Chapter 3

Technology Education in the New Zealand Curriculum

— *Alister Jones*

Technology education for all students is a relatively new phenomenon in national and international curricula. Although New Zealand has a long history of technical education in the senior primary and secondary school (Burns, 1992), a framework for technology education for all students has only recently been developed (Jones and Carr, 1993). Aspects of technology have been included in many existing school programmes and some programmes have included 'technology' in their title. However these programmes have not been presented and undertaken in a coherent way. Technology as it has developed in past curricula encompassed a limited range of skills, processes and knowledge resulting from a narrow perspective. The technologically-oriented subjects in the past, including science, have not been inclusive of all students. As a consequence students have not had the broad experiences in technology which they need to successfully contribute to society. If there is little change in existing practice then technology education will undervalue the contribution of all students in all cultures. New Zealand's society and economy will be the poorer.

In this chapter, the way in which experience of existing school programmes influences teacher perceptions of technology education is discussed, and reasons for teaching technology are outlined. A relationship between technology and technology education is suggested and the structure of technology education in the New Zealand technology

curriculum is described. A particular focus is the role of technological activities in technology education, and this is developed in the final section.

Influence of technology teaching traditions

There is increasing agreement internationally as to what constitutes technology education at a policy level (McCormick, 1992), but there are distinct differences in the practice. According to McCormick, these differences reflect the traditions of teaching technology, namely those school programmes that have included aspects of technology in the past, and the forces exerted by the various interest groups the programmes have generated. McCormick identifies the various traditions as being: craft; design and art; science; science, technology and society; and industry, productive work and education. Within each country these traditions have had different emphases and influences on the development of a technology curriculum.

These different traditions also influence the perceptions that teachers and others have of technology and technology education. These perceptions are different within each interest group. For example, research in New Zealand (Jones and Carr, 1993) indicates that teachers have different perceptions of technology education depending on the teaching subculture they work in and their background experiences. In this research it was found that subject subcultures were internally consistent and were a strong influence on *secondary* school teachers' perceptions of technology education. Science teachers emphasised applications of science, social studies teachers focused on societal aspects of technology, English teachers focused on journalism, media studies and drama, accounting and economics teachers mentioned computing and resources, and technical teachers focused on technical skills, designing and making. While each of these subject areas contributes to technology education, no one teacher had a broad view of technology education.

In the *primary* schools, the subject subcultures did not appear to be as strong, although they did emerge in some of the teachers' comments. There was an emphasis in these schools on problem-solving and many of the teachers talked about technology education as using technology, particularly computers, to solve these problems. Those teachers with a

special interest in science emphasised science and technology. Science specialists saw technology as a vehicle to teach science or applications of science and this view was written in the school schemes. Teachers mentioned making students comfortable with and aware of technology. It became apparent that because teachers had a narrow view of technology education they may not have been aware of the technology that is already part of their teaching programmes.

Teachers' perceptions of technology education were also influenced by their past experiences both in and out of school. Interests, for example, in music and computing, contributed to teachers' views of what technology education might be. Teachers who were beginning their teaching career were concentrating on 'survival' and coming to terms with what they had to teach, and technology was seen as an extra. Those teachers who had worked outside teaching were influenced by their past careers and tended to focus on 'hi-tech' as being the highly visible technology, apart from those who saw technology in terms of construction where the focus of the teacher was on manual skills. Those teachers who had been involved in some form of long-term teacher development programme felt confident about the introduction of technology education, although this was often in terms of science and technology. Interactive teaching had a big influence on teachers' confidence to tackle new subject areas such as technology.

It was apparent that there was a range of views about technology education and it is expected that these views will influence curriculum development and implementation in the area of technology. These perceptions will have a direct influence on the way in which technology education is developed, interpreted and implemented in the national curriculum, school curriculum and in the classroom itself. An imposed curriculum that does not take account of the existing ideas of teachers, and the realities of the school could be distorted in such a way as to threaten the improved learning that could take place.

Reasons for teaching technology

Technology has a major influence on individuals, on communities and on the wider society. It influences the needs and wants of people in their immediate and larger communities, and people influence technology. Technology ranges from simple devices such as the clothes peg to high

technology associated with electronics and computing. Technology includes the development of artefacts, systems and environments. There is an increasing realisation of the need for a critical awareness of the impact of technology on our lives. Technology is important and should be part of the education of all students.

Six grounds for developing technology education are listed below.

Economic

Enterprise and the wider community have expressed the need for education to develop people who are creative, innovative and resourceful and who can combine enterprise, initiative and imagination with knowledge and skills. People need to be able to translate ideas into action, to co-operate in their work, and to adapt to a rapidly changing world. Our economic future depends on developing product and market niches. This argument points to the value of the interaction of school students with the commercial world. This could provide students with real problems to solve and could provide enterprise with a better understanding of education in schools. An outcome of this interaction would be recognition of the importance of technological innovation.

