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Perspectives on Technology Education in New Zealand: Twenty years of progress?

Bruce Granshaw

Abstract

This paper provides an historical review of the implementation of the technology learning area in New Zealand secondary schools with a view to identifying aspects which may, or may not, have enabled success. The intention here is to build on previous studies and to consider issues which may have been problematic to some teachers and other stakeholders. By reflecting on this process it may be possible to provide further understanding of present and future needs, which can guide the continuing development of both the technology learning area and its ongoing implementation.

The paper draws significantly from the author's experience as a professional development facilitator and pre-service technology teacher educator over a twelve year period. Through this work there has been opportunity to gain considerable understanding of issues concerning technology education, implementation, and the facilitation of professional development for teachers of technology.

Keywords: Technology education, implementation, professional development, educational reform.

Introduction

This paper provides an historical review of the implementation of the technology learning area in New Zealand secondary schools with a view to identifying aspects which may, or may not, have enabled success. The intention here is to build on previous studies and to consider issues which may have been problematic to some teachers and other stakeholders. By reflecting on this process it may be possible to provide further understanding of present and future needs, which can guide the continuing development of both the technology learning area and its ongoing implementation.

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Over the past 20 years technology education in New Zealand has been developed and revised a number of times, namely Technology in *The New Zealand Curriculum* in 1995, preceded by a draft document, followed by *The New Zealand Curriculum*, gazetted in 2007, also preceded by a draft document. The curriculum learning area of technology replaced the previous workshop craft syllabus and traditional learning areas which for year 7–13 students might be described as 'woodwork, metalwork, cooking and sewing'. This was a new learning area for students at years 1–6. Arguably, the implementation process has been mostly successful in that New Zealand has a technology learning area which, relative to most other OECD countries, has advanced technology education in line with current international thinking and practice. The basis for this hypothesis is discussion and debate that has taken place at international conferences that the author has attended, including Pupils Attitudes Towards Technology (PATT) (2011), PATT (2013), and most recently PATT (2015). Such an hypothesis at this point is based on anecdotal evidence; however, it is certainly open to further investigation.

The implementation process has had many challenges, some of which are yet to be fully resolved. An ongoing process of further development and refinement, informed by relevant research and feedback from the technology community, is appropriate and to be expected.

Technology in *The New Zealand Curriculum* is described as:

> intervention by design: the use of practical and intellectual resources to develop products and systems (technological outcomes) that expand human possibilities by addressing needs and realising opportunities. Adaptation and innovation are at the heart of technological practice. Quality outcomes result from thinking and practices that are informed, critical and creative. (Ministry of Education, 2007a, p. 32)

It is evident then, that the intentions for student learning within a curriculum area such as this are far more sophisticated and complex than those which might have been the case under the previous skills-based syllabi. The Ministry of Education goals for technology are stated as being "to develop seamless quality technology education for all New Zealand students from early childhood, and through years 1–13, as part of students' general education" (Ministry of Education, 2010, p. 6). A process of continuity and progression is essential if this is to be achieved. This paper explores a range of perspectives on the development and implementation of technology education in New Zealand schools.

Technology in the New Zealand Curriculum

Technology in *The New Zealand Curriculum* (Ministry of Education, 1995) was gazetted in 1999, making technology education mandatory for all students from years 1–10. Its aim was to develop in students a technological literacy by experiencing technological practice. Three strands, Technological Knowledge and Understanding, Technological Capability, and Technology and Society provided structure to the technology curriculum across a wide range of technological areas. These strands included materials technology, food technology, electronics and control, biotechnology, structures and mechanisms, production and process technology, and information and communications technology. The work produced by students based on technological practice involved their consideration of the effects of the technological development (i.e. the technology outcome) and its implementation on people and the wider environment.

The intent of this curriculum differed from previous workshop craft-based prescriptions in that students' technological outcomes were developed more from a sociocultural perspective (that is, the impact of the technological outcome in a sociocultural context) than in terms of the intrinsic take home value and quality of craftsmanship. This shift from an emphasis on high levels of craft and design skills - a strong emphasis on the learning of hands-on practical skills - to a more sociocultural approach to the development of technological outcomes required teachers to adopt more of a constructivist learning theory approach to their teaching (Harwood & Compton, 2007). The essential point is that the new technology, while still incorporating hands-on learning, embeds this within a broader focus on technological literacy, design, critical thinking and problem-solving. There is a focus on the sustainability of technology.

