Improving children's performance in numeracy: Two countries, two approaches

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This paper discusses the developments that have taken place in both Britain and New Zealand in response to the endeavours by the respective governments to develop more numerate populations. The British National Numeracy Strategy experience is described and then reference is made to research that assesses its effectiveness in enhancing numeracy. This is followed by a description of the New Zealand experience, the Numeracy Development Project, along with some comparison with the British programme, and finally a discussion of the key differences against research findings is presented to explore which has been more effective.

Introduction

In the latter part of the 1990s the election of Labour governments in both Britain and New Zealand created a shift to what has been referred to as the 'Third Way'; a move to a social market economy and social democracy. This has been more pronounced in New Zealand and been evidenced in such things as the resurrection of school zones and more importantly by the greater involvement of educationalists in curriculum development. In Britain, the Labour government, despite professing to having made changes, has been described as "continuing the previous Conservative government's stance on retaining direct, whole-class teaching in primary schools" (Brown, Millett, Bibby & Johnson, 2000, p. 469). However, underlying the policy agendas in both countries has been a belief in the importance of the key skills of numeracy. These are assumed to have direct implications for economic performance and as such new initiatives began to take shape in the field of mathematics education in both Britain and New Zealand (Robinson, 1998). Because of the different political climates the strategies for enhancing numeracy skills formulated in each country were quite different.

What does it mean to be numerate? Most researchers agree that numerate students should have instant recall of the basic number facts, be able to calculate accurately and efficiently, and be able to explain their methods and reasoning using correct mathematical terms. A working definition of what it means to be numerate as an adult "the ability and inclination to use mathematics effectively at home, at work, and in

the community" (MoE, 2001, p. 1) has been developed as part of the work arising from the New Zealand Numeracy Development Project.

The British Experience

An important factor leading to the intervention of the British Government and the eventual development of their National Numeracy Strategy (NNS) was that three specific concerns had been voiced in the Office for Standards in Education (Ofsted) reports about primary mathematics teaching in the early 1990s. Of concern was the level of foundation skills in arithmetic, and in particular the dominance of schemes that overemphasised standard written methods at the expense of mental techniques, alongside teaching approaches which appeared to place undue responsibility on students for controlling the pace of their own learning. As a direct result of this the role of the teacher was seen as reduced to that of a classroom manager who involved the students in little direct teaching or discussion about their mathematics (Straker, 2000). Further to this, some studies were showing a positive correlation between improved performance and whole-class teaching (e.g. Reynolds & Muijs, 1999). The findings of such studies had a big influence on the development of a teaching approach that came to be referred to as "interactive whole-class teaching". The rationale was that focusing on "organising students as a whole class helps to maximise the direct contact they have with the teacher so that every student benefits from good interaction for sustained periods" (Straker, 2000, p. 42). The result was the development of a formula for what has come to be known as the "Numeracy Hour" that was implemented in 1999.

The main purpose of the NNS was to raise standards of numeracy in participating schools, in line with national expectations (targets) for primary students. These required improved school management of numeracy through target setting linked to systematic action planning, monitoring, and evaluation, and the encouragement of family support for student achievement in addition to more interactive teaching with whole classes. Reaction was almost immediate and the feelings of many of the leading researchers and educationalists in Britain at the time could be summed up in the following statement:

> It is fascinating to note that the NNS, with objectives biased towards calculation skills rather than meaning or application, can be likened to that which existed in the nineteenth century primary schooling system but with a twentieth century obsession with targets and the presumption that education "standards" and "effectiveness" are defined at the primary stage by these alone.
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> (Alexander, 1999, in Brown et al., 2000, p. 460)

Such analogies have proven to be prophetic when recent evaluations of the NNS are taken into consideration.

British Teachers Professional Development Programme in NNS

The British professional development programme provided each teacher with eight days of training in NNS by a local consultant and this was followed up by regular "twilight" sessions on planning and teaching aspects of numeracy throughout that year at a local numeracy centre. In addition, each school was entitled to use the local consultant to provide up to two training days for all staff each year, and eight more days of school-based consultancy over the next two years. The latter included demonstration lessons and teaching in tandem, where the focus was to be on interactive whole-class teaching. The mathematics co-ordinator in each school had five days extra release each year to give extra classroom support and coaching to his/her colleagues.

