The Journal of Technology Studies

Technology Education in New Zealand

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Technology in New Zealand schools is a new area of learning that is now compulsory for all students (years 1–10). Technology education policy was first developed in 1992 (Jones & Carr, 1993). Since then there has been a sustained research and development focus to inform the structure of the curriculum, its subsequent national implementation, and classroom practice. This article discusses the structure of the technology curriculum, programs that were developed to inform teachers of the curriculum and its content, and strategies to enhance the classroom practice of technology.

The New Zealand Curriculum Framework and the Technology Curriculum

The New Zealand curriculum framework defines seven broad essential learning areas rather than subject areas. They describe the knowledge and understanding that all students need to acquire in health and well-being, the arts, social sciences, technology, science, mathematics, and language(s). Schools have flexibility in how the curricula are delivered and have the responsibility for making implementation decisions. The curriculum framework requires that the essential learning areas specify clear learning outcomes against which students' achievements can be assessed. These learning outcomes or objectives must be defined over eight progressive levels and be grouped in a number of strands.

The general aims of technology education in *Technology in the New Zealand Curriculum* (Ministry of Education, 1995) are to develop technological knowledge and understanding, technological capability, and an understanding and awareness of the interrelationship between technology and society.

Technological Knowledge and Understanding

It is impossible to undertake a technological activity without technological knowledge and using and transforming other knowledge bases. Students need to develop an understanding of the principles underlying technological developments such as aesthetics, efficiency, ergonomics, feedback, reliability, and optimization. The specific knowledges and principles are dependent on the technological area and context within which students are working. The understanding of systems is essential in developing knowledge in technology. Students also need to develop an understanding of the nature of technological practice and how this has similarities and differences in different technological communities of practice. It is important that students have an understanding of a range of technologies and how they operate and function. An understanding of strategies for the communication, promotion, and evaluation of technological ideas and outcomes is integral.

Technological Capability

Technological activity responds to the identification of some human need or opportunity. Within the identification of needs and opportunities students need to know and use a variety of techniques to determine consumer preferences. In technological activities students develop implementation and production strategies to realize technological solutions. Part of this involves students in generating ideas that lead to solutions as well as developing and using strategies to realize these ideas. Students need to manage time, resources, and people to 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. Throughout the technological activity students should continually reflect upon and evaluate the decisions they are making.

Interrelationship Between Technology and Society

Students should develop an understanding of the ways in which beliefs, values, and ethics promote or constrain technological development and influence attitudes towards technological development. Students should also develop an awareness and understanding of the impacts of technology on society and the physical environment.

Technological Areas

The practice of technology in the world outside the classroom covers a diverse range of activities from agriculture to electronics and the production of synthetic materials. Technology education must reflect this diverse practice and not limit itself to designing and making with a limited range of materials. Each technological area 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. To develop a broad curriculum a number of technological areas relevant to New Zealand were included: materials technology, information and communication technology, electronics and control technology, biotechnology, structures and mechanisms, process and production technology, and food technology.

Interpreting the Curriculum for Teachers: Professional Development

The introduction of a "new" learning area in schools, such as technology, has been somewhat problematic in New Zealand. Teachers' existing subcultures in terms of teaching and learning, subject area, and school, in association with their concepts of technology, influence the development of classroom environment and strategies, and consequent student activities. In order to introduce technology into the classroom, it is important not only to have a developed concept of technology but also awareness and understanding of technological practice. Two different programs have been developed and trialed in the New Zealand context: the Facilitator Training program and the Technology Teacher Development Resource Package program.

National Facilitator Training Program

The year-long Facilitator Training program was run twice. It involved training a total of 30 educators (15 each year) from all over New Zealand. The program stressed the importance of developing theoretical perspectives in technology education, particularly when having to discuss implementation issues with school managers and boards. The participants also stressed the importance of learning about the techniques and practices of the different technological areas. After the training program these participants then worked with teachers on a national basis. The evaluations from the teachers on these programs show that the majority of teachers who participated perceived the facilitators' programs very positively. The very common call from teachers' personal comments was for more teacher development of this type. This, along with 87.2% of the responses rating the program as above average or excellent, reflects clearly the success of the facilitators' programs, and of the training program overall. Most of the teachers (83%) considered the programs developed by the facilitators had helped them with their understanding of technology education generally and the technology curriculum specifically. Over half of the teachers (63%) also found the program helped them with their understanding of the concept of technology itself. Approximately three quarters of the teachers (76%) considered the areas of school and classroom implementation had been helpful, and over half of the teachers (66%) had found the program helpful in providing them with ideas for classroom activities even though this was not a primary focus of the programs (Jones & Compton, 1998).

National Technology Teacher Development Resource Package Program

The Technology Teacher Development Resource Package program was trialed in 14 schools over a 3 to 6 month period in 1996 and includes video material of technological practice, classroom practice, and accompanying explanatory text as well workshop activities. All the evaluations both in the trial schools and from subsequent general use indicate the successful nature of these programs and the usefulness of the model as a basis for the development of teacher professional development in technology education. This resource package (Ministry of Education, 1997) is now used in most schools and forms the basis of nationally funded professional development in New Zealand.

