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Technology Education in Australia: A Case of Some Good News But Some Serious Challenges Ahead

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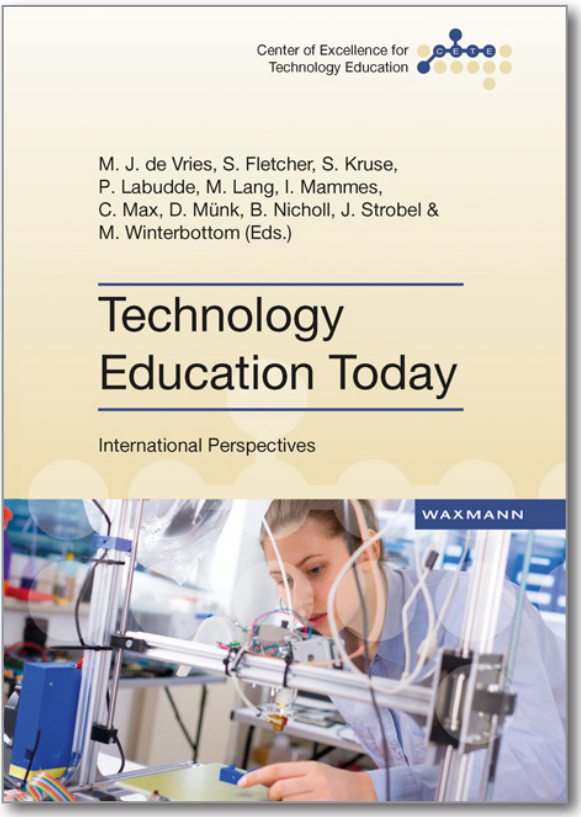

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1. Introduction

In this chapter we attempt to do three things. Firstly, we provide a brief historical account of the development of education in general and technology education in particular in Australia as a context for the rest of the chapter. Secondly, we provide an analysis of the current position in terms of: the development of the National Technologies curriculum; implementation of the curriculum in both primary (elementary) and high schools; the current and possible future role of the national professional association; teacher education; and research. Finally, we attempt to draw together some themes to characterise the current position and provide pointers to future developments.

2. Historical Context

Any examination of current technology or design and technology education in Australia needs to be preceded by some historical background if it is to make sense. The following paragraphs provide a brief history of some aspects of Australia since European settlement in the late 18th century and of the ways this development influenced education policy and practice. Prior to Federation in 1901, Australia consisted effectively of seven separate colonies that had little to do with each other. This was largely to do with distance (Sydney is over 3000 km from Perth by air or 4500 by road). After Federation, many things did not change because the delivery of important services such as health and education remained the responsibility of the former colonies which were now state or territory governments. The Federal government could influence educational practice via funding mechanisms, but states tended to stick to their preferred ways of delivering education. For much of the 20th century these differences mattered little as the population

was not particularly mobile. It was common for people to be born, educated and employed in the same town or at least the same state.

This stability started to break down in the 1980's, with greater mobility the cause for arguments being raised for some consistency of educational provision across the states. Parents didn't want their children disadvantaged if they moved between states for employment. Individual states were, however, often reluctant to change well-established practices.

The first formal acknowledgement of the need for some consistency was the Hobart Declaration (Australian Education Council, 1989), a document that outlined moves towards a more standardised educational provision. In 1994 a curriculum based on 8 learning areas was proclaimed, called the Key Learning Areas (KLA) curriculum that all states and territories had agreed to adopt. The KLA curriculum covered the years from the start of school to Year 10. One of the KLA's was Technology and this represented a major shift for the area which had previously been an optional area of study and not offered in primary education. The Technology KLA was presented in 2 documents (Curriculum Corporation, 1994, a & b).

In the period between 1994 and approximately 2006, despite much work and expenditure, the general consensus was that the aims of the KLA National Curriculum had not been met. Again, the general consensus was that one major reason for this failure was that individual states and educational organisations had not been sufficiently involved in the development and this led to a lack of commitment to implementation. This perceived lack of stakeholder involvement was an important factor informing the establishment of the Australian Curriculum, Assessment and Reporting Authority (ACARA) that was established to develop a new national curriculum, including a new Technologies curriculum. The new ACARA, Technologies curriculum is outlined in the following section.

3. National Curriculum Development

In 2010 the Australian Curriculum, Assessment and Reporting Authority (ACARA) commenced working with educators from each state to develop a National curriculum. The *Shape of the Australian Curriculum* (ACARA, 2009), first approved by the council of Commonwealth and state and territory education ministers in 2009, guided this development. Drawing on the identified learning needs for the 21st Century, the educational goals for

young Australians, and National and International curriculum, the writing of the Australian Curriculum commenced in 2011 with four subjects: English, Mathematics, Science and History. The development of the Arts, Health and Physical Education, Geography and Technology curriculum followed later in 2012. Once developed, the curriculum was trialled in a selection of primary and secondary schools throughout Australia. All subjects within the Australian curriculum were approved and endorsed by the ACARA board and the Australian education ministers in late 2014.