The key criterion for planning for teaching the daily numeracy hour was that of 'controlled differentiation'. This involved the whole class working at meeting the same learning outcome at the same time, but with the level of difficulty of the tasks varying depending on the level of ability of each of the students. These lessons were designed to include: ten minutes of oral work/mental calculation, including rehearsal of "number bonds" and basic facts, followed by the main teaching activity (thirty to forty minutes) and a ten minute plenary session. Planning for these lessons was to be based around the principles of direct and interactive whole-class teaching, and the emphasis was to be on oral communication, and to involve a balance of "*demonstration*, *explanation*, *questioning*, *discussion* and *evaluation"* of students' responses, and *direction* (Straker, 2000). For example, the teacher might *demonstrate* how to add on by bridging through 10 on a number line, or how to multiply a three-digit by a two-digit number; *explain* a method of calculation and discuss why it

works; use techniques of *questioning* to encourage students to extend and expand on ideas or to help identify common errors or misconceptions; involve students in *discussion* to justify a particular method of calculation or to probe understanding; or give clear *directions* to ensure that students know what they should be doing by drawing attention to points over which particular care should be taken.

The NNS Framework

Whilst the guidelines for planning for the numeracy hour are very prescriptive, the "Framework" can only be described as being "loosely hierarchical". What it does is: set out programmes of teaching objectives (and exemplars for each) to be taught in each year, provide guidance on the daily mathematics lesson in which this teaching takes place, and guidelines on the assessment of student progress. Templates to help teachers plan a term's lessons accompany each year's programme. These show how topics can be grouped into units of work so that suitable emphasis can be given to number, provide a recommended number of lessons for each unit, and build in time for half-termly assessment and review. Everything is done to a strict timetable.

This combination of detailed curriculum description and the pressures of accountability is seen as having a negative impact on learning. "Teachers' ability to scaffold students' learning by building on prior knowledge may be hampered by an overemphasis on pace (often interpreted as speed)." (Myhill & Brackely, 2004, p. 272).

The approach to the development of mental computation can only be described as spurious and analysis of the requirements only reinforces the appropriateness of the 'loosely hierarchical' descriptor that has been used by many to describe it. Many of the statements made are contradictory and the intent appears to be to encourage students to intuitively develop their own mental strategies. But when the prescribed teaching methods are analysed the emphasis is very much on explicit teaching. Is this really just guided instruction or instructivism in another guise?

Much of the prescribed framework has merit. It is difficult to disagree with, for example, students being encouraged to develop a range of mental strategies, or the need to develop an understanding of the number system, or the expectation that

students must learn their basic facts in order to help facilitate a move to part-whole thinking. But, when compared to the logical and hierarchical structure of the New Zealand framework one is left wondering how British teachers can really come to grips with the intent of theirs; maybe, as is outlined in the Mathematics Education Review Group (EPPI, 2004) evaluation, they have not.

As the British "Framework" does not provide specific guidance for teachers the training videos appear to have done so. One of the aspects of the Strategy which observation suggests has been particularly quickly implemented in classrooms is the use of certain specific number "props" which feature in the training videos e.g. numberlines,100-squares, counting sticks, fan cards and individual number cards. However, the mathematical bases of these materials are not made explicit in the Strategy and their use in the classroom appears to be limited to the examples shown in the videos (Brown et al., 2000 p. 467).

An expected characteristic of British classroom practice is the provision of opportunities for students to discuss their mathematical activities and investigations. Such a practice gives teachers the opportunity to capitalise on child-invented strategies that would provide the key to understanding the operations of arithmetic. This is supported by Carraher, Nunes and Schliemann (1998). However, they suggest that these strategies need categorisation if any great benefit is to be gained from their use by classroom teachers. Further, it is felt that focus on the teacher's role in promoting students' thinking at a metacognitive level in order to gain efficiency with student understanding (Beishuizen & Anghileri, 1998) is needed both in the classroom and in research.

