Teaching socioscientific issues and ethical decision-making: a self-study

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Kirsty Jane Farrant

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Abstract

The research outlined in this thesis involved reflecting on my teaching practice in a self-study to investigate whether changes could be made to the way I teach ethical decision-making on socioscientific issues. I wanted to improve the students' ability to justify ethical decisions they made as part of an assessment.

During 2011 I actively gathered data for a self-study in science education, investigating my teaching of ethical decision-making to my Year 13 Biology students. I was aware that students were not justifying the ethical decisions they made as part of an assessment done in the course, and wanted to develop their ability to do this. The theoretical framework of this research was constructivism. In the case of this self-study, I considered myself to be the learner, making sense out of what I found. The self-study was conducted in a New Zealand secondary school Biology classroom.

The tool used for enabling the students to improve their ethical decision-making is located on the Biotechnology Learning Hub. The Ethics Thinking Tool was developed for use within science classrooms, and provides a selection of ethical perspectives for students to explore.

Data were gathered from a range of sources, in particular my professional journal and interviews with a group of students in my Year 13 Biology class. The interviews, held at the conclusion of the course to minimise ethical concerns, focussed on the teaching that had occurred in a unit on socioscientific issues. These interviews, when analysed alongside my professional journal and critical conversations with a mentor, provided a rich source of data.

Ten critical incidents occurring within the teaching of this unit were identified as being significant events in terms of either the teaching process or the

research process. These were reflected upon and whilst each of these critical incidents revealed insight into my practice, four of them seemed to offer real impetus for change in teaching practice. These four critical incidents were unpacked for further, more in depth, analysis.

Four main ideas emerged from the data, one from each of the critical incidents analysed in depth. I now recognise the significant value of being critically reflective on my teaching, particularly when using new teaching tools or resources. The second insight is that I found that my intended outcomes as a teacher did not always match what the students thought the intended outcomes were. Whilst this dissonance did not necessarily impact on the experience for the students, as a teacher it is important to reflect on differing perceptions within the same teaching and learning environment. It also highlights the tension in secondary education between preparation for university versus preparation for citizenship. The third insight is that it is also essential to teach general research skills as well as subject-specific research skills. My fourth insight is that there is significant value in talking to students about more than the content. Further, conversations with a pedagogical focus can be beneficial for both the teacher and the learner. The result of all of these insights has been a shift in how I conduct conversations with students. Only by changing the focus have I been able to make changes that I hope ensure students develop competencies they can use in future contexts.

As a consequence of this study I intend to take the notion of self-study back to my school to enable other teachers to use the framework developed as part of this research to explore their practice. This type of innovative inquiry within the secondary setting has the potential to lead to real change in the way teachers reflect on their own practice, allowing them to make informed change that will make a difference for both the teacher and the learners, in a collaborative and supportive environment.

Acknowledgements

Originally published in 1949, Joseph Campbell's book[1] on comparative mythology introduced what was at the time the revolutionary idea of the Hero's Journey. Campbell outlined the notion of adventure and transformation that exists in nearly every myth. I started to think of my doctoral journey as my own hero's journey. The Hero's journey is divided into three acts, Separation, including the Call to Adventure; Descent and Initiation, including The Ordeal; and the Return, including the Road Back. I suspect many people, from many walks of life, might identify with such a journey.

Importantly, a Hero's Journey features a cast of characters. I like to think that obviously I am the Hero in this journey, but I would like to acknowledge a number of other cast members. First, there are a number of 'villains' who I do not wish to thank but will quite honestly acknowledge. These (and their role) are Shadow (to destroy), Shape shifter (to question and deceive), Trickster (to disrupt/defy), Tempters (to tempt/mislead/lure), Enemies and Rivals (to oppose/defeat). All of these characters are internal, played by the parts of my own personality that on occasion will procrastinate.

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[1] Campbell, J. (2008). *The hero with a thousand faces*. Novato, California: New World Library.

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Chapter One Introduction

1.1. Overview

This chapter provides a rationale for the research conducted for this thesis. There is, first, an introduction to the research context. This is followed by an account of my journey in time. This is of significance, as in self-study it is impossible to separate the self from the study. Following this account is an introduction to the New Zealand context. The research focus and question, along with the research design are outlined next, and finally the structure of this thesis is outlined.

1.2. Introduction

It can be argued that the place of science has become increasingly important in today's world (Gluckman, 2013). Many of the complex dilemmas that now face us have their foundations in science. Issues such as genetic modification of animals and crops, use of nuclear power, vaccination, development of wind farms, genetic screening of embryos and the use of mobile phones all have a strong science base, but are debated in everyday society. These types of issues are referred to as socioscientific issues. Ratcliffe and Grace (2003) define a socioscientific issue as "one which has a basis in science and has a potentially large impact on society" (p. 1). Such issues may impact locally, nationally or globally, but the crux of such issues is the intersection between science and society.

Many researchers have suggested that a goal of science education should be the attainment of scientific literacy (Fensham, 2004; Holbrook & Rannikmae, 2009; Laugksch, 2000). Further to that argument, as a society, we need a scientifically literate workforce and citizens (Brown, Reveles, & Kelly, 2005;

Bybee & Fuchs, 2006; DeBoer, 2000; Fensham, 2004; Post, Rannikmae, & Holbrook, 2011).

New Zealand's Chief Science Advisor to the Prime Minister, Sir Peter Gluckman has argued that "how society obtains and understands scientific and technical knowledge is critical to a well performing participatory democracy" (Gluckman, 2013, p. 2). In an earlier report Gluckman described the need for an education system that encouraged "a strong focus on the science literacy approach" and where "the main emphasis of teaching programmes would be on exploration, critical thinking and discussion of socio-scientific issues" (Gluckman, 2011, pp. A-48). In another New Zealand report on science education one of the four purposes of science education is listed as "building students' science literacy to enable informed participation in science-related debates and issues" (Bull, Gilbert, Barwick, Hipkins, & Baker, 2010, p. 7).