Key Features of Teacher Professional Development

Experience to date suggests that the following key features should be taken into account when developing technology education teacher professional development programs consistent with both the New

Zealand national curriculum statement in technology and past research findings. All focus on the importance of developing the following:

- Robust concept of technology and technology education.
- Understanding of technological practice in a variety of contexts.
- Technological knowledge in a number of technological areas.
- Technological skills in a number of technological areas.
- Understanding of the way in which people's past experiences both within and outside of education impact on their conceptualization of, and in, technology education.
- An understanding of the way in which technology education can become a part of the school and classroom curriculum.

From Curriculum to Enhancing and Sustaining Classroom Practice

A major research program (Learning in Technology Education research projects 1992–1995, 1998–2001; Moreland & Jones, 2000) has been examining classroom practice in technology. In 1998 there appeared to be significant problems for teachers in assessing technology. Teachers commented that their difficulties were not just confined to technology but were also related to other subjects. In comparison with earlier research (Jones & Carr, 1992) it was found that teachers had developed broader concepts of technology as a result of the teacher development models discussed earlier and the trialing of curriculum material in classrooms (Moreland, 1998). These concepts, though, were still not broad or detailed enough to take into account many conceptual and procedural aspects. The teachers' lack of understanding about conceptual and procedural aspects of technology appeared to be confining their assessment in technology to assessing affective aspects of learning such as *did they enjoy it* and the social and managerial aspects such as *working in groups, turn taking, sharing.* Technology had yet to become an integral part of the talk of classroom teachers and the community. In their planning of technology, teachers were focusing on the activities rather than on specific learning outcomes.

Also impacting on teacher assessment practices in technology were the existing subcultures in schools and schoolwide policies, teacher experiences, and teacher subject expertise. What teachers relied on for assessing in technology was largely dependent on what they already did and knew in other curriculum areas. All teachers in primary schools have common understandings of teamwork, leadership, turn-taking, discussing, depicting ideas, gathering information, describing, reflecting, etc., and these common understandings of social and managerial skills had became the focus of assessment in technology. Therefore in terms of the technology curriculum, teachers focused on aspects of the achievement objectives that aligned with social and managerial aspects, for example, discussing, exploring, and sharing.

The next stage of the research program was undertaken during 1999–2000 and was designed to enhance formative interactions between the teachers and students. The conceptual and procedural aspects of learning in technology were highlighted as the means to enhance the formative interactions of the teachers and the learning outcomes for the students. This resulted in teachers moving from using general concepts about technology to more specific concepts within different technological areas. For the first time teachers were able to identify the specific technological learning outcomes they wished to assess. Teachers' developing conceptual and procedural knowledge enabled them to write specific learning outcomes, and they began to move with more confidence between the general area of technology and the specific technological learning outcomes.

The teachers were able to choose more suitable tasks that had the potential to develop student learning in technology. This shift in focus from providing a technology experience to providing opportunities for students to develop technological learning outcomes was significant. By investigating a wide range of learning outcome possibilities and then selecting particular learning outcomes teachers pursued a more appropriate approach to technological learning. They became focused on the technological learning of their students. Teachers' talk about technology education had a higher profile and was increasingly embedded in teacher conversations. Teachers demonstrated greater confidence with formative assessment, particularly in relationship to providing appropriate technology feedback to the learners. Direction

was given where deemed appropriate, which led to more appropriate interactions. Not only was there more emphasis on providing feedback and assistance to students to develop particular technical skills, there was also more emphasis on conceptual and procedural aspects rather than social and managerial aspects. Additionally, there was less emphasis on praise as the sole formative interaction and more emphasis on assisting students to move on, to reflect, and to assess their own progress. These are illustrated in one of the teachers' comments below:

> Dividing planning into conceptual, procedural, societal, and technical allowed me to more effectively hone in on the technology involved.

The number of appropriate pedagogical approaches also increased. A variety of methods were employed by the teachers, including student interviewing, conferencing, observation, use of considered portfolios, and analysis of appropriate learning outcomes. The use of the assessment models also enabled the teachers to differentiate between the different levels of effectiveness of student learning and to justify the differentiation. The teachers also noticed enhanced student learning in technology. Their comments were illustrative of this:

> Children's differences in learning can be better identified with specific learning outcomes, with more effective children coping with more variables.

This research project has developed intervention strategies that encourage teachers to identify the conceptual, procedural, societal, and technical aspects, task definition, and aspects of holistic assessment. The results are very encouraging with the focus at the conceptual and procedural levels rather than in terms of an activity. Teachers have moved from thinking about progression in terms of a series of activities to examining the conceptual and procedural aspects of student learning. In summary, the assessment models that were developed, coupled with the intervention by the research team, had a major impact on improving teachers' formative interactions and understanding of summative outcomes. As a consequence student learning has been significantly enhanced in technology.

Progress So Far

For a new curriculum to be introduced and be sustainable a strong emphasis needs to be placed on a coherent and long-term research and development program that is then able to inform classroom practice. Curriculum implementation requires informed teachers who are able to develop sustainable programs in order to enhance student learning in technology. This has involved research and development on teachers' existing practices and student initial experiences, teacher development, resource development both in terms of teacher professional development and classroom material, and strategies for the enhancement of teacher knowledge and student learning. Associated with this is the development of effective mechanisms for the dissemination of the research findings to inform all teachers. This has occurred through teacher professional organizations such as TENZ (Technology Education New Zealand) and the Ministry of Education. However, this is only the beginning of this process, and more research and development work is required to develop sustained classroom practice in technology consistent with the New Zealand technology curriculum.

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