The Contested Notion of Sustainability: Possibility or Pipe Dream for Numeracy Reforms in New Zealand

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This paper provides a critique of the notion of sustainability situating the analysis in the context of recent developments in mathematics education in New Zealand It examines how the term sustainability is used internationally in the literature on curriculum reform and nationally with reference to the Numeracy Development Project I argue that the complexity and multi-dimensionality of the term is underestimated and it appears to have become an inappropriate slogan for the next stage of numeracy development in New Zealand

Issues of sustainability are of considerable importance to countries who have recently implemented major curriculum reforms in mathematics Over the last two decades, central government agencies in a number of countries including England, Holland, The United States, Australia and New Zealand have committed considerable financial resources to developing new ways of teaching mathematics and more specifically number Under the current reform programme, procedural mathematical knowledge, which focuses on using correct computational procedures, has been usurped by principled knowledge which involves students using key mathematical ideas and concepts to construct procedures for solving mathematical problems (Spillane, 1999) A significant dimension of the reforms has been the way that it has focussed teachers' attention on students' mathematical thinking and reasoning and provided ways to use the information to plan more effective teaching and learning programmes With the reforms now moving beyond the initial conception and implementation phases, the focus has shifted to sustaining the reforms in the longer term This signals a desire for the funding agencies to have feedback on the effectiveness of their substantial investments

The term "sustainability" appears to be used without a clear definition or shared meaning There are tensions between sustainability measured as improved student outcomes irrespective of how they are achieved and sustainability focused on the maintenance of pedagogical practices introduced at the outset of the reform programme If so, these pedagogical practices have not been clearly articulated At a recent National Numeracy Facilitators' Conference in Auckland 2005, there appeared a feeling of "we're now into doing sustainability" as if the original NDP largely had been completed In 2004 the Ministry of Education contracted numeracy sustainability pilot projects to the six School Support Services around New Zealand This ranged from the establishment of an e-learning environment in Auckland to the training and development of principals and lead teachers in Dunedin I believe that a number of recent discussions and projects on sustainability are repeating a traditional fixation of keeping something going over time with continued support from external providers In doing so however, these discussions trivialise the idea of sustainability They reduce it to maintainability, to the question of how to make the improvement last, and add little to the analysis of adaptation and institutionalization

This theoretical paper will critically analyse the national and international literature on sustainability of curriculum reforms by problematising key assumptions, asking questions about major claims and examining the tensions that stem from its complexity and multi-dimensionality The last section of the paper entitled "The Warning Signs" examines the

NDP using Earl, Watson and Torrance's (2002) dimensions of sustainable change in schools; motivation, capacity and situation This provides some words of caution and challenges for the future of the NDP in New Zealand Interwoven through the analysis are issues regarding funding, resourcing, and power These lie at the heart of any discussion on sustainability Davison (2001) suggests that questions concerning sustainability are essentially normative and therefore "any answers they prompt are essentially contestable" (p ix)

Defining Sustainability

Historically the term sustainability was popularised by the World Commission on Environment and Development, who recognised that notions of sustainability were embedded in economic theory and promoted "limits of growth" and "green discourses" in the early 1970s They suggested "interpreting and applying the concept of sustainable development was increasingly viewed as a way to promulgate just and practicable economic, environmental and social policy" (Lumley & Armstrong, 2004, p 367) The concept subsumes a number of ideas such as inter- and intra-generational equity, concern for the future, altruism, the conservation of nature and balanced development

More recently, when applied to curriculum reform, the term focuses on a concern for the future of reform initiatives Wright (21 January 2005, personal communication), a lead developer of the NDP in New Zealand suggested that sustaining the NDP involved schools having consistently high quality teaching of numeracy across their classes and evidence of the use of student achievement data to inform teaching and learning He noted that sustainability could be measured as gains made in student achievement by using such tools as GloSS (Global assessment Strategy), asTTle, (Assessment Tools for Teaching and Learning) Exemplars and NEMP (National Education Monitoring Project) items

Hughes (2005), another lead developer of the NDP in New Zealand made a similar point Sustainability is "paradigm shifts in pedagogy remaining embedded for a prolonged period of time…measured by student achievement data…The programme remains after the support is withdrawn" (29 January 2005, personal communication) Key New Zealand numeracy project researchers such as Higgins (2004) completed an evaluation of the Advanced Numeracy Project (for students in years four to six) and devoted an entire chapter to sustainability   In her opening statement, she argued "issues of sustainability are important to any externally generated initiative with the ceasing of external support The degree to which the essence of the project is reflected in sustained classroom practices is governed by the extent to which teachers within a school internalize the classroom implementation" (p 53) These notions of sustainability are interesting given the fact that some recent sustainability projects have involved external agents continuing in a professional development role in schools Earl, Watson and Torrance (2002) used the term "embedded" as a descriptor for sustainability of the national literacy and numeracy strategies in England They stated: "We are now particularly interested in sustainability - how to embed the reforms so that improvement continues when the National Numeracy Strategy is no longer the centre of the educational agenda" (p 43)

