BRIDGING THE GAP BETWEEN

THEORY AND PRACTICE

What impact do the national curriculum exemplars and the associated matrix have on teaching and learning in science?

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Abstract

Formative assessment continues to be influential in shaping teaching and learning. A National Assessment Tool, the Exemplars and associated Matrix have been designed and provided for teachers to support formative assessment practice. While considerable research exists on formative assessment, the impact of the exemplars and matrix on teaching and learning in science is unknown, therefore this Participatory Action Research study explores the impact on teaching and learning, assessment and the resultant teacher–student interactions in science learning.

Two schools were involved in the action research project in 2004. Seven teachers participated in the research study. The students ranged in age from five to nine years. Through in-depth classroom observations, planned interventions and semi-structured interviews, two major themes emerged: the teacher participants' science knowledge and pedagogy; and, their formative assessment practice and knowledge. Two sub-themes emerged and impacted on the major themes: the 'teacher as a learner', and the research/professional development model.

The matrix and exemplars were the vehicles for change and the findings of this research study, clearly show evidence of improvement to teaching and learning in science.

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To the wonderful teachers I worked with, thank you. You are indeed inspirational and a joy to work and learn with.

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Hold fast to dreams for if dreams die
Life is a broken winged bird
That cannot fly

Langston Hughes

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BRIDGING THE GAP BETWEEN THEORY AND PRACTICE

What impact do the national curriculum exemplars and the associated matrix have on teaching and learning in science?

CHAPTER 1: Introduction

This Participatory Action Research study is an investigation into the impact of the National Science Exemplars and associated Matrix on science teaching and learning. It aims to explore the impact on teaching and learning, assessment and the resultant teacher–student interactions in science learning. The impact of the exemplars and matrix on teaching and learning in science is unknown and has therefore led to this research.

A Ministry of Education research project (Poskitt, 2002), has followed the development and the early implementation of the exemplars and the effects of the exemplars on teaching and learning within curriculum areas. However, the national research study did not look at individual teacher development and use of the exemplars over time, which was the aim of this project. The present research will inform the researcher's practice and understanding as a science advisor and an assessment facilitator in the Ministry of Education Assessment for Learning project. Knowledge gained about the procedures and issues confronting teachers in using the National Exemplars and the Matrix will help shape future professional development in Science.

The exemplars and the associated matrix

The development of the National Curriculum Exemplars as a key component of the *National Assessment Strategy* (Ministry of Education, 2000) provided an alternative to National Testing of students at stages during their primary and intermediate schooling.

With recent research and thinking in assessment (such as Crooks, 1988; Sadler, 1989; Gipps, 1999; Clarke, 2001; Black, & Wiliam, 2002; Clarke, Timperly and Hattie, 2003), changes in the purpose of assessment occurred. Assessment 'for' learning, that is formative assessment, became more preferable to assessment 'of' learning, or summative assessment. Interest in national testing waned in favour of exemplar development, which would provide schools with a tool to moderate their own performance against a national standard and provide teachers and students with criteria and indicators of progression[1] to support their learning within specific curriculum areas.

According to the Ministry of Education (2002, p. 1) an exemplar is an "authentic example of student work annotated to illustrate learning, achievement, and quality in relation to the levels described in the national curriculum statement. Each exemplar highlights significant features of that work and important aspects of students' learning". Exemplars have been developed in each of the seven curriculum areas: English, mathematics, science, technology, social studies, health and physical well-being and the arts. The exemplars have also been developed in the equivalent Maori-medium curriculum areas. Features of the exemplars (see Appendix 1) are:

- Examples of student work both, in an annotated and unannotated form. Annotated samples of work demonstrate appropriate criteria and achievement.
- Links to the national curriculum document, and learning outcomes and teaching sequence according to a curriculum level.

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1 Progression: refers to significant changes in knowledge, skills, processes and concepts across time.

- 'Where to next', the next learning and teaching steps for students and teachers.
- Teacher-pupil interactions, which provide a model for eliciting what the children think and how their learning could be extended.

The associated matrices are a rubric-type framework, which specify key aspects of the particular curriculum area, and identify progress indicators for each of these aspects from novice (level 1) to expert (level 5). The progress indicators link closely to the annotations on the exemplars. The matrix has been divided into four categories or matrices of science:

- Developing interest and relating science learning to the wider world,
- Investigating in science,
- Thinking in scientific ways,
- Developing and communicating science understanding.

In each of the matrices the key aspects and progress indicators provide an insight into the nature of science, and teaching and learning in science. The matrices are linked to the contextual and integrating strands and the levels of the National Science Curriculum.

