

## Part 1

# The Assessment of Problem Solving Skills

## Overview

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Problem solving has long been recognised as a key element in performance, in most school subjects as in life itself. One is not educated without the ability to adapt one's knowledge and skills to tasks and situations that are significantly different from those one has studied in school. The best teachers of gifted and talented students have always challenged them with non-routine tasks that require the student to construct, not just to remember, long chains of reasoning involving connections that are new to the student. Over the last half century such work has become part of the intended curriculum in many subjects in many countries – the UK, the US, Australia, the Netherlands have been among the pioneers while Japan, Taiwan and other Far Eastern systems are increasingly moving in this direction. Enquiry-based approaches to learning science, investigative work in mathematics, and the emphasis on design in the technology curriculum are all examples of this.

Assessment has sometimes made an important contribution by recognising and rewarding problem solving performance. The introduction of coursework into the UK GCSE is one example; it requires students to produce a portfolio of extended pieces of work which are assessed and included in their final score, along with the marks on timed written tests. Generally, however, high-stakes assessment of problem solving has lagged behind the curriculum developments, and so inhibited their large-scale implementation.

The reasons for this are both developmental and institutional. The design and development of assessment for higher-level skills like problem solving *is* more challenging than for the recall of facts and learned procedures. More powerful development methods are needed; they are one focus of this part of the book. The institutional barriers vary from place to place. The US assessment tradition has an emphasis on carefully trialled short items that assess one specific thing in isolation – but problem solving is largely about extended chains of reasoning in which the different elements interact strongly with each other. In the UK, in contrast, the tasks in the

high-stakes examinations are often much longer. However, there is usually no opportunity for trialling tasks; they are drafted by a principal examiner then, without any student responses, they are discussed, revised and approved by a committee. Those involved rightly feel responsible to the community of teachers whose students will take the examination. It is not surprising that the tasks that emerge are minor variants of those set in previous years, all of which will be practised by students preparing for the examination. In all systems, there are such pressures to ‘*routinize*’ the assessment; an active countervailing ‘*engine for improvement*’ is thus a system element that is essential for the sustained assessment of problem solving.

The chapters in Part 1 discuss these challenges in three complementary ways. In Chapter 1, I give a broad outline of principles that underlie the assessment of problem solving, and the roles it can play in education. The discussion is illustrated with some assessment tasks and includes a section on specifying an assessment domain in a useful way, which complements the task set.

In Chapter 2, in contrast, Randy Bennett and Hilary Persky from ETS describe in some detail the form and development of a single problem solving task. It offers a technology-rich environment to students, through which they can explore the buoyancy of a gas balloon, using skills in both scientific enquiry and computer technology. The scope and refinement of the development methodology are a notable feature.

In Chapter 3 Gabrielle Matters describes a specific initiative that is broad in both scope and ambition. The State of Queensland has a well-developed tradition of externally-monitored school-based assessment. The Rich Tasks are an exciting and challenging new approach, broader in many ways than what has been tried elsewhere. Each task embraces a trans-disciplinary range of knowledge, skills and problem solving in a focussed project format.

A notable feature of all three chapters is that all the tasks, though assessment is their prime focus, also provide high-quality learning experiences to the students who take part – and thus a stimulus to the curriculum.