Between 2001 and 2003, the Ministry of Education conducted a review of the National Curriculum with the intention of taking stock of all the curriculum essential areas and developments which had occurred over the previous decade. The Curriculum Stocktake (Ministry of Education, 2002) aimed to examine the quality of *The New Zealand Curriculum*; its implementation and effects on student outcomes; and the developments needed for the future.

The University of Waikato was contracted to facilitate the National Schools Sampling Study which investigated teachers' experiences of implementing the technology curriculum. This study used questionnaires, focus groups and case studies across the entire school sector, and a number of issues emerged. The primary sector was most concerned with curriculum overcrowding as it was responsible for coverage across all curriculum areas. Intermediate school technology teachers' key concern was managing effective assessment, whereas secondary school technology teachers had problems with understanding the curriculum language and intent as well as a lack of confidence in their content knowledge and pedagogical strategies to effectively deliver this revised technology education (Ministry of Education, 2002). The publication of the New Zealand Stocktake Report (2002) resulted in the New Zealand Curriculum Marautanga Project being established with the aim of re-developing the curriculum framework and essential learning areas within it.

Technology education went through another shift with the development of *The New Zealand Curriculum* (Ministry of Education, 2007a) and the technology essential learning area within it. The focus on developing students' technological literacy remained central but three new strands were introduced: Technological Practice; Technological Knowledge; and Nature of Technology. A new approach to the teaching of technological literacy (Compton, 2007) was developed as a result of perceived limitations in students' understandings; this perception related to the emphasis given in many schools to technological practice alone. Between them, the three new strands now provided opportunity for students to develop a broader, deeper and more critical technological literacy than had previously been the case (Compton & France, 2006; Compton & Harwood, 2006).

Early implementation issues existed for many technology teachers who had difficulties in establishing technology education in their schools. They cited a range of reasons including inadequate facilities, timetable constraints, and lack of enthusiasm on the part of both teachers and middle and senior management (Jones, Harlow, & Cowie, 2004). However, a significant sector of technology teachers may have felt out of step with the developments described above. Although many of these teachers were highly skilled people with technical and trade backgrounds, they were only provided with limited opportunity to be trained to teach the new technology. Consequently, a gap existed between the goals of the new curriculum and the implementation strategy to fulfil these goals.

Table 1 below sets out the key historical developments relating to development and implementation of technology within the New Zealand curriculum school context. The discussion that follows the table highlights some of the entries of particular importance.

Table 1: Key historical developments in technology education in New Zealand

Date	Development
1990 Achievement Initiative	Government announced the Achievement Initiative for schools. A series of new statements would be developed for Maths, Science and English specifying clear achievement objectives (AO's) for student learning. Technology was included as an essential learning area and therefore became a new curriculum area for NZ schools.
1991-92 Development of technology consultation	Policy work was undertaken to establish a framework for development of a technology curriculum. A discussion booklet *So this is Technology* was published in April 1992 based on suggestions and questions provided by primary and secondary teachers, teacher educators, and tertiary and industry representatives.
1993 Development of technology in schools policy	University of Waikato was contracted to develop policy papers which were summarised in 'Technology in Schools' published in April, 1993. The *New Zealand Curriculum Framework* set out the *essential learning areas* including technology developed by a further contract with University of Waikato. A draft

