greater focus on abstract mathematics is mainly assessed using achievement standards. The course that has a more practical focus is mainly assessed using unit standards.

2 Decile is used as a socio-economic indicator of New Zealand schools. A rating of 10 is the highest decile level, and 1 the lowest.

spread, to preserve the schools' anonymity, and to minimise the number of participant schools that had been involved in previous SNP evaluation studies, the researchers and their colleagues around the country compiled another list of successful schools. The combined list was used to select five target schools, which were then approached to take part in the study. Four agreed to participate.

Data was gathered by means of questionnaires for all participants (see Appendix G, pp. 95–98, Questionnaire) and individual semi-structured interviews with the HoDs, the ISFs[3], at least two teachers from each school, and a sample of three regional facilitators (see Appendix H, pp. 99–100, Interview questions). In total, data was gathered from 26 teacher questionnaires, six regional facilitator questionnaires, 15 teacher interviews, and 3 regional facilitator interviews. Teacher interviews were conducted face-to-face and regional facilitator interviews by telephone. All interviews were recorded and transcribed.

Three of the study schools, each in a different city, have between 1200 and 1700 students. The fourth school draws approximately 300 students from a rural town and its surrounding district. Three of the schools are co-educational, and one is a single-sex school. Two of the schools are low-decile, and two are mid-decile. All four had a stable core group of mathematics teaching staff who had been at the school for a number of years. One school commenced its participation in the SNP in 2005, two in 2006, and one in 2007. The three regional facilitators interviewed all had several years' experience working within the SNP.

Results

This section discusses practices that the teachers in the study schools reported using in the classroom. It also considers practices used by the schools' mathematics departments and with the whole staff. In order to detect if the impact of the SNP on year 11 practices differed between achievement standards classes and unit standards classes, the responses for the teachers of these two types of courses are shown separately (see Table 1).

Teachers' Practices

The range of strategies that teachers reported using is diverse, reinforcing the view expressed by many teachers and regional facilitators that there is no single way of teaching mathematics. The responses to questions asking for the frequency of use of specific teaching practices were tabulated, and the strategies that were most commonly cited were classified into broad themes for later discussion.

Teachers were asked to complete a table (see Appendix G) showing how frequently they used specific teaching strategies at year 11. Results from 23 teachers, listed roughly from the most prevalent to the least prevalent practices, showed a wide variation (Table 1).

[3] In one school, the ISF was the HoD, and in another school, the ISF was one of the joint HoDs.

Table 1
Teachers' Responses Regarding How Frequently They Use Specific Teaching Approaches with Year 11 Classes

	Course Style	Most lessons	Several times per week	Several times per month	Several times per term	Several times per year	Seldom or never
Students work from textbook or worksheets	Unit standards	7	1				
	Achievement standards	9	6				
Homework set	Unit standards	2	5	1			
	Achievement standards	12	2	1			
Students discuss ideas with other students sitting near them	Unit standards	6				1	1
	Achievement standards	9	5	1			
Students present ideas to the class	Unit standards	5	1		1	1	
	Achievement standards	1	3	6	2	3	
Students are involved in investigations/ problem solving	Unit standards	1	1	4		1	1
	Achievement standards	2	4	5	1	3	
Practical work	Unit standards		1	3	2	1	1
	Achievement standards		1	2	7	2	3
Games	Unit standards		1	1	5		1
	Achievement standards		1		5	6	3
Student work marked by me	Unit standards					1	7
	Achievement standards	2		4	9		
Students use computers	Unit standards					1	7
	Achievement standards					3	12

Note: The table shows data from 23 teachers rather than all 26 because three teachers did not teach a year 11 class in the year of the questionnaire.

Some care should be taken in interpreting the Table 1 results. For example, one teacher responded "Several times per term" to the prompt "Student work marked by me", but added the comment "However, I do check that they have marked the homework". Another teacher indicated that they used textbooks in most lessons but generally for brief periods of time. Comments from other teachers that were not able to be displayed in these results included: teachers would prefer to use certain strategies more frequently than they had indicated in the questionnaire but felt restricted by a lack of emphasis on assessment within mathematical investigations; they didn't know enough suitable games; and there was a lack of access to computers.

The most common practices reported for both unit standards and achievement standards classes were: textbook and worksheet work, setting homework, and students discussing ideas with those around them. Practices used relatively seldom with unit standards and achievement standards classes included using computers and games. Differences in the practices that participant teachers used with unit standards and achievement standards classes included: students in unit standards classes were more likely to learn using games and by presenting their ideas to the class; achievement standards students were more likely to have their work marked by the teacher.