However, despite broad agreement on the need for a national curriculum to ensure greater national consistency in educational priorities, provision and outcomes and to facilitate the education of students who move between states, the processes of developing and implementing the Curriculum has once again been complex and at times fraught. A recent governmental review (Australian Bureau of Statistics, 2014) of Australian Curriculum found that support and implementation across the states and territories has so far varied considerably. The review found that the states with smaller populations such as South Australia and Tasmania and those that had aligned more closely with Outcomes Based Education (OBE) appeared to be the strongest supporters. The more populous states, such as New South Wales and Queensland, which have a longer history of curriculum development and the critical mass to undertake their own curriculum design, have been more reluctant to embrace the Australian curriculum. The review (2014, p. 5) found that one of the major contributing factors to this reluctance was the nature and size of the Australian Curriculum, with the report citing that, "this has impacted on the independence of schools to offer a context rich curriculum that can address the specific and local needs of the school population."

Similarly, the development and implementation of the Curriculum for Technology Education, titled *Technologies* within the Australia curriculum, has been complex with considerable difficulty in finding agreement on the focus and content of the curriculum. There appears to be discrepancy in the level of 'uptake' of the new curriculum, both within schools and across the states and territories of Australia. One of the major reasons for this can be attributed to the limited professional development opportunities provided to support teachers in their understanding and implementation of the Technologies curriculum, particularly the Digital Technologies subject. State governments no longer fund curriculum advisors to support teachers in developing their understandings of new curriculum initiatives. The addition of a Digital Technologies subject within the Technologies curriculum has raised

concerns, particularly from Design and Technologies educators, that greater emphasis will be placed on this subject in the school timetable as well as through funding allocations. Furthermore, requests from some primary schools to integrate the Technologies Curriculum into other subjects to alleviate issues generally characterised as the "crowded curriculum" and the increasing emphasis on student achievement standards, particularly in literacy and numeracy, have also added to the difficulties of implementing the Technologies Curriculum.

However, the outcome of the extensive consultation and debate that occurred in the development of the National Curriculum is a *Technologies* curriculum which places strong emphasis on a curriculum that is designed to teach students that they can be active participants in shaping their future (including technological) rather than being passive recipients and in doing so, become mindful that developing an understanding of sustainable practices is a central element of their learning. The National Technologies Curriculum has coined the term "creating preferred futures" to characterize this priority. The introduction to the Technologies curriculum states:

> *The Australian Curriculum: Technologies* draws together the distinct but related subjects of Design and Technologies and Digital Technologies. It will ensure that all students benefit from learning about and working with traditional, contemporary and emerging technologies that shape the world in which we live. In creating solutions, as well as responding to the designed world, students will contribute to sustainable patterns of living for themselves and others. (ACARA, 2012)

The Technologies curriculum describes two distinct but related subjects:

- Design and Technologies, in which students use design thinking and technologies to generate and produce designed solutions for authentic needs and opportunities.
- Digital Technologies, in which students use computational thinking and information systems to define, design and implement digital solutions.

The key ideas that shape the Technologies learning area are: systems thinking and the overarching idea of creating preferred future and project management, described as:

> An essential element in building students' capacity to successfully innovate in both Technologies subjects. Project work and project management occur as a part of everyday life and are critical to many fields of technologies employment. Technologies education al-

> lows students to develop skills to manage projects from identification of need or opportunity through conception to realisation. Project management is addressed in all years of schooling as individuals and groups of student's plan how they will work to bring a design idea to fruition.

Knowledge, understanding and skills in each subject are presented through two related strands: Knowledge and understanding and Processes and production skills.

Eight years ago, Middleton (2008) identified the Technology Key Learning Area (KLA) as including Industrial Arts, Home Economics, Business, Agriculture and Media. There have been significant changes in the naming of Design and Technologies content with the ACARA National Curriculum. In the Technologies curriculum the content of the Design and Technologies subject is taught through five contexts. These contexts are:

- Technology and Society
- Engineering principles & systems
- Materials & technologies specialisations
- Food and Fibre production
- Food specialisations

(ACARA, 2012)

For the first time, the teaching of food and textiles is a mandated requirement of not only the secondary school curriculum but also the junior and primary levels of schooling. This requirement is a result of a growing national concern for food security (Australia Food Security in a Changing World, report of the Prime Ministers Science, Engineering and Innovation Council, (PMSEIC), 2010), climate change, and personal health and wellbeing. The Technologies curriculum is intended to facilitate not only the development of strategies to ensure the personal health and wellbeing of Australia's future citizens and also promote critical and creative thinking skills as students are encouraged to think more broadly about their own design solutions and those of others. Students are taught to plan for sustainable futures through developing their project management and enterprising skills. The Technologies curriculum recognizes that Technologies play a key role in transforming, restoring and sustaining both the natural and designed world.