	statement was required which would describe eight levels of achievement for all strands of technology.
1994 Draft curriculum	Technology in the New Zealand Curriculum Draft was issued for consideration and comment. Schools were invited to use it optionally for planning technology programmes from 1994 onwards.
1995* Gazetting of Technology in the New Zealand Curriculum	*Technology in the New Zealand Curriculum* was published taking into account feedback on the 1994 draft version from across the sector. It provided the basis for technology programmes in schools from years1–13 and placed emphasis on technological practice. It replaced the previous *Forms 1-4 Workshop Craft Syllabus for Schools* (1986). *Actually gazetted in 1999 due to the PPTA moratorium
1998-2000 Technology in Years 1–8 resources	*Implementing Technology in New Zealand Schools* and a series of nine technology area specific resource books, titled *Classroom Practice in Years 1 – 8* resources, were published.
2000-02 Curriculum review of technology	A curriculum review was undertaken for technology based on recognition that technological practice alone was insufficient. Students were considered to lack breadth and depth and required a stronger focus.
2002 Introduction of NCEA	The National Certificate in Educational Achievement (NCEA) was introduced as a national initiative which emphasised assessment in the form of Achievement and Unit Standards at the senior secondary level of education (see later text). This standards-based assessment structure replaced School Certificate, Sixth Form Certificate and Bursary qualifications.
2003 Techlink website established	The website Techlink was established by the Institute of Professional Engineers of New Zealand (IPENZ). This became the repository for resources, relevant literature, case studies and exemplars to support teachers and others involved in technology education.
2003 Growth and Innovation Fund	The Growth and Innovation Fund (GIF) was established by the Ministry of Education providing funds for the 'G3 + initiative'. This initiative provided funding to enable technology teachers to upgrade their existing qualifications to enable them to access the new higher salary grade.
2005 Beacon Practice	Beacon Practice project began, aimed at developing technology education in schools and providing teaching resources for technology. The project ran over three phases and was extended to 2012. This has since been extended to cover the primary school sector.
2005 IPENZ	Institute of Professional Engineers New Zealand (IPENZ) was contracted for materials development, with publication of resources on the Techlink website.
2006 New Zealand Curriculum Draft Consultation	New Zealand Curriculum: Draft for Consultation 2006 was published across all curriculum areas and requests for submissions were issued: 10,000 responses were received from stakeholders. Technology was one of eight learning areas included in the curriculum.
2007 *New Zealand Curriculum* published	*New Zealand Curriculum* (2007) was published and included statements on the nature of each learning area and how it is structured. Technology was one of the eight learning areas. Previously each learning area was described as “essential;” this word was removed.
2008 Technology Curriculum Support Document	The Technology Curriculum Support Document was published providing guidance to teachers by unpacking the strands and components of technology for each strand at all eight curriculum levels. Further reviews and research expanded this document which was revised in 2008 and again in 2010. A ‘New Technological Literacy’ was defined in a paper by Compton and France (2007). Explanatory papers were included to cover all eight components of technology

	across the three new strands.
2011–2013 NCEA Alignment with NZC	An Achievement Standards alignment process took place involving the re–writing of technology NCEA achievement standards so they would align more closely with the Technology learning area in the 2007 curriculum. This process was progressively implemented one level per year over three years. Teaching and Learning guides were also published to support teacher understanding of senior assessment.

Some issues concerning intervention and educational reform

Radical educational change or reform is complex and embedding the change so that it works, rather than just operates, needs very careful consideration (Hall & Irving, 2010). These writers, from an analysis of literature on educational change, identify three aspects in particular that need to be addressed: the role of professional development in spreading the change; co-construction in the design and implementation of reform; and the need for specialist expertise on the ground (p.103).

Hall and Irving (2010) drew upon analysis by Perris (1998) and Wood (1998) of the education reform process in New Zealand through the 1980s and 1990s. Hall and Irving propose that:

> while radical educational reform may be able to be driven through so that it is in place and operating, problems are likely to remain unless considerations relating to professional development and the co-construction of policy implementation with experts and practitioners are carefully addressed. (p.104)

Of particular interest is that Hall and Irving deliberately drew on literature pre-dating the reform movement of the 1980s and 1990s to illustrate that much was already known about factors and/or conditions that facilitate the introduction and embedding of radical reform in education. Hall and Irving drew on, in particular, Morrish (1976) and Nicholls and Nicholls (1975). For example, Morrish identified seven impediments of significance to successful reform:

- Environmental resistance;
- Over centralisation;
- Teacher defensiveness;
- Absence of ‘change agent’;
- Underdeveloped scientific base;
- Confused goals; and
- Uniformity of approach.

It is not the intention of this paper to systematically analyse the technology curriculum learning area in line with all of the points made by Morrish (1976). However, two in particular seem to be relevant to the New Zealand technology curriculum learning area: environmental resistance, and teacher defensiveness.

