

A critical examination of mathematics in the New Zealand curriculum

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Introduction

Mathematics in some form or other has been part of the primary education curriculum in New Zealand since at least the provincial period. It is interesting to note that for many years the mathematics (or arithmetic) curriculum was written by a central education authority and sent out to teachers in the field to be implemented. However, during the time of Beeby, Ewing and J.J. Lee, teachers' knowledge and input into mathematics curriculum development were taken as the norm (Biddulph & Taylor, 1995). This changed again following the restructuring under the so-called 'Tomorrows' Schools' initiative. Since about 1990, and with the demise of the Curriculum Development Unit in the former Department of Education, curriculum development in New Zealand has been privatised (but within central government control) and teachers have no longer been recognised as having an integral part to play in mathematics curriculum development - until this year! (For more on this last point, see our first recommendation at the end of this paper.)

Perhaps not surprisingly, the New Zealand curriculum documents have been the subject of considerable criticism from educationalists over the last few years. Much of this criticism stems from a feeling amongst educators that the curricula documents attempt to impose a New Right perspective on schools and their communities. Irwin (1999, pp.162-163) describes the effect of the new documents as turning schools into, "...production lines turning out workers with predetermined skills and attitudes".

Codd (1999, p.9) describes the New Zealand Curriculum Framework as, "...a curriculum for social control".

In addition to criticism of the latent intention of the curricula documents, the way they are structured has also attracted critical comment. Elley (1993) discusses the eight level progressive structure of the documents and concludes that the structure used has no basis in research. He cites Dr Peter Dines who noted during a visit to this country in 1991 that in England, "...the levels have been set where they are, chiefly on the basis of the subjective opinions of the teachers who served on the committees." The same is probably true in New Zealand. Elley also questions whether the sequencing of skills and knowledge actually provides a clear progression at all.

While views may be diverse, as they inevitably are when curriculum is the topic, it is clear that there is a need for indepth analysis of the documents. This paper provides an analysis of Mathematics in the New Zealand Curriculum (MiNZC) by examining some of the underlying assumptions inherent in the document, reporting on contradictions within it, and highlighting some of the more significant strengths and weaknesses. The paper concludes with some recommendations for the future.

Assumptions Underlying MiNZC

MiNZC was developed in a political environment dominated by New Right ideological thinking. Otherwise known as 'neo-liberalism', New Right ideology holds that individualism, competition, accountability, market

forces and choice are (or should be) the basic tenets of society. Many of the assumptions that underpin MiNZC are therefore based on the premise that a neo-liberal society is the society that New Zealand should be aspiring to.

MiNZC assumes that New Zealand society should be an individualistic one. Biddulph, Taylor and Biddulph (2000) note that this form of society is characterised by notions of private gain and education as a commodity leading to the betterment of people as individuals. This is promoted through the initiation, development and distribution of MiNZC by the central Ministry of Education. The implementation is subject to central inspection (via the Education Review Office) and emphasises accountability through systems of student evaluation. Thus seen, the MiNZC document amounts to a form of social control intent on maintaining the status quo and producing social conformity (Biddulph et al, 2000). It is characterised by a focus on standards to be attained, which revolve around skills deemed necessary for the society the authorities aim to develop.

The MiNZC document assumes that schools are (or should be) technocratic institutions. Neyland (1995) suggests that technocratic schools are symbolised by industrial type processes where students are considered outputs which have to meet certain 'quality control' standards represented by the achievement levels specified in MiNZC. According to Neyland (ibid.) the accountability through assessment emphasis inherent in MiNZC is a form of external control of teachers who need to demonstrate that they are producing the required outputs.

The MiNZC document is based on the assumption that curriculum serves utilitarian purposes in which curriculum is "...intended to develop the competencies and skills needed for work and industry..." (Biddulph et al, 2000, p.32). The document's emphasis on objectives and assessment against these

reinforces the utilitarian ideology underpinning MiNZC.

Another assumption underlying MiNZC is that curriculum needs to be initiated, developed and distributed by a central authority. The implementation of the MiNZC document, as part of New Zealand's Curriculum Framework, is subject to central inspection and emphasises accountability through systems of student evaluation, thus meeting the definition of centrally based curriculum development and control outlined by Biddulph et al (2000).

