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The status of teaching and learning of technology in primary and secondary schools in Australia

Dr P. John Williams and Steve Kierl
Edith Cowan University, Perth, Australia and University of South Australia, Australia

Abstract

For the first time, technology education has received national research attention in Australia. An investigation of the teaching and learning of technology in Australian primary and secondary schools has recently been completed. A national task force conducted the research, guided by a steering committee and responded to by a group of critical friends. A range of both qualitative and quantitative methodologies were utilised in reporting on these deliverables, including surveys, interviews, document analysis, focus groups and data analysis.

The research team developed a model of effective practice and validated it through the identification of leading sites. The results of this research included findings that:

- technology education is well placed to be instrumental in implementing the Federal Government’s Innovation Plan
- physical facilities for teaching technology in primary schools are inadequate
- technology teachers rated the status of technology education as lower than other groups
- there is some confusion in the integration of vocational and general education offerings in schools
- current teacher shortages are going to get worse in the next few years
- the range of teacher training models is diversifying.

Recommendations made to all levels of government, universities and schools as a result of the research findings will be summarised in the presentation.

Keywords: Australia, technology education, primary, secondary, research

Methodology

A range of qualitative and quantitative methodologies were used in this investigation in order to collect the type of data required. The techniques included literature reviews, surveys, focus groups, interviews and observations. Over 300 documents were reviewed including reports, research, position and discussion papers and all substantial Australian curriculum documents and teacher support materials in technology education.

Data on student participation and achievement was collected in each state from system policy and curriculum documents and reports through the use of a pro forma by task force members, and through interviews with key personnel from education systems and professional associations.

All state and territory curriculum documents were reviewed to determine how values are addressed. This information was then reality checked through 17 interviews with key officers responsible for technology education in each state and territory and eight focus groups (one in each state and territory) of 74 participants, who each completed a questionnaire.

To gauge the level of understanding about technology education, questionnaires were mailed out to representatively selected schools, parents and business leaders. In order to obtain general information from schools, an electronic survey was sent to selected schools, according to stratified random criteria, resulting in responses from 149 schools. This sought information on the structure of technology education offerings in
schools, professional development, compulsory and elective subjects, assessment and reporting, timetabling and the perceived status of the learning area.

**A history of technology education**

Technology education as a learning area in Australian schools is relatively new. In 1987, the Australian Education Council (AEC) began a series of initiatives that led to the publication in 1994 of nationally agreed curriculum statements and profiles related to eight learning areas, one of which is technology. In 1990 the K-12 (kindergarten to Year 12) Technology Curriculum Map (AEC) revealed a shift in emphasis in many schools toward gender equality, flexible outcomes and a variety of teaching and assessment strategies. The 1994 documents extended this trend.

The declaration of technology as a learning area had profound implications. Firstly, all subject areas in secondary schooling from which technology education developed were located within the elective areas of the curriculum. The implication was that these subjects provided specific learning experiences relevant only for specific groups of students with particular interests or career destinations in mind. Indeed, some of these subjects were regarded by students and the community as relevant only to a particular gender. Secondly, in the case of primary education, technology had not generally been part of school programmes, and primary teachers have little experience to draw on to develop programmes. The challenge for technology education was to determine the learning experiences that are essential for all students, and are unique to technology education or best undertaken within the area.

Prior to the 1990s, school curricula addressed technology in a very limited way. In the main, technology was referred to in elective or optional syllabuses. Most often students’ perceptions of technology were developed from a very restricted range of learning experiences, for example, students might learn about the tools and machines used to work with timber. Invariably learning focused on an established body of technical ‘know-how’. In some courses students learnt about designs that characterised past eras.

The technology classroom activities of today have developed out of these traditions. At the primary school level, technology education practices tend to have developed out of art and craft and science. Technology and science still tend to be bracketed together for primary education as illustrated by recent government reports (ASTEC, 1997) and some learning area documentation.