Environmental Resistance and Teacher Defensiveness

Many teachers in secondary schools did not believe that replacing the previous workshop craft-based subject with one which was considerably more academic would be suitable for their pupils. They believed that the subject should place primary focus on vocational, practical skills, which would put students in a good position to enter trade type jobs (e.g., Granshaw, 2010). Parents employed in such trades also tended to agree with them. Even now, nearly 20 years after initial implementation of a technology curriculum, some teachers still resist teaching technology, preferring to continue to teach practical craft-based programmes and not developing a senior pathway for technology in their schools. Instead, they assess students with Industry Training Organisation (ITO) unit standards rather than engaging with either generic or skills specific technology achievement and unit standards. They argue that technology is too academic for their students and therefore they have no choice but to use a practical skills-based approach to their teaching. This assertion is based on the author's experience as a professional development facilitator. An alternative view might be that these students, or at least some of them, would engage effectively with technology if the junior programmes allowed them to develop a significant technological literacy, enabling them to access the NCEA Technology Achievement Standards within a well-balanced senior technology programme. While it can be argued that there is a place for both types of programmes in schools - ITO Unit Standard based courses may be more suitable for some students within certain communities - it is important that a senior pathway for technology is available so that all students, if they desire, can aspire to a broader understanding of technology which encompasses study for university entrance.

When considering the issues above concerning implementation of major educational reform which Morrish (1976) identified, and merge these with those specific to technology, that is, as identified below by Fergusson (2008), we see the nature of the challenge which has faced many technology education stakeholders over the last 20 years. Positive factors for successful change have also been noted by others, including Nicholls and Nicholls (1975); these include teachers' understanding and supporting the change, having the knowledge and ability to implement it, possessing relevant resources, and being supported at an organisational level including with professional development. It has certainly been recognised that effective professional development is a key to successful implementation of this change (Granshaw, 2010). Adequate time is also required; the internalisation of the changes by teachers so that new practices become embedded in schools may be a lengthy process (Hall & Irving, 2010).The risk here is that change is taking place but in a limited and shallow way. In addition, the timeframe for supporting participants may need extending and to be ongoing in nature if minor changes to any new policy continue to take place. This appears to be the case with the implementation of senior secondary technology, as well as realignment of NCEA achievement standards and the New Zealand Scholarship examination.

A smooth implementation

Fergusson (2008) in his comprehensive publication, *Development of Technology Education in New Zealand Schools 1985 – 2008,* cites a range of issues which may have hindered a smooth implementation of the technology learning area within the *New Zealand Curriculum 2007*:

- Principals' understanding and support;
- Accommodating technology into existing curriculum structures;
- School facilities;
- Negative feedback from the Business Roundtable (Education Forum Reports);
- Teacher training and retraining of former 'manual teachers';
- Salary negotiations and the G3 issue (explained below);
- NCEA re- alignment with the technology curriculum;
- University entrance issues. (Technology was not an entrance subject until 2005);
- The 'theoretical versus practical' perspective; and
- Post Primary Teacher Association (PPTA) views and issues of 'under resourcing'.

Some of these may be considered to have had a relatively minor impact on the implementation process: for example, issues such as school facilities (secondary schools generally have sufficient facilities to deliver some technology courses), university entrance, and education forum reports, but others have had a far greater impact. A major issue for many in the secondary sector was the salary negotiation and the "G3" issue where teachers were asked to support a PPTA initiative which created a new pay step for teachers who held a substantive degree and a teaching qualification. Technology (technical) teachers with alternative 'subject content knowledge' qualifications and a teaching diploma were led to believe they would be eligible for the new pay step and voted in favour of the initiative. After ratification it immediately became clear that this was not the case. This negatively affected the salaries of many highly experienced technology teachers with relevant subject specific qualifications other than a degree, and created a major division amongst teachers. Many technology teachers found themselves ineligible for the new pay step whilst younger and less experienced technology teachers could access it immediately. Opportunity was provided to teachers to improve their qualifications through part time study. Some participated, while others did not, citing a range of reasons including school workload and stress levels. For teachers in this situation, a strong disincentive to participate positively or fully in the reforms was provided by the new pay structure that they perceived to be unfair.

Another key issue raised by Ferguson (2008) was the requirement to accommodate technology education into existing curriculum structures. It became evident that effective technology curriculum coverage would take more time than was previously allocated to the option subjects such as graphics or workshop craft, and also it should be delivered to all students. School curriculum planners and senior management teams frequently did not understand, and therefore did not allocate suitable resources, including time, for technology delivery to all students. Many simply failed to see technology as a curriculum area equivalent to the traditional core subjects of Maths, English, Science and Social Studies. Technology teachers faced significant challenges not of their own making, in many cases, with little support or guidance.