A Model NNS Numeracy Lesson

So what might a daily numeracy lesson for a Year 5 class (nine and ten year olds) look like? The following is an outline of a videoed lesson that was provided as an exemplar (model) and used extensively for inservice training. The lesson introduction involved the teacher telling the students the lesson outcome for the day (the aim of this particular lesson being to look at doubling), and that they would be looking at the two times table, which is also described as "multiples of two", (the first seven terms are generated by the teacher). Once that was completed the four times table (or

multiples of four) was generated by using the results of investigating the multiples of two. Lastly the eight times table was generated from the multiples of four, by doubling each answer to the four times table. A miscalculation was shared and interestingly enough, later in the lesson the teacher consciously asked the student who made this miscalculation a question that she knew the student would get right. It is explained that this was done to help ensure that that student didn't finish the lesson on a 'negative note'.

For the main part of the lesson students were requested to offer their 'favourite thee-digit number' e.g. 246 and other members of the class were asked to double it using the expanded numeration method (2 x 200) + (2 x 40) + (2 x 6). Discussion then moved onto why it is more challenging to double a number like 37 than 23. The students were once again encouraged to use the expanded numeration method when exploring this idea e.g. 37 = (2 x 30) + (2 x 7). After these practice examples had been completed 'controlled differentiation' took over and the class was divided into two groups. The 'first group' contained the more confident students. They stayed on the mat and looked at the Egyptian doubling method of long multiplication (which involves multiplication by 10 and two [doubling]); it was stated that this would reinforce the idea that there is 'more than one way to strategise'. The 'second group' containing the less confident students stayed at their desks and did more practice of the original doubling activity. Finally in the plenary part of the lesson (lesson conclusion/warm down) the whole class played a game called 'Whizz' and then, in order that the lesson conclude on a positive note the, teacher told the class to applaud themselves. One of the concluding comments in the presentation was that in their next lesson this class would move on to learning a new concept re meeting a new learning target (Straker, 2000, Video – *Numeracy in Action*).

The learning outcome for the model numeracy lesson was to look at doubling. For what purpose? Granted, one of the key aims of the NNS was to foster the use of mental strategising when dealing with number. Surely the intent should have been to help make calculating mentally easier. To this end students need to be helped to identify efficient strategies and to recognise when it is best to use them. Doubling can be an effective strategy and students need to be able to make the distinction that doubling is effective when solving problems like 44 + 46 (45 + 45), but it is not when

you are confronted with a problem like 35 + 23. This is an example of where the lack of specificity in the "framework" generates problems. Judicious choice of examples by the teacher seems eminently more appropriate than eliciting the students' favourite numbers to investigate. Once students have identified when doubling is an effective strategy to employ they could then demonstrate their understanding (the fact that they have abstracted the concept) by suggesting suitable examples for other students to solve by using a doubling strategy.

The fact that the recommendation is that this class (or for that matter any class) would move on to learning a new concept for new each lesson raises a real concern. This is, whether those students who do the 'easier' work can really be considered to have met the learning outcome for that lesson. Strategising can be difficult and often the most effective strategies are the most difficult to master. If mathematics learning is the result of the making of abstractions and the ability to demonstrate this knowledge in a variety of situations (von Glasersfeld, 1992), then how can these students have internalised the concept(s) being taught?

The use of mental strategies is promoted; the intent being to encourage students to develop (intuitively) their own mental strategies. But, when the prescribed teaching methods are analysed, the emphasis is very much on explicit teaching in order that the requirements of the prescribed programme are met and that the students are ready for the half-termly tests (Myhill & Brackley, 2004).

Research into the Impact of the NNS

The following statistics, prepared by researchers at King's College, London, were published in the Times Education Supplement on 27th June 2003:

- Nine year olds who had worked on the National Numeracy Strategy for two years were found on average to be only two months ahead of those taught before its introduction. The scores of the least able were actually worse.
- Students' grasp of multiplication and division had declined.
- What gains there were, were found to be the result of teachers teaching to the tests and not as a result of improvement in the use of strategies.