Pedagogic

Technology provides a context for the integration of knowledge and skills from many school subjects and from out-of-school experiences. It is a rich source of understandings and questions which would contribute to better teaching and learning. Students who work from their existing knowledge, skills and understanding as they carry out technological activities will be motivated towards acquiring further knowledge and skills in order to resolve problems in an individual and innovative way.

A further pedagogic argument acknowledges a world-wide concern about the lower esteem accorded to skilful practice in relation to academic achievement. Technological knowledge and capability are recognised as crucial areas of learning. It is now acknowledged that intelligence and cognitive complexity are manifest in doing, as much as in knowing. By increasing students' practical capability,

their knowledge base is likely to be expanded rather than diluted. School programmes need to integrate the learning of knowledge and skills so that students are able to apply their learning in a real and meaningful way. Students are more creative and innovative when they are asking and attempting to answer their own questions. They are better problem-solvers when they perceive the problem to be a real problem relevant to them.

Technology education which addresses these arguments would be more than designing products. It would involve students in solving problems which require the use, adaptation, evaluation or the enhancement of existing technology, perhaps the creation of new technology, and the development of an understanding of the crucial links between technology and society.

Motivational

Human needs and interests provide motivation for engaging in technology since students readily can see the applicability of knowledge and skills. Health technology, communication technology and sports technology, for example, evoke strong interest from large sectors of the school population and can be entry points into wider aspects of technology education.

Cultural

Different cultures have developed different technologies over a long period of time, and have different responses to technology. These perspectives can provide an entry point into technology education and an enrichment of the view of technology for all students in a multicultural society. The opportunity to apply technological knowledge, cultural feelings and beliefs can provide a diversity of worthwhile solutions and responses. The various cultural perspectives could provide potential for future technologies.

Environmental

Helping pupils to explore the impact of technology on their environment encourages them to take responsibility for that

environment, and equips them to cope better with changes caused by technological advance.

Technology education should include the study of the history, growth and future trends of technology as they relate to the protection of world resources and security. This could encompass interdisciplinary and multi-disciplinary theoretical and practical endeavours.

Personal

Students respond positively to learning environments which address their needs. In a technological world students should be aware of their responsibilities as members of a technological society to contribute to informed decision-making about technology and to become empowered to be active in response to new technological challenges.

Technology education provides a means of addressing these personal needs if appropriate recognition is given to access regardless of gender, ethnicity, or academic ability.

A further personal argument has to do with technology education providing an environment which allows the students to engage in risk-taking. Traditional teaching, learning and subsequent assessment environments often do not encourage students to display initiative or to take risks. Technological activity does not always operate in situations which are stable and predictable. There are technological skills in responding to situations such as gas leaks or power blackouts. Technology education should encourage students to take risks, learn how to make sound decisions, be innovative and develop strategies from their knowledge and skills which can deal with stable and unstable problems in their real world.

The role of human values, both of the individual and the community, has been underplayed in school education. Technological activity inevitably confronts conflicting constraints and requires judgements to be made by way of choices. The whole activity is consequently influenced by human values.

The above six arguments for technology education overlap and interrelate. Taken together they represent a powerful argument for a more formal organisation of technology education in the New Zealand school system.

Careful consideration needs to be given to the development of a new subject. Technology education will enrich the education of all students provided that it is not seen as narrow vocational training. A well structured and implemented technology curriculum that provides alternatives has the potential to engage all students and to enable them to make a contribution to their society. An obvious requirement is that technology has a status equal to other subjects in the school curriculum.

From a definition of technology to technology education

There are numerous definitions of technology and different views of what technology might be. However, one possible definition is:

> Technology is a purposeful activity aimed at meeting needs and opportunities through the development of products, systems or environments. It takes place within specific contexts and constraints, and is influenced by value judgements.
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> (Jones and Carr, 1993: 2)

A definition of technology should not define technology education but inform it. Thus, in relation to the definition of technology given above, community values, socio-cultural and economic activities, as well as individual needs for knowledge, skills, and experiences, play a significant role in determining the content of technology education. Technology education, does not merely involve using technology, such as computers, in parts of the curriculum. While this may result in proficiency in the use of that particular tool, it does not lead to a better understanding of technology, nor does it develop technologically literate citizens.