In the interviews, many teachers reported making more opportunities for year 11 students to share their mathematical thinking than had been the case before their involvement in the SNP. Similar to the changes in students' views regarding the value of their own mathematical thinking found by Young-Loveridge, Taylor, & Hāwera (2005), the study teachers reported that they valued students' mathematical discussions more than they had before their involvement in the SNP. Teachers reported having experienced and adopted a range of ways to create access to student thinking (for example, peer teaching, teacher questioning and listening, group and class discussions). It appears that teachers who had used strategies in the junior school that were consistent with the SNP had realised that these provided them with opportunities to assess students' progress and to help individuals learn through being involved in the discussion. Examples included involving students in teaching the class or getting help from another student: "He's just done it, go and ask him to explain it to you right now."

Teachers reported using questioning to generate student contributions to lesson content:

> I basically try to get everything out of them … I don't really want to tell them anything.
>
> [Since my involvement in the SNP], I ask more questions and better questions.

Teachers reported that improving their listening skills had allowed insight into students' mathematics misconceptions:

> I am better at picking up student misconceptions now because I am allowing myself to draw more on individual students' strategies.

One teacher commented on his increased skill at interpreting observations of students:

> Perhaps previously, I might not have noticed or picked up on that … Now I can actually interpret it … [and] make a decision about what I see in the classroom.

Others expressed their own similar development as being better able to "seize the teachable moment".

Several teachers reported increased use of class and group discussion and stated they now interrupt students less often than they used to:

> [I'm now] listening to kids ... There are really rich conversations going on.

A structured approach to eliciting students' thinking is illustrated by one teacher's practice of starting lessons with a true or false statement, such as "A plus A is A squared", for students to debate.

Teachers reported that having better knowledge of student thinking enabled them to be more flexible in their classroom practice:

> I [now] can make [planning] decisions about what I see in the classroom.

Other frequently reported teaching practices that included using exposition, modelling, and encouraging students to practise newly learned skills. Three teachers stated that they now structure their teaching to emphasise understanding of new mathematical ideas.

Explaining changes of practice in year 11 classrooms, one regional facilitator commented:

> I think they tend to explain ideas more; they tend to work with smaller groups more. It's not necessarily pre-planned groups, it's kind of incidental almost, on the day.

Impact of the SNP on Teaching Practices

In the questionnaire, participants were given a list of practices that teachers may have adopted or enhanced as a result of their involvement in the SNP. Teachers were asked to rate, on a five-point scale, the degree to which they had changed their practice since participating in the SNP. A 1 indicated little change in practice and a 5 a major change. In order to compare the impact of SNP-style practices

between teachers' practice at the junior and senior secondary school levels, the participants were asked to rate each practice in relation to their teaching of both junior and year 11 classes.

Results are given in tables 2–5 below. Additional tables of results are found in Appendix I, pp. 101–102. Again, the results should be interpreted cautiously. For example, a low rating signifies little change to practice and does not indicate the extent to which the teachers use the practice. Twenty percent of teachers rated the impact of the SNP on their use of a strategy as low but added comments that indicated that the strategy had been an embedded element of their teaching practice before the SNP and remained so.

Consistent with the SNP focus on developing junior secondary school practice, in general the results indicate that the SNP has had a greater impact on teaching at years 9 and 10 than at year 11. The degree to which teachers have adapted their teaching of year 11 classes indicates the extent to which individual teachers have adopted and transferred SNP-consistent pedagogies to their practice outside the junior school. Data from the regional facilitators indicate that they also perceive that the SNP had a greater impact on the teaching of years 9 and 10 than on the teaching of year 11 mathematics.

Table 2
Reported Impact of the SNP (the Teaching Model[4]) on Teacher Practice

Use of the teaching model (materials → imaging → abstraction)	Impact on teaching				
	1	**2**	**3**	**4**	**5**
	Little impact				Major impact
Years 9 and 10	0	1	6	10	6
Year 11 unit standards	0	2	2	2	2
Year 11 achievement standards	1	6	5	2	1

Table 3
Reported Impact of the SNP (Differentiated Teaching[5]) on Teacher Practice

Differentiated teaching	Impact on teaching				
	1	**2**	**3**	**4**	**5**
	Little impact				Major impact
Years 9 and 10	1	4	9	7	2
Year 11 unit standards	0	3	3	1	1
Year 11 achievement standards*	1	5	6	1	1

Note: * denotes 1 non-response

Tables 2 and 3 indicate that the SNP has had a considerable impact on teacher practices of using the teaching model and "differentiated teaching" at the year 9 and 10 levels and some impact on these teacher practices at the year 11 level. Similarly, many teachers reported that they had incorporated increased use of group work and grouping by strategy stage into their years 9 and 10 teaching and, to

[4] Strategies are the mental processes used to solve operational problems with number. NDP *Book 1: The Number Framework* describes a hierarchy of increasingly sophisticated stages.