Clearly, there is a need to consider scientific literacy, and the use of controversial science issues as contexts within teaching is one way to do this. Within the international literature there is a strong drive to try and include teaching and learning about such issues in the science curricula (Driver, Newton, & Osborne, 2000; Hodson, 2003; Kolstø, 2001). In the case of the New Zealand curriculum, changes have occurred within the science learning area to reflect this standpoint.

However, there is no common understanding about what scientific literacy actually is. Bybee's (1997) definition of scientific literacy proposes a framework of hierarchical levels for scientific literacy, ranging from illiteracy through to multidimensional scientific literacy. A person at this highest level would demonstrate an integrated contextual perspective, with their knowledge going beyond conceptual and procedural science to include other facets such as philosophical, social and historical aspects of science. In addition, such a person would be able to make connections between contexts, between science and technology and between science and technology and social issues. Bybee

makes it clear that depending upon the context an individual may not always be at the same level on the framework. He states that attaining full multidimensional scientific literacy is not likely in a single individual, but suggests it is something to work towards (ibid., 1997).

A second definition of scientific literacy is that provided by the Organisation for Economic Co-operation and Development (OECD): "the capacity [for young people] to draw appropriate and guarded conclusions from evidence and information given to them, to criticise claims made by others on the basis of the evidence put forward, and to distinguish opinion from evidence-based statements" (OECD, 2004, p. 39).

Both these definitions involve an evaluative element. One aspect of scientific literacy as it relates to socioscientific issues is the ethical decision-making that sits alongside. How those decisions are arrived at is critical. Gluckman argues that "good decision-making requires that both the public and policy makers are informed as to the quality of the evidence" (Gluckman, 2013, p. 12). Scientific literacy, therefore, requires more than an understanding about the issue. It also requires students to be able to evaluate the evidence and come to their decisions using reasoning.

1.3. Locating myself as the researcher

I am a senior teacher holding responsibility for the Science Faculty at a co-educational urban high school. I have held this position since 2006. I think it is important to consider my pathway to get here, as the self is such an important part of a self-study.

I grew up in a family that valued education. Both of my parents had tertiary qualifications and one of my grandfathers (as well as his brother) was a teacher. It was assumed that my siblings and I would gain a tertiary

qualification. As a secondary school student I loved the sciences, and the conversations with teachers that I remember most clearly are the ones about issues. I recall learning about assisted reproductive technology as part of my Year 13 Biology course, as that was an important contemporary issue at the time.

After gaining a science degree in genetics and microbiology, I went on to pursue a Masters degree in microbiology, focusing on molecular microbiology. As my postgraduate studies continued what became clear to me was that I loved the laboratory demonstrator work I was doing, and had a strong desire to become a teacher. I decided to pursue a career in secondary education, as it allowed me to share my passion for science, particularly in senior Biology.

As a beginning teacher in 1999 I followed the advice and guidance of those teachers more experienced than me. The courses I taught were developed by someone else. In fact, when I started as a teacher the courses were largely prescribed, at least at the senior level, by the New Zealand Qualifications Authority (NZQA), as they determined the assessment. Year 12 operated differently, with an entirely internal course, but again, as a beginning teacher, I followed the programme as determined by someone else.

As I developed as a teacher, so our education system also changed considerably in the senior school. NZQA moved to standards based assessment, introducing the National Certificate of Educational Achievement (NCEA) in 2002. This was phased in over three years, beginning at Year 11 in 2002, followed by Year 12 in 2003 and Year 13 in 2004 (NZQA, n.d.). My recollections of that time were of considerable change, and of fear among teachers about workload issues and consistency of marking. I taught Year 13 Biology for the first time in 2003, following a scheme developed by experienced teachers who had gone before me. The following year, NCEA Level 3 was introduced at Year 13, and change was evident.

One aspect of NCEA that always appealed to me was the flexibility to pick and choose the standards that were assessed as part of a course, thereby altering the focus of the teaching. Initially (in my experience) schools tried to assess all of the standards offered in a subject by NZQA, but this quickly changed. The school I was teaching in started to recognise the value of mixing Achievement Standards and Unit Standards (refer to section 1.4.2) as well as offering fewer credits in a particular subject, to meet the needs of the learners in the classroom. By now I was more experienced, and I was starting to contribute to the planning and development of the Year 13 Biology course in 2004. However, my thinking and ideas remained largely a product of my experience.

In 2006, another change of school, this time with promotion to Head of Science, meant that now I was in control of a Faculty and the courses being taught within it. I was in a position to be able to make the changes I wanted, but also I was sufficiently experienced to be starting to recognise what I wanted to achieve and what teaching meant for me. The Year 13 Biology course at the new school offered a standard I had not taught since the introduction of NCEA. This standard, AS90714 (Biology 3.2) *Research a contemporary biological issue* (NZQA, 2006), was a standard not offered at my previous school for a variety of reasons. Once I had taught and assessed using this standard for the first time, I began to see the potential of it as a way to focus on biology that would be useful for life rather than simply preparation for university.

For several years I taught the unit of work on contemporary biological issues, with a focus on the assessment. I considered some aspects of my practice, recognising that I needed to change how I taught research skills, putting some of those ideas into place. I also spent some time considering how I taught the necessary content, ensuring that the students understood the biological processes and implications aspect of the assessment. However many of these changes were made without much consideration of the evidence, based largely on a gut instinct. If asked, I would have described myself as a reflective

practitioner. When I look back now, through my almost post-EdD eyes, I think I was able to be reflective but was far from being a truly reflective practitioner as I see it now; that is, one who is critically reflective.

In 2009 I enrolled in the EdD[2] programme, and started to consider education and my own practice in a more critical and evidence-based manner. Early on in my study I determined that the contemporary biological issue unit was the one that I wanted to base my thesis research on. Increasingly, I was frustrated with the way in which students articulated and supported their opinions in the assessment for this unit, and I was beginning to wonder what I could do differently to support them to improve the quality and depth of their answers. Early ideas involved argumentation theory and informal reasoning. However, always bubbling away, just below the surface of consciousness, was the drive to do something with a very strong practitioner focus.

