THE ROLE OF TECHNOLOGY EDUCATION IN SUPPORTING A DEMOCRATIC LITERACY

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ABSTRACT

Democratic literacy underpins much contemporary curriculum theory and recent developments in New Zealand have sought to provide a national curriculum framework in keeping with such a democratic ideal. In this paper I discuss the overarching aim of the New Zealand Curriculum Project and explore the role that technology education can and should play in supporting this aim. I assert that technology, through the revised technology curriculum, has the opportunity to play a leading role in this regard due to its specific aim of providing students with the opportunity to develop a broad, deep and critical technological literacy. I provide examples of how technology provides a powerful site for mediating the 'values' and 'key competencies' into classrooms, and also provides a natural setting for the support of cross-curricula learning. These are all aspects identified as key to the development of future empowered and democratically-aligned citizens.

1. INTRODUCTION

Important shifts to the concept of curriculum have arisen over the past two decades whereby earlier concepts of 'curriculum as content' have been replaced by that of 'curriculum as framework'. Such a shift is in keeping with contemporary learning theories (such as constructivist and socio-cultural learning theories) and a growing sense of the teacher as a professional capable of and culpable for the design of classroom curricula that incorporates the needs and interests of their students alongside that of national curriculum guidelines. While it can be debated how well this been communicated within the text of the *New Zealand Curriculum Framework Draft for Consultation* (Ministry of education, 2006a), such a shift is discernable in its design intent.

The *New Zealand Curriculum Framework Draft for Consultation* states in its vision that it seeks to ensure students "reach their individual potential and develop the competencies they will need for further study, work and lifelong learning". This is seen as key to equipping them to "participate fully in New Zealand society and contribute to the growth of its economy" (Ministry of Education, 2006a, p.8). It therefore appears to uphold an overarching aim of educating for democratic citizenship. The implications of an education system committed to democratic citizenship supports a notion of student literacy as embedded in the need for critical dialogue and decision making so that students can develop into 'empowered citizens' (Skovmose, 1998). Such a 'literacy for empowerment' goal has been described by Elmose & Roth (2005) as *Allgemeinbildung* – a broad and general liberal education for all specifically framed to deal with the increasingly complex contemporary world. This increasing complexity has been linked to recognition of the implications of a 'risk society' whereby a significant feature of participating as citizens is that "any choices and decisions among different solutions have to be made on the basis of incomplete and uncertain information" (Elmose and Roth, 2005, p.16).

In order to fully recognise the implications of a curriculum designed to support the development of citizens able to participate in a democratic fashion, there must be equal priority given to realising the potential of students with the goal of enculturation into society. The *New Zealand Curriculum Framework Draft for Consultation* states this in terms of ensuring students "reach their individual potential" as key to equipping them to "participate fully in New Zealand society and contribute to the growth of its economy" (Ministry of Education, 2006a, p.8). The dual focus on an outcomes-focused curriculum and realising individual potential allows these two goals to be brought together in a mutually enhancing fashion. This is in keeping with Wells' (1995) argument that traditionally these education goals have been seen in conflict, but with a new curriculum stance, this need not be so. With a curriculum framework where teachers are positioned as professionals to develop programmes that both value and validate the "knowledge and practices that have been built up and refined by past generations" and to ensure "opportunities necessary for all students to realise their full potential and creativity" (Wells, 1995, p. 235), these goals have been merged to underpin the nature of the literacy being advocated. The resultant 'citizen' can be envisaged as an informed critical and creative individual who can participate both independently and collectively in a confident, competent and innovative manner to both support and change the world in which they live.

The *New Zealand Curriculum Framework Draft for Consultation* (Ministry of Education, 2006a) attempts therefore to bring together these goals through a commitment to personalised learning *alongside* the provision of national guidance by way of the principles, attitudes and values, learning area introductory statements and associated achievement objectives. It is envisaged that all will work together to signal the role of the teacher as a professional in realising an outcomes-focused curriculum with a student-centred focus (Chamberlain, 2007).

As an essential learning area technology, along with all other learning areas, must work within this overarching framework. The remainder of this paper will justify why I see technology as well placed to do this.