[5] For example, different work for different students

a lesser extent, into their year 11 teaching (Appendix I). In contrast, responses regarding the impact of the SNP in terms of using real-world examples show similar moderate-impact response patterns for junior, unit standards, and achievement standards class teaching (Table 4).

Table 4
Reported Impact of the SNP (Real-world Examples) on Teacher Practice

Real-world examples used in teaching	Impact on teaching				
	1	**2**	**3**	**4**	**5**
	Little impact				Major impact
Years 9 and 10*	1	3	8	5	5
Year 11 unit standards*	0	1	3	0	3
Year 11 achievement standards	2	4	3	4	2

Note: * denotes 1 non-response

Perhaps most heartening is that the study teachers reported that the SNP has had a major impact on the degree to which they emphasise understanding of key ideas. In terms of the SNP's impact on their teaching, 70% of teachers of year 9 and 10 students gave ratings of 4 or 5, 39% of year 11 teachers gave ratings of 4 or 5, and 64% of year 11 teachers gave ratings of 3 or higher (Table 5).

Table 5
Reported Impact of the SNP (Greater Emphasis on Understanding of Key Ideas) on Teacher Practice

Greater emphasis on understanding of key ideas	Impact on teaching				
	1	**2**	**3**	**4**	**5**
	Little impact				Major impact
Years 9 and 10	1	3	3	15	1
Year 11 unit standards	0	2	1	4	1
Year 11 achievement standards*	3	3	4	4	0

Note: * denotes 1 non-response

The results indicate that the SNP-consistent strategies most readily transferred into year 11 practice were: greater emphasis on key ideas, using real-world examples, and sharing learning intentions at the start of the lesson. The practice least often reported as transferred into year 11 classes was use of grouping by strategy stage.

Consistent with teachers' views, changes in year 11 classrooms described by regional facilitators indicate that more emphasis is being placed on making students think as part of the teaching and learning process:

> There is a desire to make mathematics education more accessible at year 11, but time pressure is interfering.
>
> "How did you get that answer?" This question and the consequent sharing are more frequent.
>
> Students are more likely to attempt problems without calculators.

Department and School Contexts

A common theme emerging from the interview data was that the context within which the teachers worked impacted greatly on their ability and inclination to adopt SNP-consistent practices. The research explored departmental and school factors that teachers reported as assisting with the implementation and transfer of SNP practices into year 11.

Department practices

The teachers in the successful numeracy schools participating in this study reported that their departments had continued practices (fostered though the SNP) that helped to enhance the cohesion and professional focus of their mathematics teams. The department practices most commonly described (discussed in turn below) included increased focus on:

- developing and sharing resources;
- giving increased emphasis to professional discussions based around student learning and understanding;
- carrying out activities for the purpose of discussing the results with colleagues;
- developing teaching schemes;
- altering assessment practices.

The teachers from several schools reported that departmental processes such as these assisted in creating an environment in which informal conversations about student learning could naturally occur:

> Good collegial atmosphere where lots of informal sharing goes on.
>
> Opportunities to discuss and share are invaluable.

The availability, sharing, and use of resources featured in many teacher responses. Examples include: support from the HoD in updating and providing resources; resources are easily available; and sharing and pooling resources.

The professional conversations between teachers were reported to be richer as a result of the SNP. The meetings within the mathematics teams were appreciated as times to share and improve practice. At times, these meetings were for the whole mathematics team, and at other times, the meetings involved teachers who were working at a particular level, indicating strategic and focused use of meeting time.

Teachers reported valuing the opportunities that such meetings provided to discuss and solve mathematics problems together, to share ideas, to have new activities demonstrated, and to work together on ways to implement new ideas into their teaching.

In one school, the meetings, which were initially focused on the SNP and led by the ISF, had evolved to focus more generally on mathematics pedagogy and included greater input from a range of staff. As preparation for meetings, some teachers reported carrying out a teaching task with their students, for example, "What do you think '=' means?" This practice was reported as giving a starting point for department discussion grounded in what students really do rather than in what teachers believe students might do.

Another school administered a diagnostic test on a topic and then analysed the results as a team to see "what the results tell us" and decide "how we are going to change our teaching because of the results".