First and foremost, I am a classroom practitioner. As such I have a strong desire to do research that will inform my practice and allow me to improve the learning in my class. In short, I want to do research that would make a difference for me and the students I teach. I am also aware of my role in preparing students for citizenship. Many students from my class do not go on to study biology at the tertiary level, and some do not enter tertiary study at all. However all are citizens, and part of my responsibility as a teacher is to prepare them for that role. Of all of the standards that could be assessed in Year 13 Biology, AS90714 (Biology 3.2) *Research a contemporary biological issue*, had the strongest links to citizenship. It was not about the content. Rather, it was about skills, ensuring that the students had developed not only the research skills to find out about their topic but also importantly, the reasoning skills to make an informed decision and justify it.

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[2] The Doctor of Education programme offered through Massey University requires two years of course work, during which time the ideas for a thesis proposal are developed, followed by the completion of a thesis.

After a lot of reading and some crucial conversations with my mentor, the path suddenly became clearer. Investigating how I taught this unit would allow a practitioner focus.

1.4. The New Zealand Context

As this study was conducted in New Zealand, it is important to have an understanding of the relevant aspects of the education system. There are two aspects of the New Zealand education system that are briefly outlined here, the curriculum and the assessment system, with particular reference to Year 13 Biology, the focus of this study.

1.4.1. New Zealand Curriculum

The current New Zealand Curriculum (New Zealand Ministry of Education, 2007) is the product of a review process that began in 1991. A draft curriculum was produced in 2006, and the final version was published in 2007. It is divided into two parts, commonly referred to as the front and back of the curriculum. The front of the curriculum includes the vision, values, key competencies and principles. The back of the curriculum includes the achievement objectives for each learning area. The development of a Biology course requires consideration of both the front and the back of the curriculum. Teachers within each learning area are expected to deliver courses that cover not only their learning area content, but also the key competencies. Within the Science learning area the relevant achievement objectives include those within the Nature of Science and Living World strands.

1.4.2. New Zealand Qualifications Framework

Assessment systems in New Zealand have undergone significant change since 2002. Change was first signalled in 1997, when the New Zealand Government launched 'Achievement 2001'. This policy included the introduction of a new assessment system for secondary schools, the National Certificate of Educational Achievement (NCEA) (NZQA, n.d.). This change was a significant move away from the largely norm-referenced systems that existed to that point. NCEA aimed to integrate the existing Unit Standards (standards-based assessments) with new Achievement Standards (also standards-based). These Achievement Standards replaced the examinations of School Certificate and University Bursary, and the internal assessment of Sixth Form Certificate, all of which were norm-referenced. Many of these Achievement Standards are assessed through national examinations, with others being gauged via internal assessment within schools (Crooks, 2002).

The Achievement Standards assessed as part of NCEA are given one of four grades:
- Not Achieved, for students who do not meet the criteria for the standard
- Achieved, for a student giving a satisfactory performance
- Merit, for a very good performance
- Excellence, for an outstanding performance

One standard that formed part of the Level 3 (Year 13) Biology course was 90715 (Biology 3.2) *Research a contemporary biological issue* (NZQA, 2006)[3]. This standard was an internally assessed standard that required students to research a contemporary biological issue, describing the biology, implications and opinions around their chosen issue. Students were also required to provide

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[3] This standard was reviewed as part of the standards realignment process, and removed from use at the end of December 2013. It was replaced with a new Achievement Standard, AS91602, Integrate biological knowledge to develop an informed response to a socioscientific issue.

a justified opinion of their own, either for or against the issue (NZQA, 2006). This Achievement Standard was well-suited for the development and enhancement of students' scientific literacy and critical thinking skills.

1.5. Research focus and research question

Based on the background described earlier, my advisors and I decided that the focus of the research would be to investigate my teaching practice, particularly as it related to AS90714 (Biology 3.2) *Research a contemporary biological issue*. This would allow me to identify areas of strength and weakness in teaching and consider how my teaching practice could be changed to potentially improve the outcomes for students. I had already recognised that a weakness in the students' performance was their making and justification of ethical decisions as a consequence of assessing student work for this standard in previous years.

Therefore, the research seeks to answer the following research question:

> Through reflecting on my teaching practice, what changes could I make to the way I teach ethical decision-making on socioscientific issues to better meet the needs of the students?

This research took a qualitative approach, using self-study as a methodology and collecting data from two significant sources of data: a professional journal was kept for the duration of the study; and interviews were conducted with a subset of students at the end of the course. The data were analysed using critical incident analysis (Brookfield, 1995; Tripp, 1993).

1.6. Outline of the thesis

The thesis is organised into six chapters. Following this introductory chapter, the literature review is written under three significant headings. The first of these, self-study, examines the literature on self-study and, in addition, the chapter synthesises literature around the methods used in this research. This is followed by two additional sections, socioscientific issues and ethical decision-making which provide the more contextual elements of this research.

Chapter three considers the methodology used in the research, including a discussion of the significant research paradigms. Chapter four outlines the findings, and includes some initial reflection as part of the early analysis.

The title of chapter four is 'Self-Study'. This is the chapter that contains what in a more traditional thesis would be termed 'analysis' and 'discussion'. The nature of this self-study meant that the two (analysis and discussion) were considered side by side as part of the self-study.

Finally, the conclusions derived from the self-study are presented in chapter six, which also outlines the significance and limitations and provides some considerations of implications that arise as a result of this research.

Chapter Two Literature Review

2.1. Introduction

This chapter is organised into four main sections. The first of these is self-study. Within this section aspects of self-study are considered, as well as some examples of self-study in practice. This section forms the methodological section of the literature review. The two sections following this, socioscientific issues and ethical inquiry form the contextual sections of the literature review. Finally, some consideration is given to pedagogy and quality teaching in the New Zealand context.