(Mansell & Ward, 2003)

In 2002 similar concerns had been expressed in the same newspaper when the results of an extensive longitudinal research study involving nearly twelve hundred science undergraduates, undertaken by Vicki Tariq at Belfast's Queens University, had been released. The results presented put the view that universities could no longer assume that their entrants (including those possessing formal mathematics qualifications) were 'numerate individuals' as defined by the government's Numeracy Task Force (Tariq, 2002). Despite the fact that increasing numbers of students in their intake had been exposed to the NNS there had been a decline in some basic numeracy skills.

There are a variety of reasons why the NNS has not been the success that was hoped for. The Mathematics Education Review Group (EPPI, 2004) investigation into the impact of the official endorsement of Interactive Whole Class Teaching was damning of the approach chosen. During their research they chose a sample group of teachers, half of whom because they were considered to be highly effective, and the other half because they were perceived as only making average progress with students. Both groups of teachers in the sample were revealed as having no clear concept of what whole class interactive teaching was despite the fact that 70% of them had received the mandatory training in this. The findings also suggested that traditional patterns of whole class interaction have not been dramatically transformed by the NNS and that only one discourse, general talk, was significantly different between the two groups in the sample.

This report also drew two other significant conclusions. The first of these was that they believed that the apparent success of the NNS may have been a reflection of greater teaching for the test, and that careful consideration had to be given to examining how the national assessment of student progress was constraining time and pedagogy in ways that were undermining the development of students' mathematical understanding. The second was that there was a major need for further in-service training for teachers (EPPI, 2004).

In another parallel research study, teacher-directed interrogation of students' knowledge and understanding was also found to be the most common form of

teacher/pupil interaction, where teacher questioning was rarely found to go beyond the recall and clarification of information. Most questions asked were of a low cognitive level and were designed to funnel students' responses to a required answer. Some teachers encouraged higher levels of pupil interaction through open questions and through feedback that went beyond evaluation of the pupils' answers (i.e. probing and the use of uptake questions) but even then seventy percent of the time pupils were providing answers of three words or fewer (Myhill & Brackley, 2004).

The New Zealand Experience

The Report of the Curriculum Review (Committee to review the curriculum for schools, 1987) recommended that there be a national curriculum for all schools from Years 1 – 11 and that this curriculum be given status by regulation. As well it envisaged that many of the current practices existent in schools would have to undergo change, and concluded that many schools were not succeeding in enabling students to be "successful learners". However, in line with previous New Zealand initiatives, the Government continued to allow schools to interpret the requirements of the curriculum, taking into account "local needs, priorities and resources". So the Government avoided explicitly imposing a "cut-and-dried philosophy" onto schools; quite the opposite of the situation in Britain.

In 1997 the Minister of Education set up a government taskforce whose brief it was to give an indication of the direction government education policy, funding, and resource allocation might take in order to address the prime concern highlighted by the Third International Mathematics and Science Study; to raise achievement in mathematics. A decision was made that the emphasis would be placed on establishing professional development programmes for teachers; particularly in the area of numeracy. The Ministry of Education responded by producing *Developing Mathematics Programmes* (1997), the *Connected* journal series (1998) and the *Figure It Out* series in an endeavour to provide teachers with the resources that they could use to help effect the change that was desired (Nathan, 2001).

In 1998 additional impetus was given to the move for a change when the Government launched a national numeracy initiative. The intention was two-fold; firstly to have students who demonstrated numeracy and secondly to raise overall achievement in

mathematics. The development of this was delegated to a special taskforce whose role it was to investigate and evaluate developments overseas, particularly the initiatives that had been developed in Britain and Australia. The taskforce initially focused on the British experience but one of its members who had an extensive knowledge of the Australian "Count Me In Too" numeracy programme, and recognised the benefits of this programme over what had been developed in Britain, managed to move the focus to the Australian initiative.