Teachers also described an increase in the richness of informal discussions as a result of their involvement in the SNP. In one school, the creation of a shared departmental space enabled informal discussions to take place more naturally. One teacher noted a shift in collegial discussions towards examining practice, reporting that teachers are now more likely to discuss their own practice, for example:

> I've realised I've been teaching this way, and they (the students) have no idea what I have been talking about, and I've noticed this because I am looking at the data.

Teachers report that as a result of the SNP, their departments have paid more attention to developing their teaching schemes and assessment practices. In one school, the department scheme has been redeveloped to increase the emphasis on mathematical understanding and teaching guides have been developed to focus the teaching of certain topics. Several of the study schools have altered their assessment practices: one school has implemented pre- and post-tests for certain topics, while another has introduced topic assessment throughout the year rather than half-yearly examinations and has included more structure than previously into how they moderate their assessments. Some teachers reported that using asTTLe (Assessment for Teaching and Learning)[6] to determine the skills of students helped them to pitch teaching to their students' needs.

The three regional facilitators who commented on this aspect had seen examples of mathematics teams working together to focus on how best to teach the topic:

> Focused analysis about how to teach each of the components of the course – time consuming but very effective at clarifying ideas about instruction.

School contexts

Consistent with Te Maro, Higgins, and Averill's (2008) findings, synergy between whole-school professional developments (for example, Te Kotahitanga[7]) and the SNP appeared to enhance the uptake of SNP-consistent teaching practices. The Te Kotahitanga project was operating in three of the study schools, and staff reported that the strong reinforcement between the goals and approaches of the two projects contributed to their progress in the SNP. The fourth study school also reported that a whole-school development their school was undertaking, which included focusing on differentiated learning and problem solving, was consistent with their implementation of SNP practices. One aspect of such developments likely to enhance teacher development is the similarities in messages between projects. Another aspect is the environment created through a school culture of focusing on developing effective practice as a team.

Other whole-school practices for SNP implementation included, in one study school, the ISF running the knowledge section of the SNP diagnostic assessment at a whole-school staff meeting. This gave the entire staff a glimpse of the purpose of the SNP and an avenue for finding out more and discussing the possible impact of the SNP on students' work in curriculum areas other than mathematics.

A regional facilitator reported that one of his SNP schools had created kits of mathematics resources to use across the school during whānau[8] time.

Impact on Achievement

Teachers' views of the impact of the SNP on student achievement at year 11 were mixed (Table 6). One-third of the teachers chose not to respond to this question (a higher non-response rate than

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6 www.tki.org.nz/r/asttle/

7 http://edlinked.soe.waikato.ac.nz/departments/index.php?page_id=2639. Te Kotahitanga is a professional development programme that focuses on lifting the achievement of Māori students in mainstream schools.

8 Sometimes called "form time", schools set this time aside for each class to meet with the teacher directly responsible for their pastoral care.

for any other question) and, in several cases, study teachers noted that they did not have sufficient information to tell if there had been an impact on achievement. For teachers of both unit standards and achievement standards classes, the median response was 3 (moderate impact). Table 6 suggests that, in general, the teachers of unit standards classes reported a greater impact than did their colleagues teaching achievement standards classes. However, the difference is not statistically significant for this sample size and is consistent with results from Harvey and Smith's (2008) study. It may be explained in part by the greater emphasis on assessing number work without the use of calculators in key unit standards.

Three of the regional facilitators felt that they did not have enough information to rate the impact of the SNP on achievement at year 11. The other three regional facilitators indicated a modest impact on achievement.

Table 6
Teachers' Views of the Impact on Students' Achievement in Year 11 as a Result of the School's Participation in the SNP

	Little positive impact				Major positive impact	
	1	**2**	**3**	**4**	**5**	**No response**
Unit standards	1		3	1	1	2
Achievement standards	2	1	6	2		5
Total	3	1	9	3	1	7

When asked for their views on the appropriateness of achievement standards for assessing learning supported by the SNP, half of the teachers indicated that they found the current assessments too solution-focused and not useful as a way of measuring the development of strategies. Several of these teachers did, however, indicate that the draft revised standards more appropriately incorporated elements consistent with the SNP.

The regional facilitators were all of the view that many of the current achievement standards assessments are too reliant on skills that do not require understanding and are poorly aligned with the SNP:

> Mostly [the Level 1 achievement standards] do not [appropriately assess learning supported by the SNP]. These are the major reasons for SNP schools not continuing to implement more numeracy-style teaching. Standards are seen as requiring [a] different approach.

The revision of the standards was welcomed by regional facilitators, with two suggesting that specific standards assessing number understanding needed to be included:

> Have a designated number [achievement standard] where the assessment task is focused on gauging understanding.