2 DISCUSSION

2.1 THE AIM OF TECHNOLOGY EDUCATION

Technology education can be described as an evolving entity that has seen many countries enter the field with variable stances and levels of political and implementation success. As described by Rasinen (2003) areas of commonality across countries appear to be more significant than areas of difference. In particular, Rasinen identifies a common underpinning goal – that is "to help students to become technologically literate." (2003, p. 31). The *nature* of this literacy is however, is evolving as international thinking becomes more focused on what technological literacy requires in contemporary societies and the implications for teachers and technology programmes becomes more apparent.

Such an evolution is clear within the New Zealand technology education context. For example, the aim of *Technology in the New Zealand Curriculum* (Ministry of Education, 1995) was on developing a technological literacy through undertaking technological practice. The importance of integrating the three original strands (Technological Knowledge and Understanding, Technological Capability and Technology and Society) was argued as essential to enable students to understand and undertake sound technological practice in a way that would develop a critical or liberatory technological literacy (Compton and Harwood, 2003; Davies, 2000).
This requirement caused a number of problems for teachers in implementing the 1995 curriculum, not least because the achievement objectives were aligned to the strands in

isolation. In every other curriculum area in New Zealand, teachers were expected to take the achievement objectives and break them down into smaller learning intentions as the basis for specific learning experiences and assessment. In technology however, they were expected to mould together achievement objectives from all strands in order to develop 'practice' learning intentions (Compton and Harwood, 2003; Compton and Harwood 2005).

The limitations of a 'practice-based' literacy have become clear over the past ten years and this led to a significant movement on from the 1995 curriculum statement as articulated in the *Draft Technology Curriculum Materials for Consultation* (Ministry of Education, 2006b). In this document, the concept of technological literacy has been extended to address earlier shortcomings. Undertaking technological practice is still seen as important within this concept, but the need to understand the philosophy of technology as a discipline and develop key concepts of technological knowledge have now been recognised as additional aspects required for the development of a broader, deeper and more critical technological literacy. This is reflected in the document with the presentation of three revised strands that work together to provide learning opportunities for students to develop such literacy. These strands are the Nature of Technology, Technological Knowledge and Technological Practice. The extended concept of technological literacy is in keeping with that discussed internationally the goal of technology education where there is a focus on ensuring an informed and critical citizenship for the future (Dakers, 2006). The three revised strands are outlined briefly below.

2.1.1 The Nature of Technology

This strand is focused on developing a philosophical understanding of technology as a discipline, including an understanding of how it is differentiated from other forms of human activity, and how technological outcomes differ from other artefacts. It rests upon a sociotechnological stance which rejects the extreme positions of technological determinism and social shaping (Bijker, 1992; Bijker & Law, 1992). Rather it views as inseparable the complex interweaving of the technological and sociocultural aspects of any technological development and outcome (Rapp, 1999) and indeed the specific political and historical context of its development and placement (Bos, 2000). Technology is described as a purposeful intervention in the world, specifically designed to meet needs and/or realise opportunities. Student learning within this strand focuses on developing philosophical understandings of two components - *Characteristics of Technology* and *Characteristics of Technological Outcomes.*

The *Characteristics of Technology* acknowledges the creativity of technologists in their initial design concept exploration, and in the way they realise these concepts in a material sense. Technology provides opportunities for human's to push boundaries, critically reflect on past developments, and project into future possibilities. It allows space for ways of looking at the world differently, in order to produce innovative solutions and provide mechanisms to extend human capability in ways which may well alter our perceptions of what it is to be human. While ideally technology can be thought of as seeking to enhance human capability, in practice, not all technological outcomes are universally beneficial, particularly when viewed historically or from multiple perspectives as determined by different social/cultural/political positions. As technologists increasingly work across disciplines and social groupings they engage in constructive argumentation, informed prioritisation, and sophisticated strategies for decision making (Pollock, 2005). In this way, technologists are better able to ensure developmental practices and outcomes are both fit for purpose, and have a purpose which is 'fit' in a wider social sense (Barnett, 1994).

Within the philosophy of technology, technological knowledge is seen as distinct from, and fundamentally different to, knowledge in other disciplines. The key difference lies in the epistemic base, which accepts that while technological knowledge is a social construct, it referenced to the 'made' rather than the natural world, and is validated through normative means where the epistemic criteria is aligned to function (Baird, 2002).

