Literacy and Language Pedagogy within Subject Areas in Years 7-11

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Text Use: Students Need Opportunities to Engage with Text in Ways that are Valued by the Disciplines and by the New Zealand Curriculum Document

International research suggests that the texts encountered in mathematics and science change as students progress through their schooling. Texts ought to become longer, more complex and more subject-specialised (Carnegie Council on Advancing Adolescent Literacy, 2010). In New Zealand, by Year 10, the texts that students are required to be able to read will include those written for a general adult audience and have terminology, structures, organisation and conventions that may function differently in different subject areas (Ministry of Education, 2010). There has been limited research about how texts are or should be used in subject-area classrooms, particularly in mathematics (Moje et al., 2011), but in order to develop experience and facility using texts for subject specific purposes, students need both support and practice with the types of texts that are valued in science and mathematics if they are to become skilled users and producers of such texts and thereby progress beyond Year 11 study.

One purpose of text use in mathematics and science classrooms is to provide one of the means by which students can develop subject content knowledge. A second purpose is to provide some of the contexts to which students apply this subject knowledge. While we did see use of teacher-made texts to provide content knowledge, we also identified a paucity of use of subject-specific texts for both purposes.

There was very little evidence of written texts, including text books, as a vehicle for developing students' subject content knowledge. Most texts used were teacher developed and 'published' using whiteboards, PowerPoint presentations and photocopied hand outs – effectively teacher written notes. In general, students had few opportunities to engage with extended texts.

One, seemingly harmless, practice served to illustrate unintended ways that text use might be constrained. On the few occasions observed when students did have physical access to extended texts (e.g., books), teachers limited students' use of these texts by directing them to read specified pages only. We think there is the opportunity here to develop students' knowledge of how to use extended texts, for example, by giving them the responsibility to locate relevant sections using the contents and index pages. With some exceptions, it appears that in general the teachers were frequently reading and summarising written subject texts *for* their students, and that students may be better served by opportunities to learn to do this themselves.

In terms of the second purpose of texts, to provide contexts, we identified issues specific to each of the two subject areas.

4.1.1 Mathematics texts

In mathematics, we identified a mismatch in the use of texts used in mathematics classrooms and those used in NCEA assessment tasks. The NCEA assessments we analysed were predominantly word and context based whereas those observed in classrooms were predominantly number based. The exception was at Year 11, where word problems were a significant focus. Thus it seemed that word problems may have been absent from students' mathematics experience in prior years, indicating a missed opportunity for development of these mathematics literacy skills in previous years. There is a danger therefore that when introduced in Year 11, these may be perceived as new or difficult, rather than as an integral part of mathematics prior to Year 11. However, teachers' approaches to word problems tended to focus on algorithm identification and computation, rather than use or analysis of the language of mathematics problems. Therefore, students had few opportunities to wrestle with the problem deconstruction and voice their understanding of the language. Instead, teachers provided a paraphrased translation of the problem. The practice appeared to reflect a desire to avoid student disequilibrium or confusion. However, in offering such support teachers may have provided a solution rather than offering students independent strategies for resolving their difficulties and tackling difficult problems.

This is not to say that national examinations should be the primary driver of classroom practice, nor that number problems are inappropriate. Rather, we use NCEA as an important indicator of what is valued in the mathematics community. This trend towards more word problems is by no means peculiar to New Zealand and there has been a general trend toward more word problems in Europe and North America since at least the 1970s (Reed, 1999). In one sense, the continued privileging of number-based problems is understandable at least at the stage of initial learning of mathematical

concepts. Nevertheless, solving such problems requires more than the underlying mathematical knowledge and research indicates that students perform 10% to 30% worse on arithmetic word problems than on comparable problems presented in a numeric format (Abedi & Lord, 2001; Carpenter, Corbitt, Kepner Jr, Lindquist, & Reys, 1980; Neville-Barton & Barton, 2005). This suggests to us a need for students to engage in extensive practice working with the written contextualised problems which, while controversial with some mathematics teachers, seem to be valued in high-stakes assessments.

4.1.2 Science texts

In the New Zealand Curriculum document, the 'Nature of Science' strand specifies that students at Curriculum Levels 3 and 4 "[e]ngage with a range of scientific texts" and at Curriculum Levels 5 and 6, "[a]pply their understandings of science to evaluate both popular and scientific texts." In our sample, a limited range of texts was observed and we saw no instance of students applying scientific knowledge to evaluate popular texts. One explanation for the limited provision of opportunities for students to engage with text is that teachers were seeking an efficient way of delivering the required curriculum content. We acknowledge this as a real and important challenge for teachers but there are obvious risks with this practice. Some studies suggest that teachers might deliberately avoid using complex written texts with groups of students who struggle, or who are perceived to struggle, with reading. McDonald, Thornley and Fitzpatrick (2005) observed, for example, that Pasifika students in lower-decile schools tended to have fewer opportunities to read and write than their contemporaries in higher-decile schools. Internationally, this phenomenon has also been noted, with teachers modifying text book use according to the academic levels of their students (DiGisi & Willet, 1995). Thus, internationally there is potential that students expected to achieve at lower levels, may unavoidably do so because of limited opportunities to engage with a more challenging curriculum, or to engage in practices required at higher or post-school levels. In our study, it is possible that the very low instances of scientific texts might play out similarly in unintended, but negative, ways. While the features of scientific and mathematical texts make them difficult to read, we would argue that this provides more reason to support students to use these texts, rather than scaffolding learning in ways that in effect restrict their access. While we do not suggest that written texts supplant other ways of teaching content or providing meaningful contexts, we do suggest that written texts might be used more often for these two purposes.