Issues Impacting on Implementation

The biggest issue that teachers reported regarding implementation of SNP-consistent practices was "time", listed in 60% of responses. The responses from one study school, where junior mathematics was timetabled for three hours per week, showed that the teachers felt that lack of time was a big impediment to implementing SNP-consistent practices. The issue of time appears in many guises, as discussed below. Other issues, each mentioned by a small number of respondents, included: the unsuitability of current texts, the unwillingness of students to try alternative strategies, and staff changes.

Regional facilitators mentioned a range of factors that can impede implementation of the SNP including: lack of buy-in to the SNP by the full school, school-wide assessment and reporting practices that are inconsistent with the SNP, staff turnover, lack of time, and timetabling issues.

Ideas for Further Development and Professional Development

The major themes of ongoing support requested by teachers related to time and more professional development. Requests for time were couched in many different ways: time to think, plan, and prepare; more time needed in the classroom with students because it takes longer to teach this way; and an extended time frame needed for the professional development so that SNP practices could become embedded in both teacher and student practices. Despite the study schools being selected on the basis of successful implementation of the SNP, these teachers still requested more professional development to help them reshape their teaching practices.

The majority of regional facilitators stated that well-funded support for schools should be extended beyond two years. Other themes discussed by regional facilitators included the necessity of aligning national assessment with the SNP and ensuring pre-service teacher education courses include a significant component of material that is consistent with the SNP.

Discussion

The limitations of this study include the fact that only a small sample of schools were used and the study draws on teachers' reported rather than actual practices. However, it is hoped that the results and findings are able to provide a snapshot of effective practice that can be considered by regional facilitators, teachers, HoDs, and ISFs in their work to develop pedagogical and curriculum practice.

Although a study of this type necessarily aggregates results, it was clear that each teacher had their own style and trajectory of change. Some teachers in the study found that there was a high degree of fit between their existing mathematics teaching and that espoused by the SNP and they were still able to incorporate elements from the SNP into their teaching. However, for many teachers, the transition of style was somewhat greater: some teachers had undergone major changes of approach, while others had been more cautious and had adopted relatively few changes.

In the study schools, the SNP has contributed to building more cohesive mathematics teams. The maintenance of these teams is likely to be essential to maximising the ongoing transformation of teacher practice (Timperley et al., 2007). What teachers working in these low- and mid-decile schools have achieved provides a glimpse of how, given appropriate circumstances, professional practice of all secondary mathematics teachers and their departments can be enhanced.

The responses of the teachers in the successful numeracy schools show that many believe the SNP has had a positive impact on their mathematics teaching at year 11. The practices most often transferred into year 11 differed for unit standards classes and achievement standards classes, and this transfer appeared to be enhanced by particular departmental and school practices (for example, a shared professional development focus). The teaching strategies consistent with the SNP that were seemingly most commonly utilised by successful numeracy schools in year 11 included:

- increased focus on student thinking and students explaining their thinking;
- increased focus on developing and assessing students' mathematical understanding;
- increased use of real-world contexts.

This study builds on earlier studies (Harvey& Higgins, 2007: Harvey & Smith, 2008) in finding that the SNP is an effective professional development for improving the quality of mathematics teaching. As

such, it is recommended that funding be continued for SNP development. Teachers and facilitators involved in this study suggested that greater funding in the third year of schools' involvement in the SNP had the potential to assist in embedding effective practice. This paper has illustrated some practices that have been used in schools and departments that have enhanced the effectiveness of the SNP and suggests that sharing such practices through the SNP professional development could assist in supporting its development in other schools. In successful numeracy schools, many teachers report increased emphasis on student thinking, focusing on key ideas, and use of real contexts. It would be beneficial if these teaching practices were to be discussed with schools new to the SNP as possible benefits of the project for senior secondary mathematics learners. Cohesion between several professional developments being undertaken within a school is beneficial, with each having the potential to enhance the effectiveness of others.

Recommendations drawn from the findings of this study include:

- continued investment in the SNP professional development across New Zealand secondary schools;
- increased funding for schools in the third year of the SNP to match that given in the second year;
- consideration of department and school contextual factors likely to enhance the implementation of the SNP within the professional development;
- a focus for the senior school on those aspects of the SNP most commonly transferred into successful schools' year 11 practice (student thinking, students explaining their thinking, focusing on key ideas, and use of real contexts);
- regional facilitators, department leaders, and teachers making strategic use of synergies between the SNP and other school-based professional development projects.

Further areas highlighted by this study as important to explore include "successful" teachers' actual classroom practice and junior and senior secondary students' views regarding how teaching approaches consistent with the SNP assist their learning, motivation, and achievement.

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