The *Characteristics of Technological Outcomes* provides a philosophical understanding of technological outcomes as entities designed by humans to exist as material products or systems for an intended function (Meijers, 2000). It suggests technological outcomes can be described in terms of an inter-related dual nature; that is, their physical and functional nature (Kroes & Meijers, 2000). The relationship between the physical and functional nature of any outcome is complex and not pre-defined in any one-to-one manner (de Vries, 2005). An exploration of this relationship provides a useful analytical tool for establishing the fitness for purpose of a technological outcome during development, and for interpreting existing technological outcomes and understanding their past, contemporary, and possible future impacts. As such it adds significantly to understandings of the outcome as it exists in the world.

2.1.2 Technological Knowledge

This strand is focused on developing key concepts in technology that are generic to all technological endeavours, and as such should be understood by all students irrespective of the specific contexts they may study and/or the technological practice they may undertaking. Student learning within this strand focuses on developing conceptual understandings of three components - *Technological Modelling, Products and Systems.*

Technological knowledge underpinning *Technological Modelling* is critical in the exploration of influences and impacts as technological developments move from conceptual ideas through to fully realised and implemented technological outcomes. It can be differentiated into two inter-related forms - functional modelling and prototyping. The purpose of functional modelling is to improve risk management by minimising unknown or unintended consequences of possible technological outcomes. Functional modelling reduces potential wastage of resources that can occur if technologists focus on a more 'build and fix' approach to technological development. A prototype by contrast, represents the next phase of development where the outcome is now a fully realised intervention in the world. The purpose of prototyping is to inform subsequent development decisions as based on the evaluation of the technological outcome's performance against the specifications driving the development. A prototype allows for a greater level of exploration of unintended consequences/impacts as new information is accessed from the physical and social environment where it is located. Prototyping therefore provides the means to trial and optimise the technological product/system's 'fitness for purpose'. Functional reasoning (how to make it happen) and practical reasoning (should we make it happen) are fundamental forms of reasoning underpinning technological modelling.

Technological knowledge underpinning *Technological Products* include understandings of material formulation, manipulation, and transformation. The field of material technology now crosses many traditional disciplines and shows increasingly diverse and exciting possibilities for material performance and therefore for technological product function. Exploring the impact of material use and new material development on product life cycles is also important in supporting a technological understanding of sustainability.

Technological knowledge underpinning *Technological Systems* include understandings of inputs/outputs, and controlled transformatory processes. The 'black box' is an important concept in technological systems, as are the concepts of redundancy and reliability. Understanding these within technological system design and performance is important in developing technological understandings of system operating parameters.

2.1.3 Technological Practice

This strand provides students with opportunity to examine the technological practice of others to inform their own practice in an increasing sophisticated fashion. Student technological practice can result in the development of a range of outcomes, including concepts, plans, briefs, and technological models, as well as fully realised products or systems. Student learning within this strand focuses on developing capability within the three iterative components of *Brief Development*, *Planning for Practice* and *Outcome Development and Evaluation*.

Brief Development is undertaken for the purpose of describing a desired outcome that would meet a need or realise an opportunity. The identification of an authentic need or opportunity is based on a comprehensive exploration and critical analysis of a context and associated issue. A brief must take into account the physical and social environment of both the final outcome and the practices inherent in its development. Specifications developed within a brief define the requirements of the outcome in terms of such things as appearance and performance, and should reflect the prioritisation of factors that have arisen as part of key and wider community stakeholder consultation. The brief provides guidance for ongoing evaluation during the development of the outcome, as well as serving as an evaluative tool against which the final outcome can be justified as 'fit for purpose' in its broadest sense. 'Fitness for purpose' in its broadest sense includes the determination of the 'fitness' of the practices involved in the development of the outcome, as well as the 'fitness' of the outcome itself, for the identified purpose.

Planning for Practice maximises the potential for achieving successful outcomes. Effective planning techniques, efficient resource management, and appropriate documentation are critical for informed and responsive technological practice. Ongoing reflection and evaluation of past practice (both one's own and that of others) generate opportunity to make informed projections into the future that underpin effective, ethical, and responsive decision making. Planning of this type allows for flexibility to incorporate modifications and respond to unforeseen issues and/or for changing environmental factors. At the same time it must be robust enough to provide guidance, and ensure resource availability and sustainability.

