Sustained Numeracy Project Practices in Two Schools

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The numeracy practices of two schools were considered in depth in order to investigate the factors contributing to whether or not schools and teachers sustain Numeracy Development Project (NDP) approaches after they have completed their initial participation. Lead teachers and four other teachers from a large, urban, contributing primary school and from a small, rural, full primary school gave interviews. Videos of mathematics lessons were taken in three classrooms. The two schools took contrasting approaches to establishing NDP practices. In both schools, lead teachers played a key role in motivating and resourcing staff. Analysis of interviews alongside videos showed that these teachers described their practice accurately. Teachers on the videos were organising their lessons in accordance with NDP suggestions and were asking for, and responding, to students' strategies.

Background

As the introduction of the Numeracy Development Project (NDP) to primary schools nears the end of its initial phase, the question of sustainability becomes of increasing importance. Schools involved in the NDP have received facilitation programmes, intended to result in long-term changes in teachers' numeracy teaching practices. An in-depth review of sustainability as a concept is beyond the scope of this paper; rather a brief summary of work related to the New Zealand NDP is provided.

The Ministry of Education has let contracts to provide ongoing support for schools through the six Colleges of Education, who employ facilitators to work on sustainability issues. Thomas, Ward, and Tagg (2004) provided an evaluation of these initiatives and found that, although teachers who had participated in the sustainability programmes reported using NDP materials and intended continuing to use NDP approaches in their classrooms, this was not necessarily driven by raising student achievement in numeracy. The teachers appeared to be at the stage of wanting resources and ideas rather than engaging with students' thinking. This engagement with students' thinking is a key element of internalising NDP approaches (Bobis, et al., 2005) and therefore underpins sustained practice (Higgins, 2004).

Higgins (2004) addresses sustainability in her evaluation of the Advanced Numeracy Project. She suggests three factors that contribute to sustained practice, which she defines as "... continuing enactment of the structural elements of the project" (p. 53). These factors are:

> innovation which leads to internalisation, which leads to sustainability. Innovation in teaching practices amongst a small group of staff ... (and) ... a collective, internalised effort creates a dynamic from which changes can be sustained at the school level. (Higgins, 2004, p. 59)

In Higgins' analysis, individual teachers are seen as the starting point for sustained NDP practice, with these individuals supporting each other in teams and generating a school-wide commitment to continuing NDP practices.

New Zealand's NDP is one of a number of initiatives internationally that aim to address the learning and teaching of numeracy in primary schools. Bobis et al. (2005) describe the implementation and effectiveness of three such programmes – the New Zealand NDP, the New South Wales' Count Me In Too project, and the Victorian Early Numeracy Research Project. A

common factor in all three programmes was the desire to overcome the drawbacks of a one-off professional development experience by encouraging teachers to:

> take research information from external sources and from their own children, reflect on it with colleagues, and make adjustments to planning for individuals and groups, with this iterative process continuing over an extended period of time. (Bobis et al., 2005, p. 50)

This gives a picture of sustainability as an ongoing process of engagement with the ideas and principles of the projects. Higgins (2004) discusses "structure" as a significant concept in understanding sustainability. This notion of structure embodies the iterative process described above and is further defined by Higgins (2004) for the New Zealand NDP as "the Number Framework and the Teaching Model" (Higgins, 2004, p. 53).

The NDP seeks to change teachers' current practice to teaching that is based on accurate observation of students' strategies and needs, that utilises interaction and discussion, and that emphasises the development of robust and flexible concepts about number. These classroom practices are framed by broader system practices at syndicate, school, and Ministry of Education level that enable, constrain, and shape what occurs in the classroom. The classroom practice builds a school-wide commitment (Higgins, 2004); the school-wide approach at the same time shapes the classroom innovations. This study therefore considered three different types of data: school-wide documentation and strategies, interviewing teachers about their practice, and video observation of classes.

Method

Participants

Teachers from two schools participated in this study. The schools were nominated by NDP area co-ordinators and were in different areas. Co-ordinators were asked to nominate schools that had what they felt was a typical response to the facilitation, rather than the most enthusiastic or most confident schools. "City School" was a high-decile, 20-teacher, urban, contributing school, and "Country School" was a mid-decile, seven-teacher, rural, full primary school. Five teachers from each school volunteered to participate in the study. In each school, this was the lead teacher and four other teachers from differing areas of the school. The teachers' experience, class level, and facilitation history are summarised in Table 1 below.