2.2. Self-Study

"Self-study is the study of one's self, one's actions, one's ideas, as well as the 'not self'" (p. 236). With this statement, Hamilton and Pinnegar (1998b) clearly place the focus of self-study fair and square on the 'self'. They go on to describe the nature of self-study as being autobiographical but also make it clear that it is more than simply an autobiographical study. "Self-study also involves a thoughtful look at texts read, experiences had, people known and ideas considered" (Hamilton & Pinnegar, 1998b, p. 236). This is important as it takes what is largely an internal aspect (autobiography) and introduces external ideas, experiences and influences.

Self-study has also been defined as "a component of reflection in which teachers systematically and critically examine their actions and the context of those actions as a way of developing a more consciously driven mode of professional activity" (Samaras & Freese, 2006, p. 11). The field of self-study, as it relates to teaching and teacher education practices, emerged in 1992 through an annual meeting of the American Education Research Association, a meeting of teacher educators. At this meeting several researchers presented

papers in a symposium in which they articulated their struggles to enhance their learning about teaching (Loughran, 2004). The participants questioned the way they taught, and wanted to know if their teaching was making a difference to their students' learning. Subsequent to this symposium the field of self-study gained recognition in terms of its value in teacher education, classroom practice and as a reflective institutional framework (Loughran, 2004).

Self-study as a methodology was first described in the late 1990's. Pinnegar (1998) described the methodology of self-study as:

> …researchers seek[ing] to understand their practice settings. They observe their settings carefully, systematically collect data to represent and capture the observations they are making, study research from other methodologies for insights into their current practice, thoughtfully consider their own background and contribution to this setting, and reflect on any combination of these avenues in their attempts to understand…For these reasons…self-study is not a collection of particular methods but instead a methodology for studying professional practice settings. (p. 33)

LaBoskey (2004a) described four key aspects of self-study. First, self-study is improvement-focussed, requiring the researcher to reframe their thinking and transform their practice, and to seek evidence to support these changes. Second, self-study is interactive, providing multiple perspectives. Interactions could be with colleagues, students, literature and the researcher's own previous work, to help confirm or challenge understandings as they develop. Third, self-study utilises "multiple, primarily qualitative, methods" (p. 859). By using multiple methods there are "opportunities to gain different, and thus more comprehensive, perspectives on the educational processes under investigation" (p. 860). The final aspect is that the self-study methodology requires that the research be formalised and available for "deliberation, further testing and judgement" (p. 860) by the professional community.

Feldman (2009) also argued that self-study is a methodology as opposed to a set of methods. Using Harding's work on the methodology of feminist scholarship (Harding, 1989), Feldman and his colleagues constructed a parallel argument as to why self-study should be considered a methodology (Feldman, 2009; Feldman, Paugh, & Mills, 2004).

Feldman describes a process whereby these distinguishing features are considered in light of self-study:

- A self-study methodology brings to the forefront the importance of self.
- It makes the experience of the teacher educators a resource for research.
- It urges those who engage in self-study to be critical of themselves and their roles as researchers and teacher educators (Feldman, 2009, p. 37).

Whilst Feldman and colleagues acknowledge that self-study does not necessarily make the self problematic, this may simply be a consequence of the field of study being relatively new (Feldman, 2009; Feldman et al., 2004).

As the field continued to evolve, it became generally accepted that there are no specific self-study methods within the self-study methodology. Nor is there a particular theoretical perspective from which self-study should be regarded (Samaras & Freese, 2006). Rather, there are a range of factors and aspects that may be considered integral to the process, and that influence how a self-study may be conducted and communicated.

Samaras (2011), describes the five foci of self-study. She states that self-study is:

- a personal[ly] situated inquiry
- a critical collaborative inquiry
- [results in] improved learning
- a transparent and systematic research process
- knowledge generation and presentation (pp. 10-11)

One of these foci, critical collaborative inquiry, relies on the development of critical friendships. A critical friend is someone who provides both support and critique throughout the research process. The relationship between researcher and critical friends is an open and constructive relationship, built on a foundation of trust and confidentiality (Samaras, 2011). The notion of critical friendship appears in areas of education other than self-study. Costa and Kallick (1993) define a critical friend as

> a trusted person who asks provocative questions, provides data to be examined through another lens, and offers critique of a person's work as a friend. A critical friend takes the time to fully understand the context of the work presented and the outcomes that the person or group is working towards. The friend is an advocate for the success of that work. (p. 50)

An alternative view is provided by de Lima (2001). He argues for the use of friendly critics rather than critical friends to enable educational change. De Lima maintains that it is not the presence of someone pretending to be a friend that will enable change. Rather it requires someone who can look from either within or from outside and see the school (in this case) from a different perspective. He recognises that this must be done in a friendly manner, "by showing respect for the school and the teachers' culture, within the framework of built in mechanisms that are intentionally organized to promote the emergence of critique, divergence, dialogue and dynamic decision-making" (de Lima, 2001, pp. 115-116). The focus of de Lima's work is on school wide change, but his premise can be applied equally well to the learning and development of a single teacher.

Neither Costa and Kallick (1993) nor de Lima (2001) are referring to critical friendship/friendly critic within the context of self-study; rather they are looking

at it from the perspective of understanding practice, and this is one of the key drivers of self-study.

The notion of collaboration and the potential involvement of a critical friend or friendly critic is one aspect that sets self-study apart from reflective practice. However, it is important to consider reflective practice as there is some common ground between the two.

2.2.1. Reflective Practice

Much has been written about reflective practice in the field of education, as well as other fields such as nursing and social work. For example, Bolton (2010) defines reflective practice as "paying critical attention to the practical values and theories which inform everyday actions, by examining practice reflectively and reflexively. This leads to developmental insight" (Bolton, 2010, p. xix). She also describes it as being used to learn from experience and ask questions about oneself and one's practice. The key aspect of her definition is the idea of 'critical attention'.