Thomas and Tagg (2004) completed an evaluation of the New Zealand Early Numeracy Project (for students in years one to three) in 2003 They devoted a chapter to the sustained development of numeracy practices and report on the outcomes of data gathered to determine the inhibiting and facilitating factors in the sustained development of numeracy practices Fifteen schools participated in a longitudinal study, and through a combination of interviews and questionnaires, teachers reported on the extent to which

they had sustained numeracy development practices in their schools The authors concluded that the NDP:

> …is continuing to have a positive impact on student achievement in number and in mathematics more generally Most of the teachers indicated that they fully incorporated numeracy practices into their mathematics programme and would do so in the future   The schools had implemented a number of practices to ensure the sustainability of numeracy practices including school-funded visits from numeracy facilitators, lead-teacher-managed classroom observations, and staff meetings for reviewing numeracy practices and evaluating student progress (Thomas & Tagg, 2004, p 64)

They classified principals and lead teacher thoughts on sustaining numeracy practices into three categories: ongoing external facilitation, internal facilitation and supporting new and beginning teachers   These responses highlight the diversity of understanding of the term sustainability within the education community   These respondents felt that external support was a key factor in sustaining the project in the longer term   This point is disputed by Hughes (2005) and Higgins (2004)

The methodology of Thomas and Tagg's (2004) research was limited to interviews and questionnaires It did not include classroom observations to support or refute information gained from interviews and questionnaires This could be a significant omission In his research on numeracy reforms in California, Spillane (1999) discovered what teachers stated on a questionnaire with reference to reformed practice and what they did in the reality of a classroom proved to be two very different things Despite the 25 teachers indicating that they were teaching in ways that were consistent with the core elements of mathematics reforms, classroom observations confirmed some evidence of "reformed practice" in some of the 25 classrooms 11 of those teachers showed no evidence of changes in the core instruction in mathematics whilst there were significant changes in only four classrooms Spillane's research supported the importance of following up self-report data with classroom observations

Century and Levy (2002) distinguished between programme maintenance and programme sustainability A programme was maintained if its basic elements were well established and part of standard practice, while sustainability stressed the importance of adapting to local conditions and improving in response to internal and external changes They perceived the maintenance phase as being an essential precursor to programme sustainability This would be supported by those who believe sustainability is fostered when a process of mutual adaptation occurs Snyder, Bolin & Zumwalt, (1992) and Berman & McLaughlin (1978) maintained that some level of local development or adaptation seemed necessary to sustain curriculum reforms particularly when teachers were implementing a highly structured model (Datnow & Castellano, 2000) as in the case of the NDP This process of adaptation or institutionalization involves additional design efforts to ensure a strong fit to the unique circumstances of each school (Datnow, Hubbard & Mehan, 2002) New practices are integrated effortlessly into teachers' repertoires, and affect many teachers, not just a few (Anderson & Stiegelbauer, 1994)

A recent article by Bobis et al (2005) commented on three large scale numeracy development projects: the New South Wales "Count Me In Too" project, New Zealand's NDP and the Victorian Early Numeracy Project examines the sustainability of the projects The section on sustainability of the New Zealand NDP highlighted four key aspects being incorporated into the project   These included:

- The establishment of Numeracy lead teachers in each school
- Building communities of professional practice both within and outside the school context

- Aligning school management and classroom practice
- Providing on going access to support from outside the school through, for example facilitator's visits and access to on line resources

In their view, sustainability includes a reliance on continued external support and building professional learning communities

I believe it will be helpful to view sustainability as the development of a school's capacity to manage and internalise change without external support A challenge for the future is to gain a better understanding of the explicit and implicit standards used to determine the sustainability of a curriculum reform project

Measuring Sustainability

In an examination of the international literature, tensions exist between a focus on sustainability as a process measured by improved classroom practices, teacher professional development and training opportunities, teacher content knowledge and pedagogical practices and sustainability measured in terms of outcomes, namely raised student achievement The first "process" camp includes Century and Levy (2002) who stated "sustainability is the ability of a programme to maintain its core beliefs and values and use them to guide programme adaptations to changes and pressures over time" (p x) Their focus is on the process of sustainability with little mention made of the maintenance of enhanced student outcomes They believe the learner is the ultimate beneficiary of the reform enterprise