Table 1
Summary of Participants

City School				Country School			
Participant	Years of teaching experience	Length of time since facilitation	Class level	Participant	Years of teaching experience	Length of time since facilitation	Class level
F	25	One year	Yr 5–6	A#	25	One year	Yr 6–7–8
G*	7	Two years	On leave	B#	23	Two years	Yr 5–6
H	3	Two years	Yr 1–2	C*	12	One year	Yr 6–7–8
I	3	Two years	Yr 3–4	D	1	Current	NE
J#	4	Two years	Yr 5–6	E	5	One year	Yr 3–4

*Numeracy lead teacher # Video participant

Method

Data was collected on school-wide planning and organisation, teachers' responses to the programme, and classroom practice. The school-wide data was obtained by interview with the lead teacher and collecting documentation. The teacher data was collected in individual interviews of approximately 15–20 minutes. These were audio-recorded and transcribed. One 45-minute lesson was videoed in each of three classrooms, two at Country School and one at City School. (The video from a fourth classroom was withdrawn by the participant.) The teachers were asked to follow their normal mathematics lesson format, and the responses of the students suggested that this was the case. Well-established routines appeared to be in place, and artefacts such as recording in modelling books and group boxes and task boards were present. The videos were analysed using a protocol derived from the Manurewa Enhancement Initiative's (MEI) indicators of NDP practices (Hughes, 2006, pers. comm.).

Findings

School-wide Implementation

City School and Country School took contrasting approaches to school-wide implementation of the NDP post-facilitation. Both schools had enthusiastic lead teachers. These teachers were cited as a key influence on practice by colleagues in the interviews and had taken responsibility for carrying on the NDP in their schools.

Table 2 summarises the schools' approaches to continuing with the NDP.

Table 2
City School's and Country School's Approaches to Continuing with the NDP

	City School	Country School
Policy	New policy written to specify NDP practices and ideals.	Policy unchanged – waiting until practice is "embedded" before they write new policy.
Planning	Standard planning formats developed with facilitator; planning standardised across classrooms.	Planning individually and on a range of formats. Discussion to take place after teachers had worked through issues in their classrooms.
Assessment	Separate assessment sheet system developed for tracking. Benchmarking system used alongside this, with comparison to national norms.	Using Numeracy Project Assessment diagnostic tool (NumPA) data from previous year, observing and re-assessing if necessary. Individual records kept – range of formats.
Equipment and resource books	Resource books in classrooms. Equipment provided for each classroom, stored in the room. Teachers making own games.	Resource books in classrooms. Equipment provided for each classroom, stored in the room. Teacher aide hired to make games. (Applied for a community grant for extra equipment and teacher-aide time.)
Outside support	Contract facilitator hired to help finish planning and assessment schemes.	Teacher aide hired to make resources, using community grant.

Country School had deliberately left school-wide policy changes until practice changes were firmly in place. They felt that the key for continuing to use the NDP practices effectively was having the resources readily available. They spent money and time resourcing each classroom and making sure that everyone had the necessary equipment to teach the lessons in the NDP booklets.

City School had hired a contract facilitator to help them complete school-wide planning and assessment systems. They had also invested in equipment and asked each student to buy a small whiteboard as part of their stationery order, but the teachers were making their own games and activity materials.

Teachers Talk about Their Practice

Teachers were asked a range of questions about their practice in teaching numeracy concepts. Responses to questions about what made the biggest difference for students and what was the most useful aspect of the programme focused on the hands-on nature of the lessons, students talking about their ideas, and how teaching was based on how students think.

Table 3 summarises the responses of the teachers to the question "What is the most difficult aspect of the Numeracy Project for you in your classroom?" The responses are indicative of the teachers' understanding of the NDP approaches. Some teachers focused on practical aspects of implementation, while others were concerned with the mathematics and students' thinking. This did not differ systematically by school or teaching experience, pointing to the construction of individual understandings about the NDP approach.

Table 3
Responses of Teachers to the Question "What is the most difficult aspect of the Numeracy Project for you in your classroom?"