A broad definition of technology education encompasses the following:

- exploring and researching needs and opportunities which can be addressed through technological activity;
- developing knowledge about technology, including technological practice and the principles of technology;
- developing knowledge and skills such as communication, research, data handling, management, planning, designing and making, the integration of knowledge, processes and skills, evaluation and reflection;

- carrying out and completing technological activities which are relevant to students and to their communities;
- developing skills which may also be used to respond to unstable situations through technology; and
- developing an understanding of the interaction between technology, human and cultural values, and society.

The structure of technology education in the New Zealand curriculum

Technology education contributes to the intellectual and practical development of students, both as individuals and informed members of a technological society.

Aim

The aim of technology education in the New Zealand technology curriculum is to enable students to achieve technological literacy through the development of:

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

The aim is three-fold and the parts, which provide the three *strands* of the curriculum, overlap. For example, technological capability involves using knowledge and understanding and also takes into account issues related to technology and society. The aim provides a framework for developing expected learning outcomes, and makes a valuable contribution to formulating a balanced curriculum for technological education.

In technology education students will design, make, modify, maintain, evaluate and improve products (artefacts), systems and environments. The aim of technology education, in terms of creativity and inventiveness can only be realised if the learning environments encourage this. Technology is a multi-disciplinary activity and this should be reflected in students' experience of technology education.

Technological areas

The practice of technology in the world outside the classroom covers a diverse range of activities from agriculture through to the production of synthetic materials and electronics. Technology education must reflect this diverse practice and not limit itself to designing and making with a limited range of materials. The development of technology education in this country must reflect the technological activity within New Zealand. Therefore it is essential that we consider a range of technological areas in the teaching and learning of technology.

Each technological area or community of practice has its own technological knowledge and ways of undertaking technological activity. It is important therefore that students experience a range of technological areas and contexts to develop an understanding of technology and technological practice. Theories of learning also point to the fact that the more students can work in a number of contexts and areas then the more likely they are to develop effective knowledge about technology and transfer this knowledge to other contexts and areas (Perkins and Salomon, 1989).

In the New Zealand technology curriculum the technological areas include: biotechnology; electronics and control technology; food technology; information and communication technology; materials technology; production and process technology; and structures and mechanisms. It is expected that appropriate technological products (such as CAD/CAM and information systems) would be used within all the above technological areas. There are activities related to these different technological areas which would be appropriate for use by students across the age range from five to 18 years. A technological activity may span several technological areas as, for example, with the solar car, students may be investigating a number of areas simultaneously. These areas are expanded upon in Part 2 of this book.

Contexts

The technological areas can be accessed through a variety of contexts, such as, personal, home, school, recreational, community, environmental, energy, business and industrial. Each broad context will provide many specific contexts for exploration, for example, within the home context,

there will be specific contexts involving safety (design of burglar alarms, safer electric stoves), economy (design of fuel-saving systems) and comfort (design of posturally-correct furniture), which are of direct relevance to the students.

Technology education should emphasise an holistic approach, the three parts of the aim are not discrete entities to be taught separately. It is recognised that a single learning activity in technological education may not address all the parts; but over a unit of work it is expected that the aim of technology education, technological knowledge and understanding, technological capability and the relationship between society and technology will be addressed. Technological areas, contexts and the three-fold aim should be seen to combine into an approach to technology education appropriate for all levels of schooling.

Technological activities

The strands, and within the strands sets of *achievement objectives*, arise from the aim of technology education. The achievement objectives (listed in the Appendix) detail aspects of the strands and provide a basis for planning. It is crucial that the technology education curriculum does not become a process-orientated one where knowledge is not deemed to be important. It is impossible to undertake a technological activity without some technological knowledge and the utilisation of other knowledge bases. The use of other knowledge bases is a valued and essential part of a technological activity.

Each technological area will have different knowledge bases which are important. Students should have an understanding of a range of technologies and how they operate and function. Technological activity does not occur in isolation from people and their needs and values. Different ideas contribute to technology and it is important that students investigate how these ideas influence technology, including technological developments. Technology relies on the utilisation of a range of knowledge bases, including knowledge bases from a range of cultures and areas, such as Maori technological knowledge, scientific knowledge, language, mathematics, design principles, and systems. Students need to develop an understanding of the principles underlying technological developments such as aesthetics, efficiency, ergonomics, feedback, reliability and optimisation. The understanding of systems is essential in developing

knowledge in technology. Students should investigate technological systems and analyse the principles, structure, organisation, and control of systems. These knowledges and principles will be dependent on the technological area and context the students are working in.

Technological activity arises out of the *identification of some human need or opportunity*. Within the identification of needs and opportunities students will need to use a variety of techniques to determine consumer preferences. Most technological developments occur through modifications and adaptations. Students should investigate existing technology in order to propose modifications, innovations, and adaptations to meet needs and opportunities.