Similarly, Mehan, Datnow and Hubbard (2003) focused on the ability of reforms to endure over time, by involving staff in ongoing professional examination, reflection and examination of instructional practices within a learning community Of course measuring conceptual change or enacted pedagogical processes is arguably more challenging than improvement in student learning   In addition Sherry (2002) also noted that an important distinction should be drawn between sustainability and institutionalisation When an innovation has been institutionalised, the change is no longer seen as a change, but has become invisible and is taken for granted Interestingly, The World Bank Group (1999) also noted that environmental policy reforms remained vulnerable to political change until they are fully institutionalised

The second "outcomes" camp, (Hopmann, 2003; Hamilton, McCaffrey, Stecher, Klein, Robyn, & Bugliara, 2003; Stoll, 1999; Timperley & Wiseman, 2003; Hargreaves & Fink, 2000) place greater emphasis on sustainability as gains made to student achievement being maintained over time There is a growing body of work however, that raises questions about using achievement data to determine the sustainability of a reform Based on his evaluation work in the United States, St John (2002) questioned the fundamental logic of sustainability based on improved test scores He disputed the idea that focusing on student outcomes will provide incentives and guidance for sustained curriculum improvement This narrow focus can drive out valuable content that is not included in tests He has suggested that schools lack the basic capacities to design, initiate and sustain on-going instructional improvement and that an ever increasing number of financial and political constraints make sustaining reforms very difficult Likewise, Cuban (2000) claimed test results proved to be an ambiguous measure of a reform's success He made reference to the use of Scholastic Aptitude Test scores in American public schools being touted as reliable measures of school performance and thus a measure of curriculum reform, despite the test-makers repeatedly stating that such claims were false In a later paper Cuban (2002) also argued that teachers should seek additional forms of evidence of sustainability apart from

test scores such as students acquiring certain attitudes and values In addition, Fullan (2002) also sounded a word of caution in focusing on sustainability as achievement scores He noted that as literacy and mathematics scores increased (England for example had gone from 57%/54% success rates for 11 year olds in 1996 to 74%/72% success in 2001 for literacy and mathematics respectively), the morale of teachers and principals was declining He believes that there is a fundamental flaw in current approaches to reform because they address the symptoms (achievement scores) and not the underlying problem (the working conditions of teachers)

A further issue examines measuring a programme's sustainability when the innovation invariably departs from the original design   How much change is acceptable? Which is more important in the quest for sustainability; longevity of the project's vision and goals, or working to have the project survive in any fashion? Hamilton et al (2003) state: "The obstacles researchers face when evaluating such programmes include variations in the implementation of the reform combined with a lack of information about actual changes in practice; variation in outcome measures available across sites; and a lack of a straightforward set of analytic methods applicable to replicated cases" (p 1) Their work on large scale reforms in mathematics and science in the United States outlined the difficulties in determining whether improved outcomes were associated with the desired changes in practice In order to do this, implementation needed to be measured directly and associated with changes in student performance In a critique of their own work, they stated their surveys, for example, addressed only the frequency with which teachers used particular practices and did not address the ways in which they were used or the overall quality of the instruction Multiple classroom observations, interviews and inspection of classroom materials would have undoubtedly provided a better measure of instructional practice Research into the long term success of Reading Recovery has suggested that the long term effect of an intervention is difficult to measure because there are many intervening variables which can influence a child's achievement and progress These may include the quality of subsequent classroom instruction, promotion and disciplinary policies, student's health, mobility and individual life circumstances

The Warning Signs

Earl, Watson and Torrance (2002) have identified three key dimensions of sustainable change in schools; motivation, capacity and situation   These provide an outline for considering the challenges regarding the future of the NDP in New Zealand

Motivation

Ultimately any changes that occur in schools happen because of the motivation of individual teachers teaching children in classrooms (Earl, Watson & Torrance, 2002) Teachers make changes when they are motivated to change, have the capacity (skills and knowledge) to change and get on-going support to make change happen   Externally derived motivational cues only tend to work when the external pressure is in place When the pressure is gone, the associated behaviour may disappear   Such pressure may serve the accountability requirements but it is unlikely to have a lasting impact on the way schools operate or the way teachers teach

In subsequent years, there is likely to be a greater proportion of teachers participating in the NDP with less commitment to mathematics learning and teaching than those involved in the project initially In Young-Loveridge's (2004) report entitled "Analysis of Patterns of Performance and Progress on the Numeracy Projects 2001-2003", she noted

that students who participated in one of the projects in 2001 achieved at a slightly higher level than those who participated in 2002 or 2003 She discussed several possible reasons for this pattern One explanation centred on the characteristics of different cohorts of teachers involved in the projects at different stages of the implementation process This will present many challenges for the NDP in the future In addition, the daily reality might indicate an uneasy juxtaposition between the particularities of the interpretivist world of individual practitioners, as they grapple with the reform and the overall general structuralist order of the numeracy reform agenda