Garbett (2012) describes her realisation that reflective practice draws an analogy to Han's Christian Andersen's story 'The Emperor's New Clothes'. In the story the Emperor is tricked into wearing an invisible suit, but claims to admire it from every angle. Garbett states that reflective practice can also be an 'illusionary device', reflecting what the person reflecting wants to see. Self-study, with its requirement for collaboration, means that new perspectives are introduced to the reflective process. In extending Bolton's (2010) reference to 'through-the-mirror writing', Garbett (2012) describes this as 'looking through the mirror'.

Zepke (2011) also makes the distinction between reflection and critical reflection, in particular if the reflection is to be effective for self-development. He identifies four key aspects for being critical:

- identify faulty facts or logic in the thinking and reflection of others;
- recognise and challenge ideas that ensure the dominance of certain ideologies;
- examine one's own reflections and assumptions about the world in light of how others explain theirs;
- actively work to improve self so that one reaches one's potential (pp. 31-32).

Brookfield (1995) describes reflection as becoming critical when it has the following two purposes:
- to understand how considerations of power undergird, frame and distort educational processes and interactions
- to question assumptions and practices that seem to make our teaching lives easier but actually work against our own best long-term interests (p. 8).

Brookfield argues that whilst reflection is an important part of teaching and learning, it is only through critical reflection that our assumptions are challenged, and that change occurs.

Self-study evolved from the fields of teacher inquiry, reflective practice and action research. Certainly when reflection becomes critical then this aligns it more closely with self-study. Loughran and Northfield (1998) describe self-study as building on reflection, taking what is largely an internal process and by making it public extending the reflective process to include others. They argue that "reflection is important in self-study but it alone is not self-study" (Loughran & Northfield, 1998, p. 15).

Lyons et al. have examined how reflective inquiry of professional education and learning can be transformative for educators and students (Lyons, Halton, & Freidus, 2013). Their self-study on the relationship between reflective inquiry and transformative practice arose from a conference presentation, and included

social worker supervision reflective inquiry, teacher-teacher reflective inquiry, and teacher educator reflective inquiry. While each of the three cases that were examined for this study provided different processes for enabling reflective inquiry, those involved all recognised a new level of consciousness. There were significant differences also in the settings of transformative learning, and how the reflective inquiry is conducted must take these into account (Lyons et al., 2013).

LaBoskey used critical reflection as one of the methods in her self-study. Rather than critically reflecting upon their own practice in isolation the participants in this study shared their journal entries. This allowed in depth collaborative critical reflection, extending the study from critically reflective to a self-study using critical reflection (LaBoskey, 2005).

Self-study took the field of reflective practice and directed the lens onto the self, onto teachers researching their own practice (Samaras & Freese, 2009). However, the methodology of self-study provides for flexibility in terms of the methods used, and methods from autoethnography may be employed.

2.2.2. Autoethnography

Reflective practice has some commonality with self-study. Another research methodology, autoethnography, also has some commonality. Autoethnography is described by Patton as one's own culture and one's place within that culture (Patton, 2002). Like self-study, there are cycles of reflection, where, almost like a camera lens, the researcher "zooms" in and out, making connections between the personal and cultural (Ellis & Bochner, 2000). This is reminiscent of the hermeneutic spiral or circle evident in self-study.

Autoethnography can also be described as "a form of critical self-study" where the researcher is both active and systematic in investigating their personal experience "in relation to cultural groups identified by the researcher as similar

to the *self* (i.e., us) or as *others* who differ from the self (i.e., them)" (Hughes, Pennington, & Makris, 2012).

Taylor and Coia (Coia & Taylor, 2013; Taylor & Coia, 2009) have used aspects of the autoethnographic methodology within a number of self-studies. These self-studies have had relationships as a key aspect. For example, a study on authority in the classroom had a strong focus on the relationships within the classroom (Taylor & Coia, 2009). They acknowledge that they have not used the autoethnographic methodology in its entirety. Rather, they have adopted those characteristics that are a best fit for their focus on self as part of a system containing complex identities and relationship and their interest in narrative and the stories of teaching.

Pennington and Brock (2012) used what they termed "autoethnographic self-studies" to examine racial identity. Using methods and tools from autoethnography, they gave white in-service teachers support to explore their identity in relation to the culture of their school. Pennington and Brock argue that this fits with both autoethnography and self-study. In terms of autoethnography, there are the strong links between the researcher examining his or her own culture and reflecting upon how it fits with the community in which they exist. Equally it reflects the goal of self-study as stated by Samaras: "self-study is critical examination of one's actions and the context of those actions in order to achieve a more conscious mode of professional activity" (2002, p. xv).

2.2.3. Action Research

Action research has been recognised as having an important role in teacher-based improvement and in teacher professional learning (Piggot-Irvine, 2009). Like autoethnography, there is some debate as to an exact definition for action research. Action research involves the development of a plan of action. The plan is critically informed, and aims to improve the current situation. This plan

is then actioned, observations are made and reflected on, and then these data inform the planning of further critically informed actions. This cycle continues until a resolution is reached (Cohen, Manion, & Morrison, 2007; Piggot-Irvine, 2009).

Action research also has similarities to self-study. The focus of self-study is always the self and one's own practice. While the focus of action research may be the researcher, it is not necessarily. Feldman, Paugh, and Mills also describe that it is possible to research one's own practice without a focus on self (Feldman et al., 2004). Each of the researchers describes their own journey from action research practitioner to self-study practitioner, and the associated shift from researching their practice to a focus on self in practice.

Casey (2012) completed a self-study that considered how 'insider action research' and reflective practice had resulted in pedagogical and curricular change. Interestingly his journey to explore change in practice began with an autoethnographical study as part of a master's degree. Clearly there is overlap between self-study and both action research and autoethnography, however, I believe it is the absolute focus on self and on practice improvement that separates self-study from the other two approaches.

2.2.4. Student Voice

The significance of student voice in educational research was first recognised in the late 1960s. Early research focussed on external researchers entering schools, talking to students and writing up their results. More recently the value of student voice has been recognised in a consultation process, operating internally within an education provider (Rudduck & McIntyre, 2007).