The research problem

Effective and appropriate formative assessment is increasingly being recognised as playing a crucial role in the enhancement of learning. Sadler (1987) and Gipps (1999) argue that the use of 'concrete models' and frameworks (the exemplars and matrix) will enhance teaching and learning, and Gipps (1999) declares that exemplars can be used to explicate to teachers the nature of the skills being taught. As a result teachers' content knowledge can be developed. The aims of this research are to investigate the reality of these claims, in the absence of supporting research, and to explore the role of the exemplars and matrix in teaching and learning in science.

The research question

Therefore the overarching research question is:

> *What impact do the national curriculum exemplars and the associated matrix have on teaching and learning in science?*

Implicit within the overarching question are several sub-questions. These were asked of the teacher participants in order to elicit their ideas and thinking about the National Exemplars and associated Matrix and, especially, to generate discussion:

- In what ways do teachers interact with the exemplars and matrix?
- What are the changes on teaching and learning in science, if any, resulting from the interaction with the science matrix and exemplars?
- What factors have contributed to changes in teaching and learning in science?
- What are the outcomes for students and teachers?

To answer these questions, a Participatory Action Research (hereafter referred to as PAR) approach was chosen as it is underpinned by principles held by both action research and effective professional development. Such an approach focuses on problems that are of immediate concern to the practitioners, develops reflective practitioners, is a collaborative activity, is undertaken 'in situ', improves the congruence between theory and practice, is dialogical and celebrates discourse, is participatory, and changes the competencies of practitioners (Hult & Lennung, 1980, cited in Cohen, Manion & Morrison, 2000; Noftke & Zeichner, 1987, cited in Cohen et al., 2000).

The participating schools

Two schools were involved in the action research project in 2004. School A, an urban decile[2] four, full primary school (years 1-8) with a roll of 300 students; and School B, an inner city decile seven primary (years 1-6) school, of 350 children. Both schools had requested on-going adviser support with science or assessment. One syndicate from each of the schools, seven teachers in total, participated in the research study. The students ranged in age from five to nine years. Further detail is provided in Chapter Three.

Emergent themes

Data from each of the sources were aggregated into categories from which two major themes emerged as the teacher participants engaged with the exemplars and matrix. The major themes: the teachers' confused assessment practice (that is, the notions of progression in science and formative assessment practices); and the teachers' knowledge of science (that is, the nature of science, science conceptual knowledge, and science pedagogy). As the teachers participated in the PAR and worked with the exemplars and matrix, two sub-themes were revealed: the 'teachers as learners', and the nature of the PAR and the professional development model. The sub-themes influenced the way the teachers participated in the action research and the way in which they interacted with the matrix and exemplars. More detail about the sub-themes is provided in Chapters Four and Five.

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2 Decile: the ranking system for all New Zealand schools on a scale of one to ten. It is a measure of socio-economic position, with one being the lowest ranking and ten the highest. Some school funding is allocated on the basis of decile ranking.

Table 1: Emerged Themes	
Major Themes/Problems	
The teachers' assessment practice • formative assessment practices • progression in science	The teachers' knowledge of science • the nature of science • science conceptual knowledge • science pedagogy
Sub Themes	
The participants as 'teachers as learners'	The nature of the PAR / PD Model

Organisation of the thesis

Chapter One introduces the research study. The purpose for the research, the research question, and the National Exemplars and Matrix assessment tool is described. A brief description of the research population and the themes to emerge are provided.

Chapter Two reviews the literature. Current theories of teaching and learning in science, and formative assessment are discussed. The purpose and benefits of assessment tools, such as the National Exemplars and associated Matrix are documented in the current literature about assessment.

Chapter Three examines the methodology used and discusses the theoretical basis for the researcher's choice of Participatory Action Research. It provides justification for the data collection and analysis techniques employed, and explains the practical aspects of the chosen methodology and techniques.

Chapter Four presents the main body of the findings as the emergent themes are revealed and developed. The themes are justified through the triangulation of data from the various sources, observations, interviews, discussions and documents. Data and extracts, presented to support the researcher's claims, are collated according to the research cycles, and then

further organised according to the phases of Action Research; planning for action, observation, intervention and reflection.

Chapter Five links the findings and the literature to identify the changes to teaching and learning in science and the issues and factors that impact on the changes, as a result of the teacher participants interacting with the National Science Exemplars and Matrix.

Chapter Six draws the research to a close. Key findings from the Action Research study and the contribution that this research study could make to the literature are discussed. Brief discussion and comments on the validation of the research model, are followed by the limitations of the study and future research recommendations are provided.