Outcome Development and Evaluation involves the generation of design ideas and the refinement of potential outcomes through ongoing experimentation, analysis, testing, and evaluation against the brief. Initial trialing of ideas, both conceptually and practically, allows for the identification of knowledge and skills required to enhance both the technological practice and the outcome itself. Outcome development is enhanced through the effective presentation of conceptual ideas to stakeholders and analysis of their feedback. Exploration of materials in terms of their functionality and aesthetic impact and implications is undertaken as extensively as possible in order to interrogate designs and planning as fully as practicable prior to the selection of materials and the development of any final outcome.

2.1.4 Technological Literacy Redefined

These three strands provide a robust philosophical and theoretical base for technology education in New Zealand and address the four concepts identified by Mitcham (1994) as being important in technology education. These four concepts being:

- Technology as Volition – addressed via Nature of Technology – specifically in terms of the Characteristics of Technology.
- Technology as Artefact – addressed via Nature of Technology – specifically in terms of the Characteristics of Technological Outcomes
- Technology as Knowledge – addressed via Technological Knowledge – specifically in terms of Technological Modelling, Technological Products and Technological Systems.
- Technology as Activity – addressed via Technological Practice – specifically in terms of the Brief Development, Planning for Practice and Outcome Development and Evaluation.

The strands have been developed to work together to support the development of a technological literacy that is broader, deeper and more critical than that achieved from the 1995 curriculum. The nature of this technological literacy is more reflective of the critical literacy discussed by Petrina (2000) and has the potential to create in students a "critical ethical consciousness" described by Keirl as key in technology education (2006, p.90). Such a technological literacy should serve to enhance democratically-aligned educational goals, and provide a base for students to understand their existence in the wider technological world. Because technological innovation is a key feature of the fabric of a 'risk society', technological literacy conceptualized in this way becomes central to the development of Elmose and Roth's concept of *Allgemeinbildung*. That is, contemporary democracy requires a high level of critical thought from citizens to enable them to deal with the unknown and uncertain. Elmose and Roth argue this rests upon three forms of knowing – "knowing why, knowing that, and knowing how" (2005, p.22). These forms of knowing can be clearly linked to the three strands in technology and therefore as underpinning a broad, deep and critical technological literacy. That is, 'Knowing why' encompasses the philosophical understandings inherent in the Nature of Technology and serves to ensure students develop a *broad* and *critical* literacy. 'Knowing that' encompasses the conceptual understandings of Technological Knowledge and serves to *deepen* and again *broaden* the nature of the literacy developed. 'Knowing how' encompasses the praxis of Technological practice, and provides an experiential site where students can embed the philosophical ideas from the nature of technology and generic technological knowledge into their own practice when appropriate. In so doing, technological practice serves to further increase the *depth* and *critical* nature of the literacy developed, as well as provide opportunity for authentic action and empowerment.

2.2 VALUES EDUCATION

Values are defined in the *New Zealand Curriculum Framework Draft for Consultation* as "deeply held beliefs about what is important or desirable. They are expressed in the ways that people think and act" (Ministry of Education, 2006a, p. 10). The framework outlines that New Zealand education should encourage students to value the following: excellence; innovation, enquiry and curiosity; diversity; respect for themselves, others and human rights; equity; community and participation for the common good; care for the environment; and integrity (Ministry of Education, 2006a, p. 10). In addition, the draft framework also encourages the development of learning experiences that would provide opportunities for all students to learn *about* values and develop capabilities related to values (Ministry of Education, 2006a, p. 10). Learning *about* values is outlined in terms of students learning about: their own and others values; different kinds of values such as moral, social, cultural, aesthetic and economic; and those values upon which New Zealand's cultural and institutional traditions are based. Developing value-related capabilities is outlined in terms of students developing the ability to: express their own values; explore the values of others; critically analyse values and actions based on them; discuss disagreements that arise from differences in values and negotiate solutions; and make ethical decisions and act on them. The following discussion of the components within each strand outlines some examples of where technology and values come together.