In 1998 Peter Hughes, Auckland College of Education, had successfully implemented a course, "Helping Children Succeed in Mathematics", which drew upon the key tenets of the Australian "Count Me In Too" numeracy remediation programme. It was so well received that when Ministry of Education contracts for pilot teacher professional development programmes were let later that year the Auckland College of Education was successful in applying for the contract. A consequence of this success was that in 1999, the Ministry of Education convened a Junior Mathematics Review Group to provide direction for mathematics at the junior school level. The key directions identified were: that number should be the core focus of Levels 1 and 2 in the mathematics curriculum, that an early number learning framework be developed along with a diagnostic tool for assessment, and that associated professional development for teachers be provided. In the same year, the development of a national number framework was undertaken and this resulted in the development of the Early Number Project for Years 1 - 3, the Advanced Number Project for Years 4 – 6, and a Numeracy Exploratory Study for Years 7 – 10. At the end of 2000 the Ministry convened a reference group for what was to become the Numeracy Development Project (NDP), an amalgamation of the Early, Advanced and Intermediate Numeracy Projects.

The NDP was not just another resource but a thrust to change the way teachers deliver the mathematics curriculum. To this end the Teaching Model, based on the work of Pirie and Kieren (1994) was developed. The express purpose of the model is to provide a structure for the teaching of Number and the change desired is one where students are changed from being passive receivers of rules and procedures into individuals who can communicate and reason mathematically (Hughes, 2003). As students progress through the strategy stages teachers, through judicious choice of

examples, are encouraged to get students to investigate a range of strategies (both effective and ineffective) and to help them discriminate which ones are the best for solving particular problems.

The clear focus regarding strategy development is on learning being based on clear constructivist principles and group teaching (as opposed to the direct teaching approach adopted in Britain) and the development of thinking skills. Herein lies the key difference between the British and the New Zealand projects; in New Zealand there are clear research-based frameworks (that demonstrate a clear learning progression), and a teaching model on which teachers can structure their teaching practice.

Alton-Lee and Nuthall (1990) state that most reforms fail because they do not focus on pedagogy. The premise is that if teachers cannot personally engage in a project, as appears to be the case in Britain because teachers have not been provided with a clear framework and rational teaching model, then it will not work. In New Zealand, the Numeracy Project is an attempt to develop an integrated number framework based on research findings about how people learn, and that links students' mental strategies across different operational domains.

Teaching Approaches

Constructivists advocate the use of manipulative materials to aid understanding of concepts in that what begins as a manipulative action is internalised and eventually becomes a mental action whereby students can work with number relationships in an abstract way. This approach has been adopted for use in the New Zealand number projects. The development of the Teaching Model arose from the realisation that materials per se do not deliver understanding, and that to link the materials to abstraction a bridge or an imaging stage is required. Being able to visualise is the bridge and students are made to focus on the number properties by fact that the numbers they are asked to deal with are "pushed up" to a level where images are no longer possible and an abstraction of the concept is required. Whereas British teachers are bound by the constraints imposed by the structure set out for the 'daily numeracy lesson', in New Zealand, where there are no such exemplars but rather suggested planning formats, this is not the case. A case in point; controlled

differentiation as such is not required in New Zealand. Instead students work at their own pace (in order to be able to accommodate learning and for them to make the necessary abstractions) and are continually challenged to move ahead. The model, however, is recursive, in that students are allowed to fold back in order to prepare themselves to 'push ahead'/be 'pushed' ahead again. Furthermore, in New Zealand, modelling is done as much by the students as the teachers and students are encouraged to reflect on and analyse suggested strategies rather than ultimately being told by the teacher.

The New Zealand Number Framework

The New Zealand Number Framework, unlike the British, has a definite structure and is hierarchical. It has two parts, the *Number Framework – Knowledge* and the *Number Framework – Strategies*. The strategy framework consists of three stages that involve increasingly sophisticated counting skills, and then four stages that use increasingly complex part-whole strategies. The knowledge framework is based on the premise that "strong knowledge is essential for students to broaden their strategies across a full range of numbers and is often the essential prerequisite for the development of more advanced strategies" (Ministry of Education, 2004, p. 6). The clear message here is that teachers could employ teaching methods, by their very nature more behaviourist, to ensure that students gain this knowledge.