Teacher	Response
D	Is each child in the group getting it, or are the group getting it?
C	Acting out the lessons yourself to make sure you get the maths.
B	Getting the children who are not with you to do something useful.
A	Planning – needs to be responsive and you need to understand the lesson.
E	Sharing with them all the strategies so they can choose what's best – they tend to stick with what they know.
I	Assessment is time-consuming, resourcing lessons, fitting in two groups.
J	Knowing when they have really grasped it.
F	Retraining myself after 25 years of doing it my way.
H	Resourcing – making games and independent activities.

Nine of the 10 interviews followed a similar pattern of response. The teachers were enthusiastic and felt that the NDP had made a positive, and permanent, difference to their teaching. Their talk about the NDP suggested that they saw it as "their practice" – it had been internalised. One teacher, "F", from City School, expressed the same enthusiasm but used language that revealed that, for her, the NDP approaches were not internalised. This can be seen in Table 4, which contrasts "F" with "A" from Country School. These two teachers had similar lengths of teaching experience and had undergone the facilitation one year ago.

Table 4
Summary of A and F's Responses to Interview Questions

Question	A	F
Previous practice	Maths Plus in three groups.	Maintenance, taught in groups, more bookwork.
Facilitation	Probably the biggest shift in my teaching since I started. Probably the whole insight of how children think – it was just amazing for me.	Never very comfortable teaching maths, worried about doing it the right way/ coverage, now have a sequence to follow.
Most useful	Real analysing of the way kids think and the stages, in-depth teaching every day with your group. Just so exciting.	Facilitator being practical, coming from a classroom base, not too much theory to sift through. Junior-based, so already had task board and equipment, see how it fits into a senior class more clearly now.
Most difficult	Planning – quite easy before – go from this page to this page, this activity, that activity, but now you are looking at what you are teaching the children. You have to get your head around the session before you start. I always used to plan my maths for a week, and now I only plan for tomorrow. I will have an idea about the next day, but I won't plan it because I have to see how they respond.	Just putting it all into practice. I got a bit overwhelmed with doing it their way after the 25 years I had done it my way, so that was sort of the most difficult part, I guess, just retraining myself. The classroom organisation was reasonably easy to take on, but you think, "oh my goodness, you are going to let children play games for 15 minutes".
How do you teach now?	Cross-grouped by strategy stage across three classes, two-group rotation, use teaching model and resources.	Pretty much how they taught me because for my own self I just think I should stick to the model and make a few variations within the classroom but, you know, stick to it so that I have got that on board, and then next year I will launch out and do the things that I really feel either philosophically or just management-wise would work better. I think all learners need revision and reminding and practice, and I don't think quick warm-up games is enough to actually maintain that knowledge. I also have a few issues with the assessment sheets … (alignment) is not as clear for me, and I fling these sheets in and out of the numeracy file all the time, and it's crazy.

Table 4
Summary of A and F's Responses to Interview Questions – continued

Question	A	F
What do you do that is not from the project?	Do a bit of formal geometry, to prepare them for secondary school.	This term I am only teaching one group. I am just trying to teach one group all the way through to number properties … the second group is really just checking up on what we have done today. I find it's too frustrating. I would rather for my peace of mind and the kids' learning take them all the way through … it's usually practice with number properties where they hit the wall. I have built in more revision and maintenance, and that's basically out of a book or worksheet … I am just going along with the assessment the way they like it.
Biggest difference to students	There is lot more focus teaching that goes on – group strategy teaching, like 20 minutes a day just focusing on strategy and being able to verbalise their thinking.	More engaging and more fun, if you are motivated you will learn it.

The contrast between these two teachers is apparent in the language they use and the substance of what they say. For A, the NDP has caused a revolution in practice.

> It was for me personally probably the biggest shift in my teaching since I started. It was huge – the whole insight into how children think. (A, Country School)

For F, the NDP approaches remained external to her core practice. She has concerns about maintenance and bookwork that have not been overcome, but she feels obliged to "stick to it" as "they" have told her to. The NDP has the feel of an imposition for this teacher. This is an important finding because it may be representative of a large number of teachers whose views may not be captured by research that asks for volunteers to contribute their ideas. The teachers who were videoed demonstrated practice that was consistent with what they had described in the interviews. In this small sample, it appears that teachers describe their practice accurately in an interview situation. The language they used to describe their practice was indicative of what was observed in the videoed lessons.