In a technological activity it is crucial that students develop *implementation and production strategies to realise technological solutions*. Part of this will involve students in developing possible ideas that will lead to solution, and developing and using strategies to realise these ideas. Within this, students will need to manage time, resources and people, and produce the outcome that meets the identified needs and opportunities. Students should communicate their designs, plans and strategies and present their technological outcomes in appropriate forms. Part of this process is the devising of strategies for the *communication and promotion of ideas and outcomes*, such as advertising, marketing, pricing and packaging. Throughout the technological activity students should continually *reflect upon and evaluate decisions* they are making. Research indicates (Jones, Mather and Carr, 1995) that this is essential if students are to realise their technological outcomes. Students should not only appraise their own outcomes, but also those from the past, present and other cultures.

The achievement objectives are expressed in eight levels, but these should not be seen as linear progressive steps. They act as a guide to the opportunities which should be provided for students. Neither should the achievement objectives be seen to imply a particular sequence. They are targets to be achieved over a period of time and through more than one technological activity. The achievement objectives should not be developed in isolation from each other. As students carry out a task they will be refining their approach through reflecting and evaluating, developing a more complete understanding of the task through applying and developing technological knowledge and understanding, gaining insights into the interrelationship between technology and society and, at

the same time, developing a more appropriate strategy in their planning, developing and producing. Undertaking technological activities involves a dynamic interplay between knowledge and skills. For example, exploring and researching needs and opportunities is achieved through an interaction between the student's existing knowledge, observations and research.

Understanding of the interrelationship between technology and society is essential to any technological activity. Too often we have just considered the impact of technology on society rather than considering different views people have about technology and the ways these are influenced by their beliefs, values and ethics.

Approaches to technology education through technological activities

There is typically no single correct outcome to a technological activity. Students should be encouraged to communicate their solutions and to reflect on and evaluate the many outcomes likely from such an activity. The intellectual and practical demands of technological activities should challenge the most able student and also provide education in and through technology for all students. As students progress they should be given opportunities to use their increasing knowledge and skills to produce outcomes which are more complex. Good learning begins from the knowledge, skills and understanding that students already have. One of the hallmarks of a good activity is that it provides incentive and opportunity both to access relevant existing knowledge, skills and understanding, and, at appropriate points in the activity, to acquire further knowledge, skills and understanding which effective completion of the task might demand.

Design and the design process have not been mentioned as a separate achievement objective. Design is a vital and inseparable part of technological capability and is therefore integrated with all the achievement objectives. Good design considers the needs of people and the environment and is essential to the economics of production and marketing of goods and services. It is discussed in Chapter 5.

The structure of technology education in the New Zealand curriculum places an important emphasis on human needs. The emphasis is on a process with values and constraints at the core. The structure means that technology education can start from students' interests and become firmly engaged with human and social interactions. The suggested

framework for technology education provides freedom to select the content and context as culturally and individually appropriate. A starting point for a technological activity can then be through the identification of needs and opportunities related to human needs and social issues.

The framework for technology education emphasises the collaborative and cooperative nature of technology. This needs to be reflected in the practice of technology education for the benefit of all students. Business and industry value co-operative approaches to problem-solving where communication and collaborative skills are important. Technological tasks should encourage students to work together and with the wider community.

The flexibility of the framework for technology education allows students to engage in activities of which they are capable. The variety of possible outcomes in terms of products, systems and environments imply a variety of ways in which these can be realised. For example, it may be appropriate for some students to develop computer models of their solution rather than constructing it in a workshop environment (students should however have access to the workshop if required). Technology education is about the whole process, not just the construction of final outcomes. Technology education must be accessible to everyone. Open approaches invite students to make decisions, and involve students in the processes of technology. The technological activity should not restrict students, allowing them to tackle technological problems which are meaningful to them.

Different cultures have developed different technologies over a long period of time and they consequently have different contributions to make to technology education. These cultural perspectives can provide different knowledge bases for technology education and enrich the view of technology for all students in a multicultural society. These various perspectives provide potential for future technologies. The impact and influence of culture and values (both individually and in the community) are central to the teaching and learning of technology. Students will bring their own values to technological activities and these should be acknowledged and validated. Students should also be made aware of the impact of different values on technology. Recognition of the personal experience and judgement of all students from many cultures is central to their learning in technology education. Moreover, the technology traditionally used can provide a starting point for technological activity

and for future technologies. Students should be made aware of the close links between society and culture and technology. The framework for technology requires strong links with the community, and that recognition be given to the values, beliefs and needs of that community. This provides opportunity for technology to be explored, undertaken and evaluated in relation to cultural contexts, needs and opportunities.

References

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