The following section of this chapter provides an analysis of where each state is at both in terms of their existing curriculum and in the implementa-

tion of the National Technologies curriculum. The diversity and discrepancy in the level of 'uptake' of the new curriculum, highlighted earlier in the chapter, is clearly visible.

3.1 Tasmania

Technology, or Design and Technology are contained within the Vocational and Applied Learning K-10 Syllabus (www.education.tas.gov.au/Students/schools-colleges/curriculum/Pages/Tasmanian-Curriculum.aspx). Within this generic title there are five key focus areas comprising: Innovation and Design (Ideas, Innovation, Creativity, Aesthetics, Functionality, Communication, Critique/Appraisal); Systems and Processes (Making, Materials, Production, Characteristics and Functions of Systems, Systems Management, Technological Impacts, Safety); Applications and Solutions (Problem-Solving, Research & Development, Sustainability, Business, Enterprise, Teamwork, Project Management, Gathering and Organising Knowledge, Ideas and Data, Evaluation); Futures Planning (Identity, Planning, Goal Setting, Futures, Self-Management, Acting Ethically, Global Thinking, Community, The World of Work); and Skills and Dispositions (Production skills and dispositions, Project skills and dispositions, Conceptual skills and dispositions, Work skills and dispositions, Literacy, Numeracy, Using ICT). Thus, while there is as yet no mention of the National Technologies Curriculum, the state curriculum embodies much of the content and processes that are found in the National Curriculum.

3.2 New South Wales (NSW)

In NSW, Technological and Applied Studies (TAS) is described as being the Australian curriculum Phase 3 learning area known as Technologies (http://syllabus.bos.nsw.edu.au/tas/). In the primary years (Kindergarten to Year 6 [K-6]) prior to 2015, a syllabus called Science and Technology was taught. From 2015, this has been discontinued and been replaced by a K-10 Science Syllabus which incorporates a K-6 Science and Technology Syllabus. The 7–10 schools will continue to teach the existing TAS syllabus until new TAS syllabuses are developed. It is unclear at this stage, how the K-6 component

of new TAS syllabuses will relate to the K-6 Science and Technology components of the K-10 Science Syllabus.

Currently, in Years 7–10, schools teach a wide range of subjects under the TAS banner including: Agricultural Technology; Design and Technology; Food Technology; Graphics Technology; Industrial Technology; Information and Software Technology; Technology (Mandatory); and Textiles Technology. In addition, schools are able to develop their own courses, and these are categorised as Content Endorsed Courses (CEC). An example of a CEC course is Marine and Aquaculture Technology.

3.3 Queensland (QLD)

Queensland has committed to a 3-stage process of implementing the Australian curriculum (http://education.qld.gov.au/curriculum/framework/p-12/index.html). 2014 was intended for familiarisation with the curriculum. 2015 also for familiarisation, with some implementation (this is an acknowledgement that not all of the new learning areas in the three phases of the curriculum development and implementation would be implemented together), with the expectation that all curricula will have been implemented by the end of 2016.

Currently, the Queensland Curriculum and Assessment Authority (QCAA) lists the Australian curriculum learning area Technologies as being available for use (https://www.qcaa.qld.edu.au/p-10/qld-curriculum/yrs-1-9-technology).

Queensland schools have always had a large measure of autonomy in terms of curriculum content. Even in the senior school years (11–12), the curriculum has not been standardised in the same way that occurs in states that have external exams, which Queensland stopped in the 1970's. School results are moderated by a general aptitude test (The Core Skills Test [CST]). This level of autonomy has had benefits in that it allowed the relatively painless introduction of new learning areas. On the negative side, it also allowed the curriculum to remain static in some schools. One indication of this is that while the learning area is described as Design and Technology, many classroom teachers still describe themselves as manual arts teachers.

3.4 Australian Capital Territory (ACT)

Prior to 1975, The Australian Capital Territory (ACT) had an arrangement with NSW where schools were staffed by NSW teachers and used the NSW curriculum. This arrangement ended in 1974, with the new ACT Schools Authority taking over responsibility for the provision of curriculum and recruitment of teachers for ACT schools (http://www.det.act.gov.au/teaching_and_learning/curriculum_programs). The ACT Schools Authority took the decision to implement school-based curriculum development and to end external exams. Like Queensland, the ACT adopted school-based assessment, even for Year 12, but like Queensland, they use a general aptitude test (The Australian Scholastic Aptitude Test [ASAT]), to moderate school results for Year 12 final assessments and university entrance purposes.