Professional Development

Arguably, one of the biggest impediments to the smooth implementation process of the new technology learning area was the lack of *effective* technology education professional development (PD) to support all technology teachers, and also to provide senior management teams within schools with an understanding of what was being asked of technology teachers. It is true that some professional development was provided (as described below) but this early PD did not cover all participating sectors within primary, intermediate and secondary schools, and was delivered by facilitators largely from a theoretical perspective, as many had never taught this newly created subject of technology. Further, the resources used were untested and, in fact, limited in their nature. The quality of this limited PD may have impeded a smooth uptake of technology for many teachers.

Technology teacher professional development is seen as the best way to support all technology teachers with their understanding of the major shifts which have occurred in the subject (Harwood & Compton, 2007). Certainly the technical teachers mentioned above required extensive support as they were, in effect, re-training whilst working full time. All technology teachers need professional support, even those most recently trained. The revised curriculum for technology and its full implementation in 2010 (Ministry of Education, 2007b, p. 6) is substantially different from the previous version, and the introduction of standards-based assessment in 2002 has had major implications for how all technology teachers work. The PD offered, however, needs to be accessible and perceived to be relevant (Service, 2014) if teachers are being expected to put in considerable time and energy on top of their already extensive workloads. If this is not the case, then there is a danger that teachers will not fully engage with the new learning and, as a consequence, continue to run programmes for students which are not consistent with the aims of the new curriculum.

There has been a history of PD and resource development in technology education. An early programme which supported the introduction of *Technology in the New Zealand Curriculum* in 1995 is described by Compton and Jones (1998). The Facilitator Training Programme aimed to train two groups of 15 technology educators, over a two-year period, with a view to their running professional development programmes in schools. The training of the facilitators was seen as effective as were the programmes these people ran in schools; however, whilst their message and facilitation was consistent between them, there was a limit to the number of schools and teachers they were able to work with. Further to this, financial and time constraints meant they could only deliver an introduction to technology education, rather than in-depth and long-term PD.

A Technology Teacher Development Resource Package was developed by the Centre for Science, Mathematics and Technology Education Research within the Ministry of Education in 1997. It included written and video material entitled *Know How*. This material was intended to support teacher understanding of technological practice, technology education and pedagogy. The package was trialled in fourteen schools before being released. The material was seen by many teachers as being effective in its purpose. Some of the resources are still used, but a limitation was that the new knowledge it contained needed to be facilitated rather than accessed voluntarily if it was to have an impact on all technology teachers, rather than just those who chose to engage with it. Facilitation opportunities for all technology teachers were limited (Granshaw, 2010).

PD which supported teachers gaining new understanding of the 1995 technology curriculum and its seven technological areas was also facilitated by private providers (technology education experts offering courses schools could purchase), and by School Support Services attached to the colleges of education and some universities. This varied in its effectiveness across the country as the facilitation and content was constructed by advisers with different backgrounds and varied experience, as mentioned above. Certainly in technology, advisers tended to be people with excellent teaching backgrounds but often not with experience of the new 'technological practice' advocated in the curriculum. As noted by Hall and Irving (2010), an issue underpinning the introduction of educational reform is the absence of enough people with practical expertise in the reform to provide informed PD. Many technology teachers felt that some PD delivered to teachers was not of a consistent nature, possibly due to the unfamiliarity of many facilitators with new subject and curriculum knowledge (Granshaw, 2010). The introduction of Ministry of Education National Meetings (Hui), where facilitators had access to leading subject developers and researchers, possibly enabled a more consistent message to become the basis for more effective PD, although there is no systematic research to verify this.

The next major PD initiative occurred between 2000 and 2004. It supported the introduction of standards-based assessment, in the form of Achievement and Unit standards for NCEA levels 1–3, and also for Scholarship. This Ministry-funded initiative was coordinated nationally and drew upon the expertise of subject specialists and advisers as regional facilitators. These people trained other facilitators using a package of resources developed by a national facilitator. Subject facilitators delivered the PD to teachers at a range of centres across the country, on specific days known as 'Jumbo days', whilst schools were closed, freeing up time for effective teacher engagement. Teachers' working together was a positive aspect of this PD (Hill, Hawk & Taylor, 2002) but it was prescriptive, due to facilitators having been instructed to closely follow the resource material step by step. A prescriptive approach to PD can be limited (Timperley, Parr & Bertanees, 2009) as it may not support deeper learning nor deal with everyday practical issues that arise. These PD Jumbo days provided opportunity for teachers to engage with the resources and share understanding of the new assessment structures. They could not, however, be described as in-depth due to the short, one-off timeframe, and they could not take into account the impact on student learning, as described by Hill et al. (2002).