A focus on the *Characteristics of Technology* component demands that students explore a range of different types of values. Analysing the history of technological development provides insight into the way in which different people's and institutions' values have influenced past technological decision making and technological practices and how these in turn impact on the values of others. This component provides opportunities for informed debate of contentious issues and the complex moral and ethical aspects involved in taking a particular position. The sociocultural and political drivers behind past developments can be explored and analysed in order to better understand how issues of diversity, equity, and respect for others have been addressed – or not, in past scenarios. It also allows for an analysis of the way these developments subsequently impacted on the people in different societies and socio-economic groupings with regards to their perception of and attitude towards technology related decisions, and the value placed on resulting technological outcomes. Exploring technology as an 'interventionary force to enhance human capability' allows students the opportunity to reflect on what and whose values have been prioritized in the past. From this position they can critique the notion of 'enhancement of capability' in terms of who has benefited and who has not, from such developments. Understanding the differences in the epistemological basis across disciplines also allows students to understand how and why different types of knowledge are valued differently as 'evidence' across contexts and cultural groups. The highly collaborative nature of contemporary technological practice allows students opportunity to examine the way in which technologists work together to resolve, or not, issues of difference associated with personal, professional, political and economic values. A focus on the *Characteristics of Technological Outcomes* provides opportunity to examine the fitness for purpose of technological outcomes in the past, and to make informed predictions about future technological directions, based on social and personal values. Interpreting technological outcomes relies on an ability to see how the purpose behind any technological outcome was justified as of value. Examining a range of historical, contemporary and potential future technological outcomes, provides opportunities for students to interrogate notions of what is fit for purpose across people, time and place. It also allows for a critical review of the fitness of any purpose, and how this changes as the values of both designers and users change over time and place. Exploring examples of mal-functioning technological outcomes allows students to explore the way this can impact on people's views of the value of technology, and the subsequent acceptance of high impact innovations.

A focus on *Technological Modelling* provides opportunity to recognise and value both functional and practical reasoning. Understanding the role of all types of values in determining whether any development should progress is critical. Decisions to terminate a development in the short or long term, to continue as planned, or to change/refine a design concept or technological outcome can be analysed against the values of different people, groups and institutions, and arguments put forward as to the ethical nature of the actions taken. A focus on *Technological Products* allows for an in-depth exploration of the materials used in a particular product and their perceived value to the designer and user. Appropriate material development and use can be analysed with regards to the values of stakeholders. The opportunity to analyse material use and development in terms of product life cycles allows for students to explore values associated with sustainability and the way caring for the environment is considered a worthy value, or not, by different stakeholders. A focus on *Technological Systems* provides opportunity for students to explore how system development can be deemed appropriate, and how acceptable it is to integrate technological systems with other systems - for example, robotic technologies integrated into human physiological systems. Understanding the values associated with a wide range of stakeholders and how they prioritise their own needs and those of others when taking positions on such issues allows students to explore their own reactions in a more informed manner. Redundancy and reliability within technological system design and performance can be critiqued in terms of how they are perceived by people and evaluated in terms of risk acceptability. Exploring the use of a black box approach when working with technological systems provides opportunity for students to understand the value of, and dangers in, such an approach. For example, weighing up the advantages of using a black box approach to gain a holistic understanding of a complex system versus the potential loss of empowerment for the end-user should the system mal-function.

A focus on *Brief Development* allows students opportunity to understand the values of others as they identify an authentic need or opportunity based on a comprehensive exploration and critical analysis of a context, associated issues, and a wide range of stakeholders' desires. In defining specifications, student will be required to understand a range of different types of values in order to ensure that fitness for purpose is established in its broadest sense. Stakeholder values from the wider community will therefore need to be analysed and compared, and any areas of contestation identified and resolved, in order for the brief to be developed in a way that is acceptable to all key stakeholders and for those who may be impacted on indirectly or in the future. A focus on *Planning for Practice* necessitates that students have a strong focus on caring for the environment as they develop capability to manage resources efficiently, and make ethical decisions around sustainable development. Ongoing reflection and evaluation of past practice is critical to this component (both one's own and that of others), ensuring the exploration of their own and others values, and developing an understanding of how these values impact on decision making. In order to work most effectively, ethically, and responsively, specific planning mechanisms need to be recognised as of value throughout the developmental work. A focus on *Outcome Development and Evaluation* allows for a strong focus on students achieving excellence and showing perseverance in producing an outcome of worth. Not all technological practice results in technological outcomes, and therefore this component allows for a range of creative and innovative ideas to be taken to various stages appropriate to the context. Such a focus allows student to arrive at a 'no go' decision when there is no defensible reason to use resources for a particular purpose. Decisions underpinning the selection of particular outcomes for further development rely on extensive reflective and critical analysis of what is of value and why, helping students to develop their capability in ethical decision making and acting in accordance with these decisions. Exploration of materials in terms of functional and aesthetic value against environmental cost should be undertaken as extensively as possible in order to interrogate designs and resourcing prior to the selection of materials and the development of any final outcome. Outcomes, and the practice undertaken to develop them, should be critically reflected on and evaluated from a range of perspectives to ensure 'fitness for purpose'. This in turn provides opportunities for students to explore stakeholder responses to outcomes, and understand these in terms of the values that are embedded in them. Justification of decisions made will provide opportunity for students to clearly identify and articulate their own values and explain how these are reflected, or not, in other social groups.