School-based curriculum development provided benefits in terms of facilitating the introduction of new content. For example, computer aided drafting (CAD) was introduced in 1983 and a number of schools introduced design-based subjects in the mid-1970's. The downsides of greater school autonomy, as described in Queensland, were largely avoided in the ACT system because unlike Queensland, which is a large state that is mostly rural, the ACT is effectively a city state, with all teachers in a learning area able to meet and communicate and access professional development.

With the move to a national curriculum, the ACT introduced a curriculum framework which articulated what are described as Essential Learning Achievements that all students must reach. Thus, the ACT is adopting the National Technologies curriculum, but schools have the autonomy in terms of how the Technologies curriculum is organised and taught.

3.5 Western Australia

The year-level syllabuses for the Australian Curriculum: Technologies was released for familiarisation in mid-2015. The achievement standards will be published during 2016. The Western Australian syllabus (http://k10outline.scsa.wa.edu.au/home/p-10-curriculum/curriculum) remains broadly consistent with the Australian curriculum but it has been contextualised to make them more suitable for Western Australian students and teachers. Given the phased implementation of the Western Australian curriculum, schools continue teaching some learning areas from the Western Australian curriculum

supplemented by learning areas described in the former Western Australian *Curriculum Framework*. The adapted Technologies curriculum is written on the basis that all students will study both Technologies subjects (Design and Technologies and Digital Technologies) from Pre-primary to the end of Year 8. Within Design and Technologies (Engineering principles and systems; Food and fibre production; Food specialisations; Materials and technologies specialisations), students have the opportunity to study at least one of the contexts. In Years 9 and 10 the study of Technologies is optional. In Design and Technologies, it is envisaged that schools will provide students with the opportunity to engage with all contexts across pre-primary to Year 10.

3.6 Victoria

The Victorian version of the Australian Curriculum was released by the VCAA in late 2015. Government and catholic schools are required to implement the Victorian Curriculum. Full implementation of the Victorian Curriculum will commence in January 2017. The Victorian Curriculum F–10 incorporates and reflects much of the Australian Curriculum F–10, but differs in some important respects, most notably the representation of the curriculum as a continuum of learning and the structural design. Independent schools may choose to use either the Australian Curriculum or the Victorian Curriculum when developing their curriculum. However, all schools are encouraged to plan and trial courses using the Australian curriculum during 2016.

3.7 South Australia

South Australian government schools (Foundation to Year 10) are in the process of adopting the Australian Technologies curriculum. All students will study the two subjects (Design and Technologies and Digital Technologies) from Foundation to the end of Year 8. In Years 9 and 10, student access to technologies subjects will be determined by school authorities. These could include Design and Technologies and/or Digital Technologies as outlined in the Australian Curriculum: Technologies and/or subjects relating to specific technologies contexts, determined by individual schools. Schools

have the autonomy in terms of how the Technologies curriculum is organised and taught.

4. New Directions in Technology Curriculum

Nationally there has been a significant shift from the Vocational Education Agenda (VET) of the last ten years. Currently, there is an increased emphasis on STEM education as a curriculum priority as a means to increase student engagement, achievement and retention. The Australian Bureau of Statistics data states that the number of people in jobs commonly held by individuals with science and technology credentials, is growing at 1.5 times the rate of other jobs (Australian Bureau of Statistics, 2010–11). These statistics, coupled with Australia's evolving industrial base in the area of advanced manufacturing and the impact of rapid technological change, have resulted in political pressure for teachers of Technology, Science and Maths to keep up to date with the contemporary and future nature of STEM skills. Australia's peak industry body, the Australia Industry Group (Ai Group), has repeatedly called for better school-industry links across both primary and secondary schools to lift participation in STEM (Australian Industry Group, 2013). This has meant that a number of schools are attempting to plan and deliver innovative units of work that integrate learning across Mathematics, Science and Technology subjects. An increasing number of schools are also timetabling STEM classes. However, one of the major challenges often faced by these secondary teachers is the lack of opportunity to collaboratively plan, implement and assess cross-curriculum or integrated units of work. Similarly, the mandated assessment requirements at the senior levels of secondary schooling also have significant impact in a school's ability to adopt a multi-disciplinary approach. However, there needs to be caution on the part of Design and Technology educators, and a reminder that through adopting an integrated approach the focus of Design and Technology education is not lost but is emphasised and enriched.

5. Teacher Education Programs

This section commences with an overview of teacher education programs generally before providing information on the provision of teacher prepa-

ration for Design and Technology across the six states and two territories. Throughout the last ten years there has continued to be significant change in the political, social and economic spheres in which universities operate. For instance, increased online teacher education courses have enabled universities to continue to compete for students in new markets while also seeking to be efficient and maintain standards. Local and international student cohort numbers have increased markedly. Growth in student numbers has resulted in an increase in the number of sessional staff employed and, for the first time, the employment of contracted staff into teaching only positions.