New Zealand Teachers' Professional Development Programme in NDP

The clear focus in New Zealand has been on teachers developing teachers' pedagogical content knowledge. The premise is that knowledgeable teachers determine the success of our schools. "Teachers who know a lot about teaching and learning and who work in environments that allow them to know students well are the critical elements of successful learning" (Darling-Hammond, 1998). Shulman (2004, p. 99) takes this a step further when he states that it is "the ways of representing and formulating the subject that make it comprehensible to others" that is of prime importance. If teachers do not have the ability and confidence to personally engage, (that can only be brought about by effective professional development) the much-hoped for changes will not eventuate. In New Zealand there is a belief that an emphasis on ongoing collaborative professional development that focuses on teachers assessing their own performance and not just following a prescription is the answer.

This assertion is supported unequivocally by the results of a review of research on collaborative professional development undertaken in 2003. In all but one of the studies reviewed there was a link to improvements in teaching and learning. The factors that made it work were: use of external expertise in terms of the aspect of pedagogy being explored, a strong sense of accountability to colleagues and students, provision of scope for teachers to set their own focus (to help them meet their own needs), processes to encourage, extend, and structure professional dialogue, and processes for sustaining development over time in order that new (effective) practices can be embedded into classroom settings (Cordingley, Bell, Rundell, & Evans, 2003).

Comparisons

At the heart of constructivist perspectives on learning is the significance of prior learning; not just the prior knowledge of facts (that can be determined by the use of pretests) but an understanding of the underlying principles and generalisations. It is the responsibility of teachers then to identify not only what a student knows but more importantly what they almost know and what misconceptions they might have. Myhill and Brackley (2004) make it clear that this is not the case in Britain. They reported that the teachers involved were very clear about what their pupils were expected to learn, and the activities they intended to use to achieve these, but there was little evidence of these teachers consciously planning lessons that started with, or incorporated, activities to access or check on pupils' prior knowledge of understanding.

It is becoming apparent that undue emphasis on curriculum objectives directs attention to what is to be learned, but deflects attention from consideration of cognitive building blocks and how one learning experience or conceptual understanding can support the development of subsequent learning. Also the pace at which teachers are required to meet specific outcomes no doubt impacts upon their ability to scaffold their students. Overall the findings suggest that 'top-down' curriculum initiatives like the NNS, while bringing about a scenario of change in curriculum design, often leave deeper levels of pedagogy untouched (Smith, Hardman, Wall & Mroz, 2004).

These findings bring into question not only the requirements of the British national curriculum but also the effectiveness of the in-service training programmes that have accompanied the NNS. Research into the effectiveness of the NNS supports the assertion that the British professional development model was flawed. The findings were that, while some studies in the 1990s had shown a correlation between whole class teaching and attainment, there was also significant evidence that whole class teaching can be associated with particularly poor results. The most important conclusion drawn was that it is the quality of the teacher-pupil interaction that is prime importance, not class organisation (Brown, Askew, Millet & Rhodes, 2003).

In New Zealand, when schools choose to take part in the NDP, the professional development model employed involves teachers receiving the long-term (up to two years) support of numeracy facilitators whose role it is to act as mentors. This involves workshops at which the number frameworks are introduced, use of the diagnostic interview is modelled, and familiarisation with the book resources (provided by the Ministry of Education) takes place. As a key focus is sustainability, over the next two years of the development period facilitators make classroom visits that can (depending on the needs of individual teachers) involve: the facilitator modelling best practice; observing a teacher and providing feedback; or providing advice on effective classroom management techniques, in order to facilitate the development of an effective learning environment or an amalgam of these.

The professional development programme is strongly research-based and involves assisting teachers to develop classroom environments where the focus is on learning (and not behaviour management) and encouraging the exploration of child-centred approaches. There is evidence that long before the NDP was introduced that child-centred education was far from being the norm in New Zealand. There was a significant amount of group work but of limited effectiveness and genuinely collaborative work was rare (Hartley, 2003).