At the secondary school level, technology education has tended to develop out of vocational studies such as home economics, industrial arts, agriculture and business education as well as other technical studies such as computing, information technology, media and control technology.

Technology education continues to evolve and change. At the time of this report, Queensland, South Australia and Victoria are reviewing their technology learning area documentation. These reviews are in response to progression in understanding of technology education, and developing research about the nature of teaching and learning in technology.

**A definition of technology education**

There is no specific body of content in Australia that is used to define technology education. Technology education seeks to prepare students to participate in complex processes of technological development and decision-making that will influence and shape quality of life now and into the future. Student participation in technology education is therefore active and dynamic as they work to develop and track their ideas from conception through to reality.

A survey of technology education documents indicates that through technology education, students should develop:

- a sound, conceptual understanding of the dynamic nature of technology and a concern for the future
- an appreciation of how technological change interacts with social, economic and environmental systems
- control over their environment through both input into their own learning, and through a realisation that technology is socially contrived
- qualities of enterprise, creativity and innovation in relation to the development and use of technology
- expertise in the processes through which technology and design can be applied to produce creative and responsible solutions
- a range of technological and general skills
and competencies that have contemporary relevance and can be transferred to other contexts
- positive attitudes toward their own capabilities of management, decision making and problem solving
- a capacity for fair and ethical decision making about technology
- an interest in technological developments and a willingness to critically evaluate technology, particularly new and emerging technology
- willingness to adapt to and learn new and different technological skills.

Technology education is concerned with all aspects of the development of students’ capacities, as individuals and as members of society, to interact effectively with technology.

**Technology education in the curriculum**

Since the publication of *A Statement on Technology for Australian Schools* (Curriculum Corporation, 1994) all the educationally independent states and territories have established technology learning areas through the development of frameworks, curriculum and support material. Various titles have been adopted in different states (technology education, technological and applied studies, technology and enterprise) but they contain similar elements. Technology is defined broadly, and key common elements of the definitions include ‘the application of knowledge and resources’ and that it is used ‘to extend human capabilities’. There is strong general agreement that technology involves a process, that is, there is an identifiable method used in the development of technology. This process is most commonly referred to as design, but it is not defined or described in detail. Similarly, the relationship between the concepts or knowledge of technology and the processes of technology are not explored.

In the titles ascribed to subjects, technology is commonly linked with other concepts, for example ‘materials, design and technology’, ‘science and technology’, ‘technology and enterprise’. This may suggest that existing notions or definitions of technology are inadequate to describe the scope of the intended learning, and this is an emerging area of the curriculum still in the process of definition.

There are few curricula in technology that describe an accompanying body of knowledge, though in some instances new subjects have been developed with the introduction of technology as a learning area. This has left teachers to modify existing subjects to conform to the new approach. Those that use the United Nations Education Scientific and Cultural Organisation (1985) definition express technological knowledge as ‘know how’, presumably knowledge of how to do technology.

The implementation of technology education has been problematic. This is partly because there is a conflict between the curriculum, which is quite revolutionary in nature, and its implementation, which cannot be revolutionary but is developmental and must build on past practice. Teachers have to develop their understandings of technology education and implement new strategies over time. But the technology education curriculum does not incrementally develop from what has existed in schools in the past, it is revolutionary in both knowledge and associated pedagogy.

To some extent this problem has been exacerbated by the introduction of entry-level vocational education and training in the senior secondary years. Some teachers consider the introduction of industry-accredited vocational courses as justification for the maintenance of traditional vocationally oriented methodology and content in the compulsory years.

**The status of technology education**

Technology education was traditionally an ‘elective’ area in secondary schools and is a ‘new’ area in primary schools. It is often perceived as a less important learning area because of this, and the perception has been slow to change. In addition, there is little status in study in technology education for university. Of the technology teachers surveyed, only 32% agreed with the statement that ‘technology is generally regarded in my school as a useful pathway to university’.