In reporting on the Consulting Pupils Project, Rudduck and McIntyre identify a number of benefits of consulting students, both for the student and the teacher. Students showed a greater commitment to learning, as a consequence

of feeling that they were involved and their views valued. Teachers gained ideas about how to change their teaching and the learning that occurs in their classroom to better meet the needs of the students. Consultation also allowed the teacher to know the students better as learners, and to understand the differences between students (Rudduck & McIntyre, 2007).

MacIntyre, Pedder, and Rudduck (2005) investigated the impact of student voice on teacher practice. The study involved six teachers (two each of Science, Mathematics and English) and their Year 8 classes in three schools in the United Kingdom. Six students from each class were interviewed by a researcher about their ideas on teaching and learning in the subject. The interviews were based on three specific lessons. Information from these interviews was fed back to the teacher in the form of a transcript, and teachers were then interviewed about their reaction to the transcript. This was followed by a period of time where the teacher made use of the students' ideas and both the teacher and students were part of an evaluation process. Finally, six months later, researchers visited the teacher again to see how much of an impact the students' ideas had made on the teachers' practice (McIntyre et al., 2005).

This study found that students were able to provide responses that were constructive, focussing on learning. They talked about what did and did not help their learning, without diverging into aspects that were not relevant to learning. There was also strong consensus between the students about what helped their learning, despite the fact that the teachers, classes and schools varied. The study found that teachers tended to respond positively to the ideas and feedback from the pupils, but that there were varying levels of responsiveness to these ideas from the teachers involved. Responses included short-term responsiveness, growing confidence, and problems with using pupil consultation. It is important to note that this study only involved six teachers, so while the number of students involved is not insignificant (36 students) and it is therefore possible to draw some conclusions from the students' ideas, it is problematic to do the same for the teacher responsiveness. Of the six teachers

involved, two teachers were categorised into each of the groupings described (that is short-term responsiveness, growing confidence and problems with using pupil consultation). The two teachers classed as demonstrating problems with using pupil consultation provided antithetical responses: one is described as "expecting too much of pupils" (McIntyre et al., 2005, p. 164) and the other of "not valuing the pupil perspective" (McIntyre et al., 2005, p. 165).

Student voice can be a critical aspect of self-study. Kosnik, Cleovoulou, and Fletcher (2009) emphasise that, without student voice as part of a self-study of teaching practice, we are missing a significant group of stakeholders. Data generated from the perspective of the researcher/teacher provides just one view of the situation. In order to lead to improvement, they argue that all stakeholders need to be consulted. They suggest that "interviewing our students can be a highly effective way to hear their views on teaching, for us to determine the impact of our work on them, and to give them an opportunity to offer suggestions for improvement to the course" (Kosnik et al., 2009, p. 55).

An often-voiced concern around self-study that includes attention to student voice is having the teacher conducting the research also acting as the interviewer. There is a belief that the interviewer should not have a prior teacher/learner relationship with the interviewee. Kosnik et al report that for studies they have completed this does not appear to be an issue. They have interviewed students, both in the role of external researcher and teacher-researcher, and in both instances found the students to be forthcoming. They argue that positioned as teacher-researcher they understand what they really want to learn from the students and that as the teacher they already have a relationship with the students. When interviews were conducted by two interviewers, there were no differences detected in the data collected between the teacher/researcher and the third party interviewer (Kosnik et al., 2009).

2.2.5. Journaling

Another rich source of data used in self-study is a professional journal. Holly (1997) describes a journal as "a dialogue with oneself over time" (p. 5). Keeping a professional journal allows a reflective practitioner to capture a moment and then later, with the benefit of time and distance from the events, reflect upon that moment enabling deeper levels of insight (Holly, 1997).

Bolton (2010) describes learning journals as being the "cornerstone of reflective practice and critical reflexivity" (Bolton, 2010, p. 128). She notes that whilst elements of the learning journal may well be public, shared with mentor or supervisors, others may remain private, shared only between the journal and author. This may allow the learner to write more freely, exploring areas of practice that leave them feeling vulnerable.

In the absence of feedback from clients on his work as a facilitator in the development and learning of others in a business setting, Shepherd (2006) used a learning journal as a way to improve his practice, effectively "generating (his) own feedback". He recorded within his learning journal incidents that he found interesting or puzzling. He then used a set of reflective questions to try and understand how he practised, and ultimately to try and improve his practice. The questions used were:
- How do I feel about this?
- What do I think about this?
- What have I learned from this?
- What action will I take as a result of my lessons learned?
- What have I learned from what I have done?
- What have I done with what I have learned? (p. 336)

Shepherd found that not only did this process alter how he worked with his clients, he also developed a much deeper understanding of himself in the process (Shepherd, 2006).

Journals are frequently used as a data source in self-studies. Garbett (2012) describes her electronic journal as a "diary of practice and experience" (p. 34). She goes on to describe how the act of writing in her e-journal afforded her the chance to not only portray a literal description of the events and situations that she found herself in, but became more than that. It also served as a place where she was able to begin an analysis process and supplement her descriptions with conversations and interviews, both with colleagues and students, recording her responses to them. Garbett explains that self-study has been critical in her transformation from a science teacher to a science teacher educator. Berry (2008) maintained two journals as part of her self-study, one private and the other public and available to her students. Both of these journals formed a significant part of her data set. Berry's study also looked at the transformation from science teacher to science teacher educator, and with a focus on tensions in teaching about teaching (see 1.1.5 Self-Study in Practice).

2.2.6. Critical Incidents

Tripp (1993) introduces the idea of critical incidents being a way to understand and gain control over professional judgements and also as a way of guiding the focus of action research in the classroom. The term critical incident comes not from education but rather from large-scale historical events. It has been used to refer to a circumstance or experience that is a major turning point or alteration in the life of a person or an institution or in some social phenomenon. Examples Tripp offers include war, legal negotiation, industrialisation or events within a political party. Within teaching the likelihood of such significant events occurring is rare. However, events do occur that have significance to those involved, and while these events may not have the gravitas of critical incidents in the historical sense they do have important consequences and are therefore worthy of professional reflection.