2.3 KEY COMPETENCIES

The Key Competencies as outlined in the *New Zealand Curriculum Framework Draft for Consultation* (Ministry of Education, 2006a) are derived from work carried out by the Organisation for Economic Co-operation and Development (O.E.C.D.). The specific projects was the Definition and selection of competencies: Theoretical and Conceptual Foundations (DeSeCo) project. The DeSeCo project sought to establish "a broad overarching conceptual frame of reference relevant to the development of individually based key competencies in a lifelong learning perspective" (Rychen and Salganik, 2003, p. 2). The project's stance on the nature of key competencies was not in terms of a simplistic view of focusing on "society's basic functioning and individuals' immediate survival", but rather viewed competencies from a wider perspective of ensuring "a successful life and a well-functioning society, conceiving the potential societal benefits of a well educated citizenry as including a productive economy, democratic processes, social cohesion, and peace" (Rychen and Salganik, 2003, p. 5). The competency project was therefore clearly positioned within the 'education for citizenship' argument, designed for use in a "competency for all students" whereby the "all" refers to students across countries and cultures, not just across potential future vocational arenas. The concept of key competencies underpinning the DeSeCo development "assumes that individuals and societies share some basic characteristics beneath a variety of approaches to life, life style and customs." These characteristics are further explained in terms of "the importance of social influences and the capacity for autonomous action". These are elements of what is referred to as the "human condition" and as such are "not dependent on any society or culture." (Rychen and Salganik, 2000 pp. 7-8) The DeSeCo development team recognised the socially constructed nature of concepts and argued that it is therefore critical that competencies must be developed at an "abstract level" in order to "recognize and acknowledge their development and application may take many forms depending on social and individual factors" (Rychen and Salganik, 2000, p. 8). The theory of social fields underpinning the development project holds to a view of the world as being "structured by multiple social fields, which share important aspects such as power relations, social codes, and norms." (Rychen and Salganik, 2000, p. 12) The competencies have been developed from a social constructionist epistemology, whereby "concepts are viewed as socially constructed notions that facilitate the understanding of reality while also constructing it." (Rychen and Salganik, 2000, p. 8). Competencies are viewed as being broader than knowledge and skills and structured around demands and tasks requiring "cognitive, motivational, ethical, social and behavioural components" (Rychen and Salganik, 2000, p. 8).

In keeping with this epistemological stance, the DeSeCo project reports oppose a view of competencies as being directly 'transferable' across contexts – but rather acknowledges that when faced with a new 'demand or task', "effective performance implies modification of strategies or skills" and is a "function of a dialectical interaction between 1. the existing skills and strategies of the individual and 2. the features of the new situation that faces him or her" (Rychen, 2002, p. 13). The complex relationship of the requirement for and interrelationship of the competencies and the context is explained through the notion of 'constellation'.

Three key competencies were constructed from a range of academic disciplines and interdisciplinary reflections and debates. The competencies are entitled "Interacting in Socially Heterogeneous Groups, Acting Autonomously, and Using Tools Interactively" (See Rychen and Salganik, 2003, pp 85-104 for an overview of each competency). The DeSeCo project report also discusses a cross cutting feature based on critical thinking and reflective practice as a "mental prerequisite" (Rychen and Salganik, 2003, p. 82) for the key competencies.

The New Zealand key competencies claim to uphold this basis, while restructuring the original DeSeCo competencies into the following five competencies. For example:

- ***Managing Self*** - appears to be a renaming of the *Acting Autonomously* competency of the DeSeCo framework.
- ***Relating to Others*** - not a competency as such in the DeSeCo framework – rather it is one of a set of identified abilities under the competency entitled *Interacting in Socially Heterogeneous Groups*.
- ***Participating and Contributing*** - appears to split between the two DeSeCo competencies – *Acting Autonomously* and *Interacting in Socially Heterogeneous Groups*.
- ***Thinking*** - clearly aligns with the Cross Cutting category of DeSeCo framework although in the New Zealand restructuring it appears to have lost its cross cutting nature.
- ***Using language, Symbols, and Texts*** - not a competency as such in the DeSeCo framework – rather it is one of the identified abilities under the competency entitled *Using Tools Interactively*.