The MiNZC document assumes

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that there is a body of common essential knowledge that should be provided to all learners. The document assumes that all learners will acquire this knowledge sequentially; hence the eight levels of achievement in the document.

Essentially, the MiNZC document assumes a conservative view of curriculum.

Contradictions within MiNZC

MiNZC adopts a slightly confusing view of knowledge. It states (Ministry of Education, 1992, p.7) that, "...mathematics is a coherent, consistent and growing body of concepts..." which suggests that a dynamic view of knowledge informs the document. However, the specification of achievement objectives and levels suggest strongly that a positivist or static view of knowledge is being promoted. Since this is the view that resonates with most primary teachers it is this which dominates in most mathematics classrooms we

suspect; few teachers of our acquaintance help their children experience mathematics as a dynamic and growing human construction.

The MiNZC document also seems to contain a contradictory perception of the role of curriculum. The extensive specification of objectives in the document, and subsequently, in our experience, in teacher planning, suggests an academic rationalist conception of curriculum. This contrasts with the emphasis in the document on students using skills and processes in problem solving, and the assessment exemplars which suggest that teachers should test cognitive processes and their application.

Whilst MiNZC (Ministry of Education, 1992, p.12) purports to support the right of all students to, "...achieve to the maximum of their potential..." the actual design of the curriculum document is subject, not learner, centred. The intended curriculum focuses on students being taught mathematical content derived from the academic discipline of mathematics itself. This is a significant contradiction because it effectively defines the view of teaching and learning to be followed. In this sense the document appears to be written from a mixture of theoretical perspectives. The levels and objectives are distinctly behaviourist in nature, whilst many of the suggested learning experiences and assessment activities are evidence of a constructivist approach. Worryingly, students are assessed against the achievement objectives. In other words the purpose of assessment is to determine whether students have met predetermined achievement objectives, not to determine **what** mathematics ideas and strategies they have constructed from the learning experiences provided. In short, behaviourism rules and students achieving to the maximum of their potential takes on the ring of empty rhetoric. We discuss this assessment issue further below.

Also quite worryingly, Aikin (1994) suggests that the behaviourist

model of learning represented by the surface features of MiNZC may have long term negative effects upon primary programmes and practice. Aikin specifically directs her comments towards the assessment aspect and considers that the emphasis on assessing achievement objectives is linked to neo-liberal requirements for accountability. She believes that, while primary practice strongly emphasises formative assessment to monitor the learning process, the potential clearly exists for the levels of achievement specified in MiNZC to become curriculum performance indicators and therefore a means of assessing school performance. Thus the focus and use of assessment is summative, concentrating on the 'end product', not the process. The MiNZC document stresses the value of both formative and summative assessment, but our experience is that teachers are very focused on summative assessment due to a perception that 'students have only achieved something if it can be proven'. Brehony (1990) adds credence to this view when he suggests that curricula, such as MiNZC, that are based on supposed learning progressions almost entirely ignore the question of **how** students learn. Instead they focus almost entirely on knowledge and skills. Aikin (1994) adds that the learning progression structure of MiNZC focuses mainly on the observable and measurable aspects of knowledge and skills, which she claims are very limited. This is a major weakness of MiNZC.

Specific Weaknesses of MiNZC

Aikin (1994) writes that there was very little public debate about the new curriculum framework. Add to this McGee's (1997) belief that ownership of the curriculum is important if it is to be well implemented, and it means that MiNZC was fraught from the beginning. The hasty development and introduction of MiNZC left practically no time for teachers to be

involved in its development, thus leaving them excluded from the process and without meaningful input into the final document. Of course this is consistent with the centrally based curriculum development model, but it makes the implementation of the document in the classroom highly problematic.

Teachers report that the 'objectives' in MiNZC tend to be vague and open to interpretation. This is a serious weakness if they are supposed to be a guide to the mathematics that children are expected to learn. Teachers also

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report that MiNZC is overly wordy and jargonistic, fails to indicate the links between the various strands, and provides no rationale for why it is structured in the way it is.