Capacity

Capacity refers to the power to engage in and sustain continuous learning of teachers and the school itself for the purpose of enhancing student learning Datnow and Stringfield (2000) draw attention to the importance of local infrastructure in maintaining reforms while Fullan (2000) reiterates that negative school cultures and fluctuating policies all take their toll on the fragile foothold of reforms once the central driving force recedes St John (2001) makes this point well How can those already overloaded in operating the system, also find time, energy and expertise to improve, maintain and monitor the system? He describes another paradox; "The more innovative a curriculum is, and the more it is different from a traditional curriculum, the more it needs on-going support and maintenance" (p 8) Coburn (2003) highlights issues of competing priorities for schools "Sustainability may be the central challenge of bringing reforms to scale Schools that successfully implement reforms find it difficult to sustain them in the face of competing priorities, changing demands and teacher and administrator turnover…" (p 6) The next stage of the NDP may well be to strengthen efforts already underway to build professional learning communities both within and across schools

Student achievement data and evidence are increasingly important dimensions for educational decision making (Timperley & Wiseman, 2003) Although evidence is valued to inform decisions, many teachers are not sufficiently data literate to interpret and use it appropriately (Earl, 1995) A key step for the long term development of the numeracy projects in New Zealand is continued teacher professional development in data collection, aggregation, interpretation and use This should include factors that are associated with the highest levels of student achievement

Numeracy leaders need to be developed at many levels within the school Fullan (2001) points out "the main reason that change fails to occur in the first place on any scale, and does not get sustained when it does, is that the infrastructure is weak, unhelpful or working at cross purposes" (p 18) Traditionally schools have one to two numeracy leaders This could be broadened to one or two within each team of teachers within a school

Situation

Implementing a curriculum reform initiative typically involves a short term influx of resources, professional development and other forms of assistance to facilitate the implementation of the project in the school which then dissipates over time after the external support is withdrawn (Coburn, 2003) Most would describe the NDP as highly prescriptive with high levels of compliance required for successful implementation Young-Loveridge, (2004) argues that this does not necessarily bode well for long term sustained practice in the future She notes "In some places, there is evidence that attention to the strategies might be short-lived, superficial compliance" (p 39) On the other hand Datnow and Castellano (2000) have proposed that externally developed reforms that are

more clearly defined tend to be implemented with greater commitment and in turn, tend to have stronger effects on teaching and learning than reforms that are less clearly defined In future, schools will need to balance this prescriptiveness with the need for flexibility; teachers to exercise choices, to see purpose in their learning, and to have opportunities to develop their voices (Lieberman & Wood, 2003)

Young-Loveridge (2004) also argues there is a vital need for more Maori and people of Pacific Island backgrounds to be involved in the NDP at all levels, particularly as facilitators working with teachers in schools where there are large numbers of Maori and Pacific Island students With these ethnic groups increasing as a percentage of the total population and the achievement data suggesting that these students are achieving at lower levels compared to other ethnic groups (Thomas & Tagg, 2004), this needs to become a priority in the future

Conclusion

One could argue that if widespread, sustained change is not typically the result of curriculum reform then the rationale for making this type of large-scale transformation of mathematics teaching is questionable There is no doubt that the NDP has made significant changes to the way number is taught and learnt in New Zealand primary schools All three dimensions of sustainable change, described in the previous section suggest the NDP has a delicate, somewhat tenuous hold in New Zealand primary schools with the Ministry of Education and developers needing to remain vigilant   The changes are not yet entrenched enough to continue without consistent pressure and support, which will be necessary for the foreseeable future

The term sustainability needs to be clarified Studies that examine reforms in their first few years of implementation fail to capture the essence of sustainability It is time to clarify a confusion Arguably, sustainability is not about a project It is about building on change and developing internal capacity for continued professional learning Perhaps the ultimate test of sustainability is what happens after all levels of government funding and external support are withdrawn from schools Until then, sustainability of the NDP is a global ideal that, in its entirety, is challenging to measure and perhaps unobtainable There is a need for new research designs better suited to capture the complex vision of sustainability The current emphasis should be focusing on investment in individual capacity-building, local creativity, reflection through goal setting and networking Further work might include gaining a better understanding of the explicit and implicit standards used to determine the sustainability of a major curriculum innovation such as the NDP and determining which ones carry the most weight and why

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