Of schools responding to a survey for this investigation, slightly more indicated that technology education is a priority learning area in their school than those who said it is not (56% and 44% respectively). More primary schools (68%) indicated technology education as a priority area. Many schools qualified their response by specifying information technology, rather than general technology education, as the priority area. This confusion between technology education and information technology was widespread, particularly in primary schools.
Some differences seem to exist in schools regarding teachers’ perceptions of the place of technology education in the core curriculum. Only 55% of technology teachers agreed that ‘technology is generally regarded by teachers in my school as an essential component of a student’s general education’, but 87% of school administrators and 84% of other teachers agreed with the statement. This difference in attitude also exists in perceptions of the status of technology education, with teachers of technology education rating the status of technology in their school much lower than other teachers and administrators. Parental support for core studies in technology is strong, with 91% believing that technology should be a compulsory area of study for both primary and secondary students as a component of their general education.

For secondary schools there is no clear definition or requirement for student technological literacy, and in primary schools it is accorded a lower status compared with the central importance of numeracy and language literacy.

The data indicated that many primary teachers are still coming to grips with the notions of technology education generally, and together with inadequate experience and training, lacked confidence and competence in teaching technology. The facilities and equipment are inadequate and generally not conducive to a broad range of technology experiences, though there have been significant developments with computers and information technology.

In all states and territories, technology education (as delivered through subject contexts such as design and technology or home economics) is either a centrally mandated part of the junior secondary curriculum, or the majority of schools ensure students study some technology. 90% of schools mandate technology studies in Years 7 and 8 and it is generally an elective in later years.

There are diverse perceptions of the nature and scope of technology education. It is seen in various quarters as a form of practical science; a study area in which students develop cognitive, attitudinal and manual skills that prepare them for everyday living, employment, further training, and to a lesser extent, university; a study area seen by many as predominantly catering for low achieving students and others not motivated by ‘more academic’ subjects; a study area in which students learn to understand and use emerging new technologies; and finally, a vehicle for the integration of learning undertaken in other areas of the school.

Teachers’ lack of confidence in their knowledge, skills and experience with technology education continues to be a barrier to the status and ongoing development of the area.

Values

Values in general are not effectively addressed despite the clear evidence of support in the curriculum documentation for the principle of addressing values. While policy direction and school leadership are key factors in the successful addressing of values, having good technology teachers is the key to effectively addressing values. Design is the essential element of curriculum and pedagogy that supports the addressing of values in integrated and meaningful ways for students.

Vocational education

The vocational component of technology education is vital, and the strong growth of vocational technology programmes has had a significant impact on schools, and this will continue. The links between the compulsory and post compulsory years of schooling, the general and vocational approach to technology education, are not strong, but there are some indications that these links are developing to focus both aspects on important generic skills. Vocational education is growing in importance as an educational route for an increasing number of students, and in concert with the general component of technology education experienced in Years K-10 (ages 5 to 15), this is a powerful area of the curriculum. The area of vocational education and training has been identified by the ministers of education as an area for national outcomes reporting and possible expansion into compulsory education (up to Year 10).
funding difficulties, low numbers of entry students and the development of a variety of training programmes to meet the needs of a range of students. Professional development is inadequate but vital in this period of significant curriculum revision, particularly for primary teachers who are expected to implement a curriculum in which many current teachers have not been trained.

A picture of effective practice

Principles of effective practice were initially developed from a literature review. This was then verified through observation at 16 leading sites throughout Australia, supplemented by questionnaire data from teachers and students. The following were determined as important elements of effective practice:

- Effective technology education is guided by curriculum frameworks and syllabus statements and is supported by resource material and the local school administration. Teachers work with facilities and equipment which support student activity in a range of appropriate technologies.

- Technology education is available to all students who progress in the acquisition of skills and knowledge as they proceed through the stages of schooling. The technology program is linked with other curriculum areas and with the community.

- A range of different students’ learning styles are catered for through open ended tasks which are placed within contexts that are meaningful for students. All students are challenged by the tasks which are presented to them.