In 2005, as a result of strong academic, professional and media criticism of the newly introduced Scholarship examination (and NCEA), a new PD initiative was introduced which built on what had been learned from previous experience (Ferguson, 2008). This initiative involved an expanded strategy for achieving change within schools and improved perceptions of the new curriculum. The strategy included seminars for senior management of schools and Boards of Trustees, cluster group professional learning for teachers, teacher workshops, the provision of additional resources, and follow-up evaluation of the effectiveness of the new initiative.

The PD, which supported the introduction of achievement standard assessment for senior students, did more than just inform teachers about a new assessment methodology. It provided the opportunity for technology teachers to examine the subject of technology in terms of its theoretical underpinnings, its content, and the associated pedagogy necessary for effective student learning (Ferguson, 2008). This seems to have provided the opportunity for many teachers to redevelop junior technology programmes (years 9-10), the concern being that without effective student learning during these years, students were unlikely to have the competencies required for success at senior levels.

Certainly technology PD has been designed to meet the challenges of implementation as they emerge, but often only after they have emerged. The process of PD has had its successes but these have become more limited with recent changes in funding and contracts by the Ministry of Education. Arguably, much of the most effective PD has been facilitated in the past by university based School Support Services, which were able to focus on specific curriculum PD. Schools were able to access free support in this way as and where it was needed. This was valuable as different schools and teachers have specific and diverse needs, which are particularly important to address if the focus of PD is to result in improved learning outcomes for students (Timperley et al., 2009). Within technology teacher learning Granshaw (2010) identified a set of key considerations consistent with the wider literature on effective PD for teachers. Models of technology teacher PD may not have always been effective and available across the whole school sector such that common understandings and practices could be created.

Flexibility in relation to supporting teachers through PD has been reduced with the change to the limited and more generalised national technology facilitation structure which presently exists. Many technology teachers still request professional development to support and further develop their practice (this, at least, is the experience of the writer in his role as a teacher educator). Subject associations are presently endeavouring to fulfil this need on a voluntary basis. Communities of practice can be supportive in this way, although there may be issues with consistency of information and understandings.

Resources

Resource development may be considered to be another critical factor which has impacted on the smooth implementation of the new technology curriculum. The Development Resource Package published by Ministry of Education in 1997 was comprehensive and considered effective by those teachers who voluntarily accessed and used it; however, many technology teachers, particularly those with the technical training background, were less than enthusiastic about implementation of a new technology curriculum and did not access or engage with this material. Access and acceptance may well have been greater had all leaders of technology education (e.g. HODs) across the entire school sector, engaged with the new resource. It is fair to say that a range of other resources were produced, some by the Ministry of Education and others by private providers. The Ministry's New Zealand Curriculum Exemplars for Technology publications were an effective resource. They unpacked each of the seven technological areas of the 1995 technology curriculum. However, the developing understanding of a new technology education, based on research, meant that previously developed resources became outdated and, in fact, limiting, in their effect quite quickly. Outdated resource development was not the only issue here. The primary school technology sector had few resources and PD. Technology education was often not included in learning programmes, resulting in students not having an opportunity to develop an early technological literacy.

Recognition that effective resources were vital for a successful implementation of technology education led to the development of the Beacon Practice Project in 2005. Expert facilitators were contracted to work with technology teachers in selected secondary schools to develop and implement effective technology programmes. The resources were to be published on the Techlink website and schools received specific extra funding to support this. Initially, secondary schools participated in the project and the primary sector was included in 2012, again with the intention of developing high quality resources for technology teaching.

Funding for the Beacon Practice initiative was through the Growth and Innovation Framework (GIF) Technology Initiative. Technology education received the very significant support of $2.2 million per annum, until 2013. As a result of this, not only were a wide range of resources developed and published online on the Techlink website, but many participating teachers were able to support their colleagues in and across schools.

The New Zealand Curriculum was published in 2007 and Technology as one of the eight learning areas was redefined with new strands, achievement objectives and a new direction designed to develop in students a new and broader technological literacy. The following year the Technology Curriculum Support Document (Ministry of Education, 2007b) was published, having been designed to help schools and teachers with the implementation of the technology learning area. Since then this resource has been revised, the latest version being April, 2010.

The Support Document contained a wide range of resources including an explanatory paper for each of the eight components of technology within the three strands, and one on defining the new technological literacy. It contained links to the Techlink website where examples of technology teaching were accessible. The document also contained three matrices, one for each strand of the curriculum, indicating the competencies students should have at each curriculum level from 1–8. These Indicators of Progression were intended to help teachers be clear about what students should learn and what progression in technology looks like. The indicators can also provide a basis for formative and summative assessment and for reporting on student curriculum level competencies in technology education. The author's experience as a professional development facilitator, working with this document, indicate that teachers welcomed this resource, although critics suggest that the distinctions between one curriculum level and the next are, in some cases, too fine to easily distinguish, and therefore difficult to teach, particularly at the higher curriculum levels. Further research (Compton & Compton, 2013) was undertaken with a view to gaining a better understanding of progression, particularly within the Nature of Technology components.

Further literature has been published online (Patterson, Black, Compton & Compton, 2012) which explores the impact of research on teaching technology. The authors found agreement with Rohaan (2009) and Rohaan, Taconis and Jochems (2010) who indicated that "increased teacher understandings enable greater engagement and improved pedagogical content knowledge and that this affects teaching and in turn children's understandings of technology" (p. 387). Patterson et al. conclude that regular, ongoing, in-depth professional development which is focussed on improving both subject content knowledge and pedagogical knowledge, increases teacher capability and student understanding in technology.

Ministry of Education funding allowed for the position of the National Professional Development Manager for Technology to be created. Work here included establishment of regular Hui (two per year) where pre- and in-service technology educators were able to share practice, develop and critique resources, and enable common understanding to support their practice. A key initiative which was developed through this process was the *Pre-Service Technology Teacher Education Resource* (PTTER). This provided a consensus on an effective structure for training technology teachers. Detail of the development of this resource is provided by Forrett et al. (2011).The development group consisted of one pre-service lecturer from each six New Zealand universities which taught technology teacher trainees and the National Professional Development Manager for Technology. The resource was presented at the PATT/CRIPT international technology education conference in London in 2011. As a presenter of this resource to conference delegates, the author engaged in conversations which indicated interest that there could be a consensus across different universities on a common structure to support the delivery of teacher training in this curriculum area. The PTTER resource is presently used by technology teacher educators to support their programmes.

Conclusion

The structure of the technology learning area across curriculum and year levels for students, points to continuity and progression in both teacher and student learning as being central to the delivery of technology education. It is important that a technological literacy is developed in students starting at an early (primary school) age. This may be achieved by students when they engage in creative, individual and relevant technology programmes. The development of increasingly sophisticated competencies outlined in the indicators of progression is key to this. If students are not taught, and therefore do not gain these progressive competencies, they will be at a disadvantage. Ability to demonstrate competencies across a wide range of the components of technology at curriculum level 5 by the end of year 10, will enable students to engage effectively with senior technology and assessment.

Success of the implementation process is still likely to vary across school sectors. An inspection of teaching programmes and resources currently displayed on the Technology Online and school websites suggest that many schools demonstrate good practice in technology education, with sound and innovative programmes. In secondary schools, National Certificate of Educational Achievement (NCEA) and Scholarship examination uptake and results for technology, are positive – as shown in NZQA Annual Report on NCEA and New Zealand Scholarship Data and Statistics for the last few years. In many primary and intermediate schools and technology centres, programmes are now focussing more strongly on early technological literacy. However, in some schools, technology education has not changed much from the pre-1995 craft-based programmes, with little or no opportunity for senior technology study. Clearly, here, the implementation process has not been effective. What is also clear is that most technology teachers will continue to need support through effective professional development, in order to participate in the continuing implementation process of a new technology curriculum and senior assessment structure. This will help overcome issues which still remain, as well as manage changes or developments in the future.

Identification of the many issues identified in this paper, and how they might be addressed, leading to a more complete implementation of the technology learning area within the curriculum across all New Zealand schools will require a range of data to be gathered and analysed through systematic research.

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