Evidence from Classroom Lessons

Three classroom lessons were videoed, two at Country School and one at City School. All three teachers used superficial features of NDP practice. Their lessons drew from the resource books, they used project games and equipment, the classes were grouped by strategy, and a group rotation was in operation. In each lesson, the teachers shared the learning intention with the groups they were teaching and used a modelling book to record the discussion. The lessons all followed the format suggested by the NDP, with an introductory whole-class phase, group teaching, and a wind-up session to close the lesson. Beyond this organisational framework,

however, the teachers' interaction with their students was of key interest. To attempt to systematically consider the deeper lesson features, observation protocols from the MEI were used to derive a list of key teacher actions that could be observed on the videos.

The elicitation of students' strategies and the types of responses given by teachers to these strategies were analysed. All three teachers sought strategy explanations in their group teaching, and one teacher sought strategy explanations during the warm-up game and plenary session. The frequency of strategy elicitation depended on the lesson content. The teachers had their preferred responses to strategy contributions, with one teacher offering evaluative responses (yes, good, no) and revoicing contributions, one inviting students to record, and one questioning and recording herself. This suggests that the teachers had internalised the weaving of strategy contributions into discussion, resulting in responses that suited their teaching. In all the lessons, the teachers frequently called on students to make public contributions. However, the sharing of ideas zigzagged between the teacher and the students rather than generating dialogue between the students. Sharing methods between students so that they understood each other's strategies was not evident, and there was no discussion of the most effective strategy. There was only one instance of a teacher providing a strategy.

Public recording of strategies was done in modelling books in the Country School lessons. Most of the recording in the City School lesson was on individual whiteboards. The methods of public recording contributed to the sharing pattern in the groups, with more sharing occurring when there was group rather than individual recording (this issue is addressed more fully by Higgins in this compendium, p. 65).

The teachers in these three lessons were emphasising strategies with the students. They appeared to understand the students' contributions, as evidenced by their responses.

Discussion

The findings of this study are necessarily limited by the small number of participants. The narratives about practice told by these teachers are highly individual but at the same time help to "flesh out" the patterns found in interview and survey data (Thomas, Ward, & Tagg, 2004; Higgins, 2004). As the issue of sustainability of NDP practices becomes more central, we need to develop a clearer idea of what sustained practice might look like. Thomas, Ward, & Tagg (2004) list the five criteria that might be used to evaluate the sustainability projects. Further clarification of what the key elements of classroom practice are would help in evaluating the project's effectiveness. Using the MEI criteria to analyse the videoed lessons produced the suggestion that evidence for teachers noticing students' strategies and understanding them could be found in observing teachers' elicitation of and response to students' contributions. This is an area for further consideration.

The comparison of A and F confirms Higgin's (2004) notion that internalisation forms the basis for innovation and change to NDP approaches. A's enthusiasm for the NDP was revealed in his interview responses and suggested that the approaches had become an integral part of his practice. F, however, spoke about the NDP as a separate entity, using words such as "they" and "as I have been told to". F found the NDP approach much harder to use and sustain without support than A did. Further evidence for the idea that individual-teacher change culminates in sustained school-wide change comes from Country School, where a deliberate decision was taken to wait until practice was embedded before making policy-level changes. City School's contrasting approach may have contributed to F's feeling of disconnection from the NDP, as she

refers to the assessment system in particular as not aligning with her practice and being frustrating for her.

The readily observable elements of the videoed lessons, such as the sharing of learning intentions and the use of groups based on strategy, need to be considered in combination with analysis of the interaction that occurs within the lesson. The lesson organisation creates a "space" for meaningful interaction to occur, but it is not sufficient in itself to count as "sustained practice" if we are looking for change in understanding of students' thinking in numeracy. Teachers may be able to sustain the system aspects of running an NDP-based numeracy programme, but they may not be able to sustain the depth of insight and interaction as the students progress. Further study of both teachers' narratives about their practice and observation of their teaching will enhance our understanding of what sustainability means for the NDP.

References

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