2 Assessing Technology

Technology is a universal and age-old human activity... The technologies used today have built on the ingenuity, traditions, observation and knowledge of people who, throughout history, have sought to improve their lives, solve problems and satisfy their needs and wants.

Technology in the New Zealand Curriculum (1995)

Technology in the New Zealand Curriculum

Technology became a learning area in its own right with the formulation of the *New Zealand Curriculum Framework* (1993) and the introduction of the national curriculum statement, *Technology in the New Zealand Curriculum* (1995). Technology is defined in the curriculum statement as:

> *... a creative, purposeful activity aimed at meeting needs and opportunities through the development of products, systems, or environments. Knowledge, skills and resources are combined to help solve practical problems. Technological practice takes place within, and is influenced by, social contexts.*
>
> *Technology in the New Zealand Curriculum (1995, p6)*

Aim of Technology Education

The three-fold aim of technology education in the national curriculum is to enable students to achieve technological literacy through the development of:

- technology knowledge and understanding;
- understanding and awareness of the relationship between technology and society;
- technological capability.

The three parts of the aim are interrelated; the intention is that they should be treated holistically rather than as three separate entities. For national monitoring purposes, the three parts provide a useful basis for an assessment framework.

The third aim, technology capability, recognises that technology is a multi-disciplinary process. This process is developed through problem-solving activities which involve designing, making, modifying, evaluating and reflecting.

Technological Knowledge, Understandings and Skills

Technology education is broad in its scope, yet quite focussed in the ways that knowledge, understandings and skills are acquired and used.

Technology education in the New Zealand curriculum is specifically about:

- investigating, using and understanding technologies;
- gaining knowledge of technological principles and processes;
- exploring needs and opportunities that could benefit from creative and scientific technological activity;
- creating, designing, planning, trying and evaluating ideas to improve or modify existing products and processes;
- using materials, tools and equipment skilfully and safely;
- recognising the connections between technology and society in time and place.

ASPECTS OF TECHNOLOGY FRAMEWORK 2008

CENTRAL ORGANISING THEME

Understanding, using, developing and critiquing technology and its outcomes in personal and social contexts within local and global environments.

KNOWLEDGE, UNDERSTANDINGS AND VALUES

- Ways in which technologies develop
- Interactions between technology and society in time and place
- Relationships between physical and functional characteristics of technological outcomes
- Product analysis and evaluation to determine fitness for purpose
- Properties and characteristics of materials
- Components and processes of systems
- Modeling to test design ideas (functional modeling) and technological outcomes (prototyping)

ABILITIES AND SKILLS

- Identifying and refining needs and opportunities for technological practice
- Generating possible solutions and related strategies
- Identifying, selecting, developing and/or adapting design ideas and solutions
- Managing resources (e.g. time, materials and people)
- Critically evaluating decisions, strategies, outcomes and consequences, taking into account conflicting demands
- Communicating decisions, strategies, outcomes and consequences (both actual and potential)
- Investigating and evaluating design ideas and technologies
- Technical skills and techniques
- Use of technological language

MOTIVATION

• Enthusiasm for knowing about and exploring technology •
• Voluntary engagement in technology activities •
• Confidence and willingness to try new ideas •
• Perceptions about appropriate and inappropriate uses of technology •

Areas of Technology

The areas of technology within which students develop their knowledge, understandings and skills embrace a great deal of personal, cultural, environmental and economic activity. Biotechnology, for example, involves the use of living systems and organisms; materials technology includes the investigation, use and development of materials such as wood, textiles, metals and fuels; information and communication technology covers a complex range of processes, equipment and devices that enable the management and use of numerous forms of data and information.

Design, including the processes of specification, development and testing of ideas, is central to all areas of technology. In technology education students plan, make, modify, maintain, use, evaluate and improve products, systems and environments.

Aspects of Technology Investigated by National Monitoring

Technology is a multidisciplinary activity. Its extensive cross-curricular possibilities reflect its vast pervasiveness throughout the world in which we learn and live as individuals, groups and societies. To attempt to represent all or even most of the areas, meanings and applications of technology within the national monitoring assessment programme would be unrealistic.

After careful examination of the scope of the technology curriculum, it was decided to assess some key aspects, with a particular focus on the knowledge, understandings and skills listed above. Selected areas of content and broadly overlapping contexts (e.g. personal, home, school, community) have been chosen as means to investigating the processes students use and the ideas they have. For national monitoring purposes, it is neither necessary nor practically possible to cover every area of content or all major contexts.

Framework for National Monitoring Assessment

National monitoring task frameworks are developed by the Project's curriculum advisory panels. These frameworks have two key purposes. They provide a valuable guideline structure for the development and selection of tasks, and they bring into focus those important dimensions of the learning domain that should be included for valid analyses of students' skills, knowledge and understandings.

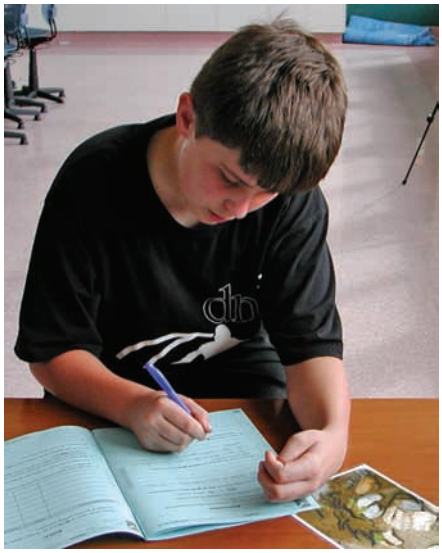
The frameworks are organising tools which interrelate content with strategies, skills and processes. They are intended to be flexible and broad enough to encourage and enable the development of tasks that lead to meaningful descriptions of what students know and can do. They also provide help to ensure a balanced representation of important learning outcomes.