Teacher education programs throughout Australia find themselves at the centre of party politics, with calls for improved professional teaching standards, reduced funding and staffing coupled with calls for increased international student numbers. For example, the latest Teacher Education Ministerial Advisory Group (TMAG, 2014) report focuses on changes to teacher education. The proposed reforms centre on five themes:

- Stronger quality assurance of teacher education courses
- Rigorous selection for entry to teacher education courses
- Improved and structured practical experience for teacher education students
- Robust assessment of graduates to ensure classroom readiness
- National research and workforce planning capabilities

Greater emphasis is also being placed on entry level requirements into teacher education programs with calls for increased Australian Tertiary Admission Rank (ATAR). ATAR is the primary criterion for entry into most undergraduate-entry university programs in Australia. Requirements are also proposed for all final year pre-service teachers to complete numeracy and literacy tests before they can graduate and register to teach. More specifically and alarmingly for Technology education is the gradual decline in the number of programs that offer Technology education, and particularly undergraduate secondary Technology teacher education programs. Limited student demand, reduced university funding and staffing have been cited as some of the factors leading to this demise.

At the stage of writing, preparation of secondary Design and Technology teachers occurs separately from the preparation of Digital Technologies teachers. Preparation for the National Technologies Curriculum (which includes the two subjects of Digital Technologies and Design and Technologies) for primary (elementary) teachers is undertaken within primary teacher education programs. But it is sometimes more difficult to identify with

precision, as in some programs courses in Technologies are compulsory while in others they are optional and the content is often difficult to identify, with some having a strong connection to science, while some others are mostly concerned with digital technologies. Most of the data revealed here relates to secondary teacher preparation as this is more easily identifiable through discrete programs or specialisations.

When analysing the 2014/2015 state and territories tertiary reports on the teaching of technology education programs at universities, the data for each state reveals the following:

5.1 Tasmania

Preparation of Design and Technology teachers in Tasmania is provided by the University of Tasmania (UTAS) at its Launceston campus. Tasmania has the smallest population of any state and, as a consequence, only a modest demand for Design and Technology teachers. State demand for teachers is not the final determinant of numbers as there is mutual recognition of qualifications across states and territories, and graduates are free to go where they wish to teach. UTAS was, however, experiencing a significant decline in enrolments with only 2 applications for the 2013 academic year. In order to cut costs, the Design and Technology specialisation within the Bachelor of Education (Secondary) was discontinued and a new degree, the Bachelor of Education (Applied Learning), was introduced in 2014. This program assumes students have acquired appropriate content knowledge and skills from industry or other studies, as the program includes no discipline knowledge and can be done on campus or on-line. There is a question mark over the degree to which any candidate coming from industry will have a sufficiently broad range of knowledge and skills required by the Design and Technology curriculum.

5.2 New South Wales

Teacher education for secondary Design and Technology teachers is provided by three universities: Australian Catholic University (ACU); Charles Stuart University (CSU); and Southern Cross University (SCU). There is a diversity of program designs and delivery modes across the three institutions.

5.2.1 Australian Catholic University

ACU provides a Bachelor of Teaching/Bachelor of Arts – Technology. This is a 4 year undergraduate program during which students specialize in either Design/Food/Textiles or Design/Engineering Studies/Industrial Technology. Numbers seem healthy with 67 entering 1st year in 2014. However, 66% of those students take the Design/Food/Textiles specialisations, so there appears to be an imbalance in terms of covering the areas within the Technologies curriculum.

5.2.2 Charles Sturt University

CSU provides 2 programs preparing teachers for what is called Technology and Applied Studies (TAS). TAS is the term that has been in use to cover the curriculum area in NSW. How the transition to the National Technologies curriculum will occur in NSW and how this is handled in terms of teacher education programs is not yet clear. CSU provides an on-campus (school leaver entry) program and a distance (Industry Entry) program in TAS, as follows:

Bachelor of Education, Technology and Applied Studies (B. Ed. TAS)

Industry Entry Program – This program is offered by distance and can be completed over five sessions of study (2 and a half years), although many students choose to study part-time. The total number of students enrolled in the program is 173, at various stages depending on their personal enrolment patterns. The majority are Industrial Technology and Food majors with a small number of Textiles, Agriculture and Computing majors. The industry entry program is currently under review.