Howson (1994) makes the point that MiNZC does not provide sufficient guidance to teachers about the relative weighting of each strand. He states that MiNZC asserts that all five strands are of equal importance at all levels. He quotes an English example in which English primary teachers continued to place an emphasis on number activities in their classroom programmes, in spite of the curriculum expecting that equal weight be given to all strands. In our experience, this also happens in New Zealand. Howson further suggests that the current structure is not based on pedagogical or sound mathematical reasoning, but more on bureaucratic convenience. This obviously lessens the quality of the document and is a strong justification for the inclusion of

classroom practitioners in any future MiNZC review team.

Although there is a whole section in MiNZC given over to 'Catering for individual needs' (p.12), there is no acknowledgment of which learning theories are underpinning the document. Worse, as indicated earlier, such learning theories as can be detected in the document (behaviourism and constructivism) are in conflict with each other. How do teachers cope with the potential confusion this causes? In our experience they tend to ignore one or the other, usually the second because the powerful bogey of accountability, coupled with the requirement that narrow sets of achievement objectives have to be met, virtually dictates the use of behaviourist assessment practices, despite the pleas in MiNZC for more constructivist forms of assessment.

Finally, the actual level structure of MiNZC has no basis in research or teacher experience, according to Elley (1993), which supports Howson's contention above. It is more likely that the levels structure is a political imperative, both Aikin (1994) and Howson (1994) making it clear that this structure forms a basis for external assessment of student achievement and therefore of school efficiency. The consequence is that MiNZC standardises mathematics teaching with that of other subjects, potentially negating more effective ways to teach mathematics. As Elley (1993) quite rightly points out, and contrary to the view of the government which initiated MiNZC, mathematics is **not** similar to other subjects; it has its own processes and pedagogical methods.

Specific Strengths of MiNZC

The vagueness in wording which constitutes a weakness of the document, can also be considered a strength. It is a strength because it allows teachers to interpret the document in ways that they feel best meet the needs and interests of their children. The development bands also allow teachers some freedom to

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plan curriculum experiences appropriate for individual students. This is in contrast to the experience of the first author in Canada where the curriculum document prescribes for grade level. Thus, all grade three students experience the grade three curriculum regardless of their individual needs. Howson (1994) welcomes the use of the development bands in MiNZC as a means of encouraging teachers to allow students to explore mathematical concepts in greater depth, or for longer periods if necessary, to gain greater understanding.

Practising teachers suggest that MiNZC has a distinctive layout that allows them to find information, 'objectives' and strands fairly readily. They also appreciate the helpful glossary included at the end of the document. Further, they appreciate that MiNZC portrays an activity-based curriculum as indicated in the statement that students learn effectively through applying concepts and skills in realistic, meaningful contexts, and as indicated in the emphasis throughout the document on problem solving. Unfortunately the honourable intention of MiNZC in this regard is hindered

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somewhat by both the number of unexplained or undefined terms in the document, and the ability of primary teachers to actually provide sufficiently meaningful interpretation of the activities and objectives. Howson (1994) suggests that terms such as exploring, relating, devising and so forth need further explanation and that such explanations should be contained within the document. Our own experience working with the document leads us to agree with Howson.

Recommendations for the Future

1. We believe that in any review of MiNZC cognisance must be taken of primary school teachers actual classroom reality, particularly their understanding of mathematics and their experiences of teaching it. In our view, primary teachers need more explanation of and guidance with the important mathematics ideas that they are expected to help children develop. In this regard we are really pleased to hear that Frances Kelly and her Ministry of Education team involved in the mathematics curriculum stocktake recognise that teachers are key figures in any curriculum development considerations, that their concerns must be sought, and that curriculum documents developed by the Ministry must communicate clearly with them (Biddulph, 2001).

2. The structure of eight levels of achievement also needs to be reconsidered. If the purpose of the eight levels cannot be clearly stated and justified, then an alternative design should be created.

3. MiNZC needs to be considered urgently in terms of its underlying assumptions, some of which we have tried to identify in this paper. We contend that this needs to be done within a context of full, open debate about the purpose of education and the type of curriculum expected by the New Zealand community at large. It is possible that a theoretically more consistent curriculum document would result, hopefully leading to more effective

teaching of mathematics. This debate would have to include an analysis of the hidden agendas contained with the present MiNZC. It seems imperative to us that curriculum development in mathematics needs to ensure that the problem of creating generations of primary school teachers and students who cannot think adequately for themselves and who often develop an aversion to mathematics is addressed squarely.

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