The technology framework has a central organising theme supported by three interrelated aspects.

The *theme*, "Knowing about technology in society and using opportunities to solve technological problems and meet needs in contexts appropriate to students' worlds of experience", is consistent with New Zealand's technology curriculum and sets the broad context for tasks.

The aspects titled *Knowledge, Understandings and Values* and *Abilities and Skills* highlight the learning that students could be expected to demonstrate while engaged with the *Areas of Content*. The knowledge, understandings, values, abilities and skills are highly interrelated both within each aspect and across the total framework.

The *Motivation* aspect of the framework directs attention to the importance of having information about students' technological interests, attitudes, confidence and involvement, both within and beyond the school setting. Educational research and practice confirm the impact of student motivation and attitudes on achievement and learning outcomes.



The Choice of Technology Tasks for National Monitoring

The choice of technology tasks for national monitoring is guided by a number of educational and practical considerations. Uppermost in any decisions relating to the choice or administration of a task is the central consideration of validity and the effect that a whole range of decisions can have on this key attribute. Tasks are chosen because they provide a good representation of important dimensions of technology education, but also because they meet a number of requirements to do with their administration and presentation. For example:

- Each task with its associated materials needs to be structured to ensure a high level of consistency in the way it is presented by specially trained teacher administrators to students of wide-ranging back-grounds and abilities, and in diverse settings throughout New Zealand.
- Tasks need to span the expected range of capabilities of year 4 and 8 students and to allow the most able students to show the extent of their abilities while also giving the least able the opportunity to show what they can do.
- Materials for tasks need to be sufficiently portable, economical, safe and within the handling capabilities of students. Viewing and listening components need to be chosen to have meaning for students.
- The time needed for completing an individual task has to be balanced against the total time available for all of the assessment tasks, without denying students sufficient opportunity to demonstrate their capabilities.
- Each task needs to be capable of sustaining the attention and effort of students if they are to produce responses that truly indicate what they know and can do. Since neither the student nor the school receives immediate or specific feedback on performance, the motivational potential of the assessment is critical.
- Tasks need to avoid unnecessary bias on the grounds of gender, culture or social background while accepting that it is appropriate to have tasks that reflect the interests of particular groups within the community.

National Monitoring Technology Assessment Tasks and Survey

Twenty-nine technology tasks were administered. Students also completed an interview questionnaire that investigated their attitudes towards, conceptions of, and involvement in technology activity.

Eleven tasks were administered in one-to-one interview settings, where students used materials and visual information. Six tasks were presented in team or group situations involving small groups of students working together. Eleven tasks were attempted in a stations arrangement, where students worked independently on a series of tasks. Finally, one task was presented in an independent approach, where four students worked on the same tasks at the same time, independently.

Twenty-two of the 29 tasks were the same or almost the same for both year 4 and 8. Seven tasks were attempted only by year 8 students.

Trend Tasks

Fourteen of the tasks in this report were previously used in identical form in the 2004 technology assessments. These were called *link tasks* in the 2004 report, but were not described in detail to avoid any distortions in 2008 results that might

have occurred if the tasks had been widely available for use in schools since 2004. In the current report, these tasks are called trend tasks and are used to examine trends in student performance: whether they have improved, stayed constant or declined over the four year period since the 2004 assessments.

Link Tasks

To allow comparisons between the 2008 and 2012 assessments, 14 of the tasks used for the first time in 2008 have been designated link tasks. Results of student performance on these tasks are presented in this report, but the tasks are described only in general terms because they will be used again in 2012.

Marking Methods

The students' responses were assessed using specially designed marking procedures. The criteria used had been developed in advance by Project staff, but were sometimes modified as a result of issues raised during the marking. Where tasks required marker judgement, the responses from year 4 and year 8 students were intermingled during marking sessions, with the goal of ensuring that the same marking criteria and standards were used for both. If these tasks were trend tasks, substantial representative samples of the responses of year 4 and year 8 students assessed in the earlier years were also intermingled into the marking process, to help ensure that all comparisons were based on the same marking criteria and standards.

Task-by-Task Reporting

National monitoring assessment is reported task by task so that results can be understood in relation to what the students were asked to do.

Access Tasks

Teachers and principals have expressed considerable interest in accessing NEMP task materials and marking instructions, so that they can use them within their own schools. Some are interested in comparing the performance of their own students to national results on some aspects of the curriculum, while others want to use tasks as models of good practice. Some would like to modify tasks to suit their own purposes, while others want to follow the original procedures as closely as possible. There is obvious merit in making available carefully developed tasks that are seen to be highly valid and useful for assessing student learning.

Some of the tasks in this report cannot be made available in this way. Link tasks must be saved for use in four years' time, and other tasks use copyright or expensive resources that cannot be duplicated by NEMP and provided economically to schools. There are also limitations on how precisely a school's administration and marking of tasks can mirror the ways that they are administered and marked by the Project. Nevertheless, a substantial number of tasks are suitable to duplicate for teachers and schools. In this report, these access tasks are identified with the symbol above, and can be purchased in a pack from the New Zealand Council for Educational Research *(P.O. Box 3237, Wellington 6140, New Zealand),* or email bev.webber@nzcer.org.nz. Teachers are also encouraged to use the NEMP website *(http://nemp.otago.ac.nz).*