School leaver entry, on-campus program – Students in this program graduate with a minor specialisation as well as the current Design and Technology and another major specialisation. Specialisations offered through the Industry Entry program include: Agricultural Technology and Design & Technology and Vocational Education & Training (VET Primary Industries); *or* Food Technology and Design & Technology and Vocational Education & Training (VET Hospitality); *or* Industrial Technology (Timber focus, Graphics and Metals focus) and Design & Technology and Vocational Education & Training (VET Construction or VET Metal & Engineering); *or* Computing

Technology (Information Systems and/or Software Design) and Design & Technology and Vocational Education & Training (VET Information Technology); *or* Textiles Technology and Design & Technology and Vocational Education & Training (VET Hospitality). Specializations offered through the on-campus program include: Design & Technology plus a major in one of: Agricultural Technology; *or* Food Technology; *or* Industrial Technology (Timber and Metals focus); *or* Information Technology plus a minor in one of: Textiles Technology *or* Graphics and Multimedia.

CSU also offers Technology for graduate entry students in a Bachelor of Teaching program. Students have a prior degree in one of: Agriculture, Computing, Food Technology or Textiles. Students may also have more designed based degrees such as Architecture, Industrial Design or Graphics Design. They all take a Design and Technology major, but their specialization depends on their base degree. This specialisation attracts about 20 students in most years.

Lastly, CSU provides a retraining program for teachers who enrol in a Bachelor of Education Studies program which has students enrolled in it for a range of curriculum areas. Each year approximately 30 teachers retrain to become TAS teachers.

5.2.3 Southern Cross University

SCU provides a Bachelor of Technology Education (BTechEd) with an Honours option that adds an additional year. Students who achieve 1st class or 2a honours with their thesis can progress direct to PhD study without completing a master's program. Unlike many countries, in Australia an honours thesis is the benchmark for entry to doctoral programs, so master's theses need to demonstrate that they are equivalent to an honours thesis.

The Bachelor of Technology Education is closely integrated with vocational education courses. Some specialisations incorporate specified certificates and/or competencies from Technical and Further Education (TAFE) or other recognised Vocational Education and Training (VET) providers. Students who already hold the appropriate TAFE or other recognised VET provider qualifications receive advanced standing. Student numbers for 2015 are: Year 1 – 77, Year 2 – 48, Year 3 – 25, Year 4 –36.

5.3 Queensland

Design and technology teacher education for secondary teaching is provided by Griffith University in Queensland. 2015 is the first year of a completely redesigned program on a new campus. Prior to 2015, the Bachelor and Graduate Diplomas in Education (Design & Technology & Graphics) were offered on the Mt Gravatt campus, with the last students from that program graduating in July, 2015. From semester 1, 2015 the program has been moved to the Gold Coast campus and completely reorganised. In years one and two of the new program, students complete content studies in the School of Engineering and School of Design, plus common educational courses such as educational psychology. In years three and four, students complete specific curriculum and pedagogy courses and undertake practice teaching in schools. While the program is listed as taking four years, the inclusion of summer schools means students graduate at the end of Semester 1, Year 4. Home Economics and Textiles education are components of the new Technologies curriculum. However, up to the present time, preparation of Home Economics and Textiles teachers has been provided by The Queensland University of Technology. At this stage, no merging of programs has been considered.

5.4 Western Australia

Design and Technology teacher education for secondary teaching is provided by Edith Cowan University. The university offers three programs. The Bachelor of Education (Secondary) addresses all areas of lower and upper secondary school curriculum including:

- Design
- Engineering Studies
- Materials Design & Technology

This program is a 4 year undergraduate double degree with entry pathways through Year 12, mature age, entry by portfolio, and direct entry. The program is small with 45 students across the 4 years. The Graduate Diploma program is one year full time, or two years part time; entry is via the completion of an undergraduate degree in a related area. There are 10 students

enrolled in the program. The Graduate Certificate in Design and Technology is a 1 year part-time program. Sixty students are enrolled in this program.

5.5 Victoria

Preparation of Design and Technology teachers in Victoria is provided by three universities: LA Trobe University, Monash University and Deakin University. There is a diversity of Design and Technology program and course offerings across the three institutions.

5.5.1 LA Trobe University

La Trobe University offers programs across two campuses. A city campus located in Melbourne and a regional campus located in Bendigo. A Graduate Diploma in Technology Education provides graduates with a double major in Design and Technology Education and Vocational Education and Training (VET) (for teaching in VET in schools programs). This is equivalent to a four year undergraduate degree program as per the current requirements for teacher registration. Entry pathways include experienced skilled and expert tradespeople, mature age entry based on a blend of an appropriate VET sector qualification coupled with relevant industrial experience.

50 students were enrolled and undertook the first year in 2015. One third were chefs training to teach Food Technology and the others a mixture of Engineering, Wood trades, Metal trades, Hospitality, Automotive and Electrical and Plumbing. The program has strong Institutional links in the provision of the course, for example the VET sector for Occupational Health and Safety (OH&S) provision. The length of the course is 2 years. In 2015 there were 80 enrolments. At the La Trobe University Bendigo Campus, primary and secondary pre-service teachers in the Bachelor of Education (4 years) complete one Design and Technology core subject.