Whereas the focus of assessment in Britain is on external testing (that has been found to force teachers into behaviourist/instructivist practices in order that students have the knowledge necessary to succeed in the tests prescribed by government agencies) the focus in New Zealand is quite different. Numeracy facilitators help teachers to self-monitor, to determine initial student benchmarks in terms of knowledge and

strategy (the strategy stage or level of cognition the student is at) through administration of the NumPA diagnostic tool which involves a face-to-face interview; an opportunity for teachers to try and 'open up their students' heads' in an endeavour to identify how they process. The on-going emphasis then is on formative assessment, the tool used to determine the shape and the form of each lesson, and not summative as is the case in Britain.

Child-centred learning, the development of positive classroom climates (by taking the focus off classroom management) reflection, self-assessment, goal setting, extending pupils' thinking, socio-constructivist teaching methods for when pupils are learning strategies, and long-term collaborative professional development are considered to be paramount to the success of the NDP. It is all very well to promote the perceived benefits but just how successful has it all been?

An Evaluation of the NDP

Whereas the NNS has been labelled a "£400 Million Failure" (Hughes, 2003) results from the evaluations undertaken of the NDP have reported relative success. The Year 4 – 6 Numeracy Exploratory Study (for example Higgins, 2004) pinpointed some positive findings where student performance had improved across the six aspects of number monitored during 2003, and as was found in the 2002 study, this growth was irrespective of students' age, gender, ethnicity and school region and decile ranking. Gains were variable however, with students of Asian and European descent making greater gains at the more advanced levels in all the six aspects of number. Unlike in England where the performance of students in multiplication and division had 'declined', in New Zealand the percentage of students who were using part-whole strategies at the beginning of the 2003 evaluation was 22% whereas by the end of that year some 50% were. So, for the third year running, the majority had improved their performance during their participation in the Advanced Numeracy Project and the marked shift from counting-based to part-whole strategies was seen as being an important marker in judging that progress.

Earlier in this paper reference was made to the importance placed on "effective facilitation". The New Zealand Numeracy Project offers every teacher who takes part the opportunity to become what Darling-Hammond (1998) refers to as a "knowledgeable teacher". It appears that because of the facilitation undertaken

changes are occurring. The Advanced Numeracy 2003 evaluation reported some promising findings with teachers feeling that their professional knowledge and practice had been enhanced by participation in the ANP. Some of the teachers' perceptions were:

- Teachers saw the facilitators as an important factor in helping them bridge between their "existing" and new practices;
- Teachers had developed greater understanding of number and how they might teach it;
- Teachers developed a more detailed understanding of the different strategies that students might use to solve a problem and the number knowledge underpinning these strategies;
- Teachers found that the results of the individual diagnostic survey had a major impact on their teaching practice - the assessment provided information that led to changes in the organisation of their instructional groups. Teachers found that they were better able to focus on appropriate strategy and knowledge development than when working with mixed ability groups;
- Teachers believed they changed their interactions with their students by encouraging them to explain their mathematical thinking when solving problems rather than just providing the answer.
- Teachers believed that they had developed a better attitude towards mathematics and the teaching of it.

(Higgins, 2004, p. ii)

As this is the case then the agencies of the New Zealand Government, involved in the development of the NDP, have not imposed a cut-and-dried philosophy and teaching method onto schools. In New Zealand the control over curriculum and professional development detail has been left to competent teaching professionals and the focus has been on the development, by classroom teachers, of pedagogical content knowledge. Sadly the one way fits all approach by the British Government seems to have failed the students of that country.

References

Alton-Lee, A., & Nuthall, G. (1990). Research on teaching and learning: Thirty years of change. *The Elementary School Journal, 90*(5), 546-570.

Beishuizen, M., & Anghileri, J. (1998) Which mental strategies in early number curriculum? A comparison of British ideas and Dutch views. British *Educational Research Journal*, *24*(5), 519 -25.

Brown, M., Millett, A., Bibby, T., & Johnson, D. (2000). Turning our attention from the what to the how: The National Numeracy Strategy. *British Educational Research Journal, 26*(4), 457.