- Students are encouraged to use a range of processes in their technology activities which are flexible and involve ideas and activities, and then to reflect on the adequacy of the process they have followed. Students use a range of investigative strategies, both independently and collaboratively. Activity in technology results in development of a range of manipulative, process, cognitive and computing skills which relate to a range of technologies.

- The technology teacher models and facilitates student’s activity with the goal of developing independent life-long learners. The assessment of students is an intrinsic part of the learning experience by being explicit and fair, and providing feedback useful for future development.

Recommendations

No single recommendation can capture the needs of technology education to make progress toward fulfilling the potential of this area of the curriculum. The recommendations need to be responded to by all levels of educational administration, working in concert to develop teaching and learning in technology education to the point where school leavers are well equipped to personally succeed and to contribute toward the continued development of Australia. Therefore these recommendations are presented in groups related to each of these levels.

General recommendations

1.1 Support initiatives which enhance the status of technology education both within the education and broader communities.

1.2 Promote the development of effective links between technology education and relevant professional bodies.

1.3 The appropriate Ministerial Council establish a small independent advisory board to recommend on priorities within the recommendations of this report and on agreements between the Commonwealth and States and Territories to produce optimal effectiveness in investment in technology education in Australian schools.

Recommendations related to the National Level

2.1 Fund the development of statements of progression for technology education.

2.2 Establish a National Strategy for Technology Awareness to coordinate currently existing technology awareness activities and to implement new initiatives.

2.3 Revise the funding model for teacher training.

2.4 Develop a policy for schools that establishes as a national priority the provision of technology education for all children.

2.5 Provide support for a national professional teachers’ association for technology education which represents all teachers of technology education.

2.6 Commission the development of a series of technology teaching resources for primary teachers.

2.7 Encourage the integration of innovation and entrepreneurship, in a values context, into technology education at all levels of schooling.
2.8. Upgrade primary school facilities to ensure all teachers have the facilities to integrate effectively technology education into their teaching.

Recommendations related to the State and Territory Level

3.1. Make technology education a core component of the curriculum, with a minimum requirement, in the compulsory years of schooling.
3.2. Develop teacher support materials which focus on both conceptual and procedural knowledge in a values context.
3.3. Organise and support frameworks for the ongoing professional development of teachers of technology.
3.4. Implement and expand programmes which provide teachers with opportunities to work in technology-related businesses and industries.

Recommendations related to the System Level

4.1. Offer a range of incentives to individuals to train as teachers of technology education.
4.2. Develop tools teachers can use to evaluate quality activities and share good practice.

Recommendations related to the University Level

5.1. Increase places in secondary technology teacher education programmes.
5.2. Credit Year 12 general technology subjects to count toward university entrance scores.
5.3. Incorporate technology education as a core component of primary teacher education programmes.
5.4. Liberalise rules for entry into technology-based courses.

Recommendations related to the School Level

6.1. Provide support for a range of types of professional development that draw on the expertise of teachers, professional providers, academics and industry.
6.2. Promote the increasing involvement of TAFE, Chambers of Commerce and Manufacturing, private providers and industry in the delivery of relevant technology education in schools.
6.3. Provide primary and early childhood schools with more equipment and materials to enable effective technology education.
6.4. Separate the leadership role for technology education from that of learning technologies.
6.5. Appoint technical assistants to provide adequate technical support for the range of technologies made available to students.
6.6. Provide professional development opportunities so that one teacher becomes a resource person for technology education at each primary school.

Conclusion

This paper is a very condensed version of a report soon to be released by the National Department of Education, Training and Youth Affairs. It is the first such report ever commissioned by a federal government in Australia and has the potential to raise the status of technology education in Australia at a range of levels.

Note

1 The six states and two territories in Australia are educationally independent and so each have curriculum framework and teacher support documents. These documents, from which the aims have been extracted, can be found at the following sites:

Queensland: http://www.uq.net.au/qscce/qscce.html
Western Australia: http://www.curriculum.wa.edu.au/
South Australia: http://www.sacsa.nexus.edu.au/

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