5.5.2 Monash University

Monash University does not offer a specific Design and Technology program or specialised course at either a secondary or primary level. In the Bachelor

of Education Primary program it is included in an integrated unit with science education, environmental education and Studies of Society and the Environment (SOSE) in the 4th year of the program. In the Bachelor of Early Childhood program there is a combined science and technology education course.

5.5.3 Deakin University

Deakin University does not offer a specialised Design and Technology program. However, each of the University campuses (Burwood, Waurn Ponds – Geelong and Warrnambool) offer one Design and Technology course in their Master of Teaching (Early Childhood and Primary) programs, Bachelor of Education (Early Childhood, Primary and International program offered in Singapore). The total number of students in 2015 was approximately 1055 students across all campuses on- and off-campus.

5.6 South Australia

University of South Australia
The University of South Australia (UniSA) offers two programs in Secondary Technologies Education. The Bachelor of Education Secondary (Design and Technologies or Food and Textile Technologies) is a new four year undergraduate program that replaces the previous Bachelor of Design and Technology program. The new program no longer has a delivery partnership with the Technical and Further Education sector in South Australia (TAFESA). Due to national accreditation requirements, courses are offered within the University in partnership with the School of Art, Architecture and Design and the School of Mechanical Engineering. There are currently 220 students enrolled in the program. UniSA provides a Bachelor of Education Secondary Education (LBSY) with an Honours option that adds an additional year. Entry pathways for the undergraduate program include ATAR, STAT test or a TAFE Diploma (Cert 4) in a related area. The Master of Teaching (Design and Technology specialisation) is a 2 year post graduate program. Current student numbers are 20. Design and Technology Education is offered as a curriculum core course (4.5 units) in the Bachelor of Education Junior Primary/Primary/Primary Middle (MBET) program to over 700 students. De-

sign and Technology Education is also offered as a curriculum core course (4.5 units) in the Master of Teaching, JP/Primary (MBET) program with 100 students.

Universities across Australia currently offer a diverse range of programs and courses to prepare graduates to teach Design and Technology Education. Alarmingly, the number of Universities that continue to offer specialised 4 year undergraduate programs in Secondary Design and Technology education is diminishing with only four universities (University of South Australia, Edith Cowen, Southern Cross University, LA Trobe University) offering such programs. The majority of Australian Universities have moved to a post graduate model, which is a Master of Teaching. This 18 month or 2 year program draws students from a range of Bachelor degrees, including Bachelor of Engineering, Bachelor of Architecture and Bachelor of Design. However, the majority of Australian universities continue to offer at least one specialist Design and Technology course at both a Masters and Bachelor level.

The state reports identify a number of major issues confronting Universities and their teaching, or limitations in teaching Design and Technology education. These issues include:

- Attracting student numbers due to comparatively low wages in teaching (compared to current industry conditions).
- Needing to change peoples' (in-service teachers, students and the wider communities) perceptions about Design and Technology education to match the Design and Futures focus of the Australian curriculum
- Lack of marketing for the university Design and Technology programs
- Shortage of Design and Technology education academics (PhD level), and as a consequence, limited numbers of permanent teaching staff, resulting in a heavy reliance on sessional contracts.
- Budget constraints limiting the replacement of new resources and equipment, thus limiting the availability of on-campus facilities.

6. Professional Associations

In Australia, Design and Technology teachers can belong to a state association (e.g. DATTA South Australia), and these state organisations are federated members of the national Association, Design and Technology Teachers Association of Australia (DATTA). State associations work closely with

teachers and provide professional development, often run annual conferences and workshops and represent teachers in communications with state bodies such as departments of education and university faculties of education. Most Design and Technology teachers know their state association well and regard it as "their" association.

The national association has had a more difficult history and has a more tenuous link with classroom teachers. As a federated organisation, teachers are members automatically by being a member of their state association. However, without individual members the national association is funded by a modest affiliation fee from each state which determines that DATTA Australia has been restricted in what it can do due to lack of resources. In light of reduced government funding for teacher professional development we argue that the place of professional associations in providing a collegial space for support and learning for teachers deserves greater recognition and a level of funding from the state and federal governments. In today's economic climate – coupled with limited professional development opportunities – such imperatives are vital for the continued success and growth of teacher's professional associations.

In 2012 DATTA Australia and DATTA Queensland combined with Griffith University's Technology Education Research Conference (TERC) to run a combined research and practice conference that allowed teachers to see what research was being conducted in Australia and internationally and for researchers to observe examples of practice. The other objective of the conference was to provide funding for DATTA Australia to allow it to provide better representation for members and to provide more tangible benefits. In 2014 TERC became part of DATTA Australia and a second combined conference was held in Sydney. Planning for a third conference in Adelaide in November/December, 2016 is well advanced. Further conferences are planned for Melbourne in 2018 and Canberra in 2020. One hope is that a suitably funded national body would be in a position to initiate projects to benefit members similar to the way the International Technology Education Association (ITEA, now ITEEA) did in 1994 when it obtained funding from NASA and NSF for the extensive Technology for All Americans Project (TfAAP) (ITEA, 2000).