Vachon and LeBlanc (2011) used grounded theory method to investigate whether analysis of past or current critical incidents had a greater impact on reflective learning and change in practice. The context for this study was medical (rather than in education) but the notion of reflective learning and change in practice are common across the two disciplines. In their study eight occupational therapists participated in a reflective learning group over a period of 15 months. Critical incident analysis was used as the main activity in the group discussions that were a significant part of this study. The study found that when the participants were analysing current critical incidents, they were more motivated to self-evaluate, increasing their self-efficacy. This also led to an improved transfer of learning into action (Vachon & LeBlanc, 2011).

A study by Shapira-Lishinsky (2011) investigated the ethical dilemmas that exist in critical incidents in education, and the responses that these dilemma elicit. In the study, 50 teachers were interviewed. Within the interview teachers gave examples of sensitive ethical issues, focussing on critical incidents. The data were analysed and categorised, and from this five main categories were formed:

1. Caring climate versus formal climate.
2. Distributive justice versus school standards.
3. Confidentiality versus school rules.
4. Loyalty to colleagues versus school norms.
5. Family agenda versus educational standards.

The researcher recommended clarification and discussion on teachers' ethical knowledge. Rather than trying to enable teachers to explore critical incidents as a way to improve their own practice in this case the researchers investigated the ethical dilemmas that surround critical incidents for the teachers. Their recommendations are of great use for the teacher education community, but of limited use for the individual teachers involved in the study (Shapira-Lishchinsky, 2011).

Critical incident analysis is used in initial teacher education as a way to foster reflective practice in pre-service teachers. Francis (1997) describes a study whereby students in their third year (of a four year teacher education course) engaged in critical incident analysis. The students worked first individually to describe the elements of their critical incident, without judgement. They then reflected on the incident, attempting to ascribe personal meaning to it. The next stage involved critical friends and group work. In small groups, with a focus on the principles of critical friendship, each student shared their critical incident and the group shared their interpretations. Finally, working individually, the students returned to their own incident and reviewed the meaning given to it earlier, reconstructing the meaning as a consequence of any change in thinking that may have occurred as part of the group process. Francis concludes that being a critically reflective practitioner is important, and often the demands of teaching mean critical reflection on action is minimal once teachers are in service. Using critical incident analysis with pre-service teachers to attempt to develop a more intuitive approach to critical reflection long term may improve the reflection occurring in classrooms (Francis, 1997).

Goodell (2006) used critical incident reflections completed by students in her class as part of the data for a four year self-study investigating her teaching a mathematics methods course as part of teacher education. She collected three different significant sources of data. These were her own personal reflections, 10 critical incidents written up by each student and submitted for grading, and questionnaires completed each semester about the usefulness of each element of the course. While this was a self-study, the critical incidents that were used for reflection were not those of the researcher; rather she was investigating the way her students used the critical incident analysis. The critical incidents were coded to allow the researcher to understand the issues facing the mathematics education students, and to recognise how important it was for students to analyse their own critical incidents in order to become more reflective practitioners (Goodell, 2006).

2.2.7. Self-Study in Practice

Many of the published self-studies relate to teacher education, conducted by teacher educators. Both Berry (2008) and Garbett (2012) describe the journey and challenges with moving from teacher to teacher educator, a role for which there is rarely any formal preparation. Both of these teacher educators have documented their journeys and conducted self-studies on their transformation.

Berry's (2008) self-study was completed over a year, teaching within a Biology methods class. She identifies a range of data sources used as part of her self-study:

1. An autobiographical account of [her] experiences as a learner and teacher.
2. Videotape of each of the two semesters of Biology methods classes that [she] taught during the one year period of the study.
3. Two journals that [she] kept throughout the 2001 academic year (one public and one private journal).
4. Field notes that [she] took during Biology methods classes.
5. Prospective teachers' responses to a 'Personal Learning Review' task (n = 28).
6. Interviews that [she] conducted twice during the year with a small cohort of prospective teachers from the class (n = 8).
7. Regular conversations with a colleague in the Faculty of Education.
8. Regular e-mail correspondence between [herself], and one of the prospective teachers in the Biology methods class, in which [they] explored [their] ideas about learning, teaching and biology. (p. 22)

From this vast array of data, Berry was able to identify problematic aspects of her practice. She identified and analysed critical incidents and investigated assumptions that she held. Berry also identified tension, ultimately ending up with a list of six tensions that she saw as tensions experienced by teacher

educators. These tensions were then worked into a framework that could be used to analyse practice. This analysis could help to make explicit the professional knowledge of teacher educators (Berry, 2008).

Garbett (2012) describes two self-studies completed as part of her transition from teacher to teacher educator. In both studies her entries in her electronic journal were significant sources of data. As close as possible to teaching sessions Garbett recorded her description of events that took place, along with her impressions and reflections. She also used the journal as a way of reflecting on triggering events and themes that were emerging from this data source.

The first of her self-studies was a peer-teaching investigation. Data were collected from her electronic journal, questionnaires administered to the students at the beginning, mid-point and end of their course, written feedback from students evaluating their peer's teaching. In addition, informal focus-group interviews were conducted at the conclusion of the course.

Garbett found a number of challenges in using peer teaching within her classes, identifying some tensions that arose. She noted that it was challenging giving the students more responsibility, and the benefits that came with it, despite the fact that at the same time she felt as if her role as an expert was being eroded. It was also difficult to try and give up class time to peer teaching, whilst at the same time still trying to fit in the same amount of content. Ultimately, after considerable reflection and consideration, Garbett came to recognise that her teacher education classes had created a community of practice with a focus on science teaching as opposed to science learning. Her move away from being 'the expert science teacher' meant others, the student teachers in the class, could now gain practice in this role.

The second of Garbett's self-studies involved investigating team-teaching. In this study, as well as keeping individual electronic journals, both participants maintained a shared log. This was used when acting as participant observer to

record observations, questions and ideas. Other data were gathered from student questionnaires administered at the mid and end points of the course, seeking anonymous responses to the team-teaching approach being taken. Finally, data were collected from the use by students of critical incident questionnaires.