Brown, M., Askew, M., Millett, A., & Rhodes, V. (2003). The key role of educational research in the development and evaluation of the national numeracy strategy. *British Educational Research Journal, 29*(5), 655-672.

Carraher, D., Nunes, T., & Schliemann, A. (1998). *Street mathematics and school mathematics.* New York: Cambridge University Press.

Committee to review the Curriculum for Schools. (1987) *The curriculum review: Report of the Committee to review the Curriculum for Schools.* Wellington, NZ: Department of Education.

Cordingley, P., Bell, M., Rundell, B., & Evans, D. (2003). *The impact of collaborative continuing professional development (CPD) on* classroom *teaching and learning* (EPPI: Policy and Research). London: General Teaching Council for England.

Darling-Hammond, L. (1998). Teachers and teaching: Testing policy hypothesis from a National Commission report. *Educational Researcher*, 27(1), 5 –15.

Department of Education and Employment. (1999). *National numeracy strategy: Framework for teaching mathematics reception to year 6.* UK: Author

EPPI. (2004). *A systematic review of the impact of the daily mathematics lesson in enhancing pupil confidence and competence in early mathematics*. London: Mathematics Education Review Group, Institute of Education, University of London.

Hartley, D. (2003). New economy, new pedagogy. *Oxford Review of Education, 29*(1), 81-94.

Higgins, J., (2004). *An evaluation of the Advanced Numeracy Project*. Wellington, NZ: Ministry of Education.

Hughes, M. (2003). The national numeracy strategy: Are we getting it right? *Psychology of Education Review*, *23*(2), 3-7.

Myhill, D., & Brackley, M. (2004). Making connections: Teachers' use of students' prior knowledge in whole class discourse. *British Journal of Educational Studies, 52*(3), 263-275.

Mansell, W., & Ward, H. (2003). A £400m failure. Retrieved July 2, 2003, from hhtp://www.tes.co.uk/searchdisplay_asp?section=Archive&subsection=News+%26+opinion&id=379071&Type=0

Ministry of Education. (2001a.) *Education Statistics News Sheet, 10*(1). Wellington, NZ: Ministry of Education.

Ministry of Education. (2003). *Exploring issues in education: An evaluation of the advanced numeracy project 2002.* Wellington: Ministry of Education.

Ministry of Education. (2004). The New Zealand Number Framework 2004, Ministry of Education: Retrieved August 2004, from http://www.nzmaths.co.nz/Numeracy/2004numPDFs/pdfs.htm

Nathan, G. (2001). Mathematics in crisis: Initiatives in New Zealand. Auckland College of Education (Unpublished paper).

Pirie, S., & Kieren, T. (1994). Beyond metaphor: Formalising in mathematical understanding within constructivist environments. *For the Learning of Mathematics, 14*(1), 39-43.

Reynolds, D., & Muijs, D (1999). *Effective teaching: Evidence and practice*. London: Paul Chapman.

Robinson, P. (1998). Literacy, numeracy and economic performance. *New Zealand Political Economy, 3*(1), 143-149.

Shulman, Lee S. (2004). *Teaching as community property: Essays on higher education.* San Francisco: Jossey-Bass.

Smith, F., Hardman, F., Wall, K., & Mroz, M. (2004). Interactive whole class teaching in the national literacy and numeracy strategies. *British Educational Research Journal, 30*(3), 395-411.

Straker, A. (2000). The National Numeracy Project 1996-1999. In I. Thompson (Ed.), *Issues in teaching numeracy in primary schools*. (pp. 39-47). Buckingham: Open University Press.

Tariq, V. (2002). A decline in numeracy skills among bioscience undergraduates. *Journal of Biological Education, 36*(2), 76-83.

Video – *Numeracy in Action* produced jointly by NNP and the Hamilton Maths Project. [Year 5, 9 and 10 year olds in Tower Hamlets]
Department for Education and Skills (n.d.). *Numeracy teaching resources, reception to year 6.*

http://www.standards.dfes.gov.uk/numeracy/teaching_resources/reception_to_year6/?leaf=1