2.3.1 Links to Technology Education

Based on the DeSeCo work and the outline in the *New Zealand Curriculum Framework Draft for Consultation* (Ministry of Education, 2006a), the key implication for teaching programmes in New Zealand is that the key competencies should be seen as fully integrative with the overall classroom curricula developed for students in a classroom learning community. They should be viewed as both supporting learning in other curriculum areas as well as being developed in turn through these areas. The learning areas provide the meaningful 'demands and tasks' and as such, specific learning intentions and competencies become mutually constitutive parts of learning programmes. This will be facilitated if the underlying philosophy and theory of each learning area, and the competencies themselves, have a workable level of consistency.

As discussed above, the overall aim of technology education in New Zealand is to support technological literacy for all. Like the key competencies therefore, it is positioned within an 'education for citizenship' argument. Further to this, technology has been clearly positioned within sociocultural theory (Compton, 2001; Compton and Harwood, 2003; Compton and Jones, 2003; Jones, 2001). Such a perspective is underpinned by "the social-interactional, the organizational and the sociological; the social-developmental, the biographical, and the historical; the linguistic, the semiotic, and the cultural." (Lemke, 2001, p. 85). In taking this stance, technology holds to a process ontology of the social world, in which "…only processes are real: entities, structures or patterns are ephemeral and do not really exist" (Sawyer, 2002, pg 283). However, it rejects the often associated adherence to inseparability. That is, "the claim that the individual and the social cannot be methodologically or ontologically distinguished" (Sawyer, 2002, p. 283). Instead research undertaken within the area (Compton, 2001; Compton and Harwood, 2003; Compton and Harwood, 2005; Jones and Moreland, 2003; Jones and Moreland, 2004) has accepted an 'analytic dualism' whereby a commitment is made to theorising "the nature of individuals, the nature of social environments and the nature of their causal relationships" (Sawyer, 2002, p. 298). Sociocultural theory therefore shares much in common with the theory of social fields that underpinned the DeSeCo development.

Technology's epistemological stance is also consistent with that of the DeSeCo work. It recognises that knowledge is a social construct and understandings result from the complex relationship between cognition, attitudes and values, and social, political and physical location. This further aligns with the key competency stance on the topical issue of 'transfer', where capability developed in one setting cannot be 'transferred' directly as it is context dependent. Instead, it must be newly situated in terms of any new sociocultural location.

I suggest therefore, that if the Key competencies hold true to the philosophical and theoretical base of the DeSeCo project, there is a high level of correlation between technology and the competencies. Both serve to challenge and support the development of students to become empowered to take a significant role in a multifaceted, complex and changing contemporary world. There are also very strong theoretical links underpinning each, with a focus on an individual's viewing and understanding of the social world as an active process of 'being' in that world. They share a view of the situatedness of this process, and also hold to notions of analysis, which allow the separation of the individual from social structures/fields, whilst still acknowledging the mutually constitutive nature of the relationship between them. Strong epistemological links are apparent, whereby in both cases knowledge is conceptualised as a social construct linked to purpose and context, relates to Gilbert's (2003) notion of knowledge as performative and learning is viewed as a process in which both learner and learning community are transformed. Both view cognition, behaviours, attitudes and values as inherently integrated in learning, and thereby have mutual demands on learning programmes.

All aspects of technology education would support and be supported by an increase in sophistication across the key competencies. For example, when undertaking their own technological practice, whether individually or as part of a group, students are required to develop *self management* skills in order to effectively plan ahead and manage resources efficiently to ensure informed and responsive practice. In order to work effectively and ethically, students must develop their own self regulating procedures as well as identify those of others to ensure the overall practice is coordinated and successful. The project based pedagogy supporting much of technology learning relies on students becoming "….autonomous learners, taking responsibility for decisions and living with their consequences." (Kimbell and Perry, 2001, p. 7). The ability to understand and undertake technological practice cognisant of the wider sociocultural context, allows for a developing sense of self, and relatedness to a range of communities, whereby students can develop an empowered identity across a range of life contexts within and outside of formal education.