Garbett describes how the act of team-teaching and critiquing each other's practice provided a model for the student teachers. It enabled them to see that within teaching it is necessary to resolve complex and challenging dilemmas, and to see a way in which that could be achieved. However, it also gave Garbett another perspective on her own teaching, and allowed her to recognise the importance of teaching rather than science education. This informed her transformation from classroom teacher to teacher educator (Garbett, 2012).

Self-study has been used to investigate one Thai science teacher educator's understanding about pedagogical content knowledge (PCK) (Faikhamta & Clarke, 2013). Using qualitative data from sources such as journal entries (both student teachers' and educator's), video recordings of teaching sessions, student work, syllabi and hand-outs, the self-study used an inductive process to investigate how the educator attempted to enhance the students' PCK. Four themes emerged from the analysis process, and these were explored in more depth. The teacher educator identified that whilst his PCK for teaching science was strong, he needed to strengthen his PCK for teaching science teachers (Faikhamta & Clarke, 2013).

Brown and Russell's (2012) self-study explores the development of a beginning science teacher during their first two years of teaching. Brown, the beginning teacher, began communicating with Russell, a teacher educator, electronically. Initially Brown was communicating nearly every day. His communications outlined his experiences, the challenges that occurred within his teaching, and the frustrations and successes he experienced. Russell undertook to respond

quickly, as a way to continue the exploration of ideas that had begun as part of Brown's teacher education.

Some of Brown's greatest challenges came in the teaching of a College Prep (CP) course, designed for the less academic students. This class was challenging both with respect to poor academic performance but also poor behaviour. Through the collaborative self-study, he was able to try multiple different teaching approaches and evaluate their success or otherwise with an experienced teacher for support. Brown came to recognise that the relationships formed with the students within this course were key to his success as a teacher (Brown & Russell, 2012).

The literature review to this point has focused on the largely personal methodology of self-study. The remainder of the review has a contextual focus, shifting from the personal to the more abstract ideas of pedagogy, socioscientific issues and ethical thinking.

2.3. Quality Teaching

In this section quality teaching will be briefly considered. The topic of quality teaching and what exemplifies quality teacher practice could in itself be an entire thesis. The focus here is on New Zealand, particularly the guidance provided by the New Zealand Curriculum, as well as by a report on quality teaching (Alton-Lee, 2003) commissioned by the Ministry of Education.

As well as providing guidance about key competencies and the learning objectives for each learning areas, the New Zealand Curriculum (New Zealand Ministry of Education, 2007) also offers guidance on effective pedagogy. This section, titled "Effective Pedagogy: Teacher actions promoting student learning" (p. 34) argues that students learn best when teachers do a number of things. These include the creation of a supportive learning environment, the encouragement of reflection, heightening of the relevance of new learning whilst at the same time making connections to prior learning and experiences, ensuring that group work and shared learning is occurring, providing sufficient opportunities for learning to take place and finally inquiring into the relationship between teaching and learning.

This final approach is supported by the inclusion of a teacher inquiry model. It is envisaged that this process will be on-going, and an inquiry could be within a moment (as teaching is occurring), on a day to day basis or over a longer time period, such as a term or a year. The time frame would be dependent upon the nature of the inquiry.
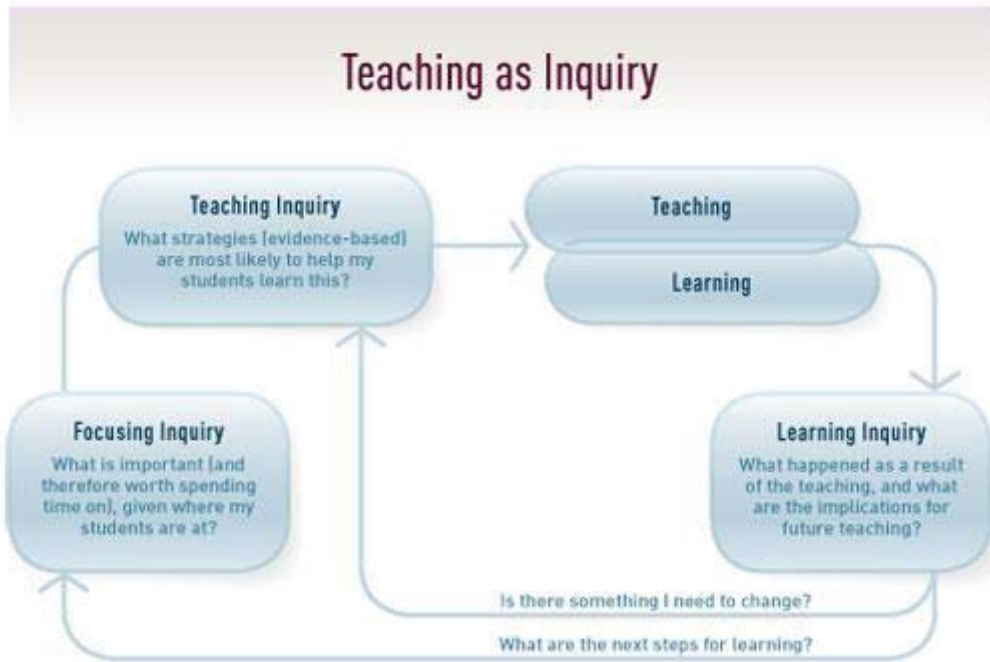
Figure 1: Teaching as Inquiry model (New Zealand Ministry of Education, 2007, p. 35)

Alton-Lee (2003) was commissioned by the Ministry of Education to write a best evidence synthesis on quality teaching for diverse learners. Evidence described in this report finds that 59% of the differences in student performance can be attributed to differences in teachers and classrooms. The best evidence synthesis produced ten characteristics of quality teaching. These were derived from evidence linked to student outcomes. The report focussed on quality teaching in New