7. Research

When comparisons are made to other subject areas, the introduction of technology education is relatively recent. As a consequence, research in the field, while developing, continues to be more limited when compared to other subjects, for instance, Mathematics education. When searching for research in Technology education, reference is generally made to digital, information or communication technologies. There is still a general perception among the wider public that Technology education is computing. Research that examines the complex and valuable learning experiences that occur in Design and Technology classrooms is vital. Research in Technology education in Australia continues to discover new ways of researching teaching and learning in Technology education. This research serves to inform and shape the understandings and practice of academics, beginning and more experienced teachers and the wider public. In 2011 Williams conducted an international review of research papers, journals and technology education research conference proceedings written between 2006–2011. The review, published in 2013, found that forty-two papers focused on design in Technology education. Topics researched during this five-year period included curriculum (34), technological literacy (34), and thinking (32). A more recent review (Williams, 2014) found five areas of increased research. These areas include: STEM, Information Communication Technologies; Sustainability/Environmental; Learning; and, more specifically, Online Learning. A review of research papers presented by Australian authors at the 2014 Technology Education Research conference (TERC) reveals a range of topics including: beginning Design and Technology teachers' professional identity (MacGregor, 2013; 2014); Technologies curriculum development (King, 2014); Gender in Technology Education (Knope, 2014); Teaching Food and Textiles (Trevallion, 2014 & Von Mengersen, 2014) and Creativity (Campbell & Jobling, 2014). TERC continues to play a significant role in providing a vehicle for Australian researchers to present their research in D & T and to share this with overseas researchers, and in some cases undertake collaborative research.

A most positive development in recent years has been the increase in book publications that highlight research, teaching and learning in the area of Technology education. For example, The Sense Publishing series on International Technology Education has been a major contributor to this effort with books and chapters dedicated to reporting research and best practice.

Specifically, Environment, Ethics and Cultures (Stables & Keirl, 2015), and Technology teachers as researchers (Skogh & de Vries, 2013) are recent additions to the publications list. The Future of Technology Education (Williams, Jones & Buntting, 2015) published by Springer is also a recent addition to the suite of publications in the field. Encouragingly, findings from Martin & Ritz's (2014, p. 16) study into research priorities for Technology states that

> The growing influence of recently published international literature and the growing popularity of participation in international conferences on technology and engineering education (e.g. Technology Education Research Conference [TERC], Pupils' Attitudes Toward Technology [PATT], International Technology and Engineering Educators Association [ITEEA]) are having a strong positive influence on identifying research needs common to all technology and engineering educators.

While research publications have increased, so too have the numbers of PHD graduates both within Australia and internationally. Such increases are heartening as we need to be mindful of succession plans as those that shaped the subject through its infancy are replaced by others that bring new ideas and visions for the future.

8. The Future?

We titled this chapter *A case of some good news but some serious challenges ahead*. In summary, the good news is that Technology education continues to be a mandated subject within the Australian curriculum. Children from birth through to the senior secondary years of schooling have the opportunity to design and create through a subject which promotes problem solving, critical and innovative thinking. However, there are looming threats and constraints on the amount of time in the curriculum that could be given to teaching Technology education in the future. These constraints include: the crowded curriculum; increasing teacher accountability through national testing in literacy and numeracy; and the addition of digital technologies as a subject in the Technologies curriculum. It could also be argued that the way STEM education is organised and implemented could pose such a threat.

There is both good and challenging news in regards to teacher education in that while the teaching of Technology education as a specialisation at a university level appears to be diminishing, particularly at an undergradu-

ate level, there are several universities in which programs are well positioned and continuing to grow. These universities also report a growing demand from interstate students to enrol in their courses. There are, however, difficulties in finding academic staff with the required PhD qualifications in the field to teach in these programs. Demand for Technology teachers at a secondary school level also continues to grow throughout the majority of states. Yet, the role of the specialist Technology teacher in a primary school is very rare compared to almost twenty years ago when Technology education was first introduced into the Australian primary school curriculum. The news is very good for research, publications and PhD completions in Technology education. In concluding, we draw advice from a previously presented paper that reflected on twenty years of teaching in Technology education:

> The future need not be seen as a lottery or beyond our control if D&T can be continuously redesigning itself in response to astute reading of political and curriculum trends (Keirl & MacGregor, 2011, p. 87).

We, as academics and teachers have continued to broaden our understandings of Technology education. We have modified our courses and programs, our pedagogical approaches and strengthened our advocacy to meet political, historical and curriculum directions. Our challenge is to continue to do so into the future.

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