Technology programmes provide opportunities to develop ongoing and mutually beneficial community relationships critical for developing student competency in *relating to others* and *participating and contributing*. Because of the inclusion of multiple knowledge and skill bases (both technological and those from other disciplines) in technology, it is common to require expertise from the community and/or industry. Inviting people in as valued experts provides a healthy platform for ongoing future relationships regarding student learning and cohesion across their local and extended communities. Students also work alongside service organisations, local businesses and other community groups to meet a school or community need. This type of working relationship allows all parties opportunity to develop a better understanding of the ethics, beliefs and understandings of respective groups and individuals, and thus enhance future interactions. All technological practice and resulting technological outcomes are situated in specific sociocultural and physical locations resulting in both opportunities and constraints. Conflicts and potential collective action are often underlying issues. Functioning effectively within such highly dynamic and complex environments requires extensive knowledge and understanding of many stakeholders – both direct and indirect. Being empowered to operate across a wide range of social groups is therefore key to increasingly sophisticated technological practice and broad and critical understandings of technology's role in contemporary society.

The specialised language inherent in technology provides significant opportunities for enhancing students' competency in using language, symbols and texts*.* An extensive range of available technologies (including language, models, symbols, and specialised and non specialised procedures and equipment) are explored alongside a range of knowledge bases, including technological knowledge. This will be reinforced through informed technological practice where critical evaluation as part of ongoing experimentation, analysis, testing and final evaluations requires students to not only understand specialised language, symbols and texts, but also to operationalise these understandings across a diverse range of contexts. Developing a philosophical understanding of technology as a discipline requires students to be familiar with a range of historical and contemporary texts, and understand many forms of codified language. Further to this, technology is "deliberately and actively interdisciplinary" (Kimbell and Perry, 2001, p. 19) and as such provides an authentic site for developing and maintaining cross curricula links. As argued by Seltzer and Bently (1999), innovation increasingly relies on the interface between different kinds of knowledge, allowing insights from one discipline to be applied to others. Therefore, technology provides the potential to not only develop this competency within technological literacy, but across a range of learning areas, thereby allowing students to more clearly understand how and why evidence claims and argumentation differ across disciplines. Such a position supports students in their ability to select and use language, symbols and texts in appropriate and informed ways.

Critical and creative thinking are clearly valued as essential in technology and technology education has been identified as a place where creativity can be uniquely fostered (Lewis, 2005). Metacognitive awareness and reflective processes are also discussed as critical. As Kimbell and Perry point out the ability to 'helicoptor out' is key for students in technology in order to "take stock and review what is being done and why; what alternative approaches might be adopted and why" (2001, p 14). Such thinking, as defined in the key competencies and DeSeCo material, is therefore essential to learning in technology. Opportunities for the enhancement of such thinking are clearly identifiable whether working within innovative problem solving situations, debating contentious issues, or projecting into alternative scenarios during the analysis and/or development of a technological outcome. Such thinking is essential to making informed decisions that are based on ethical, as well as functional grounds, allowing for an understanding of fitness *for* purpose, as well as explorations of the fitness *of* any stated purpose.

3.0 CONCLUSIONS AND RECOMENDATIONS

Technology as a learning area has much to offer as a pivotal player in New Zealand education. I believe it can provide strong leadership in supporting the development of a democratic literacy for all students – in its own right and through its mutually enhancing relationship with values education and the key competencies. By providing students with experiences of a rich and varied nature, where theory and practice are inherently connected, many past issues associated with the goals of general education can be resolved.

Achieving its potential to play this role will however, rely on a significant level of engagement and understanding from not only technology teachers, but from all teachers across the primary and secondary sectors. Past lessons have taught us that it is only through collaboration across learning areas that students will in turn be able to see the links across their learning as a whole. In this way students will be able to develop an overarching literacy that will enable them to become informed and critical citizens in the future.

I believe this will require shifts at all levels of education – not just within schools. Policy decisions need to be focusing national curriculum implementation strategies to this effect. Learning area curriculum leaders within the Ministry of Education, national groups and leaders within schools, need to realign to ensure they support programmes that focus on making student learning a more cohesive experience. As long as the majority of practitioners at all these levels continue to work in isolation, no matter how 'good their intent', the ideals behind the new directions of the revised national curriculum framework are unlikely to be mediated into the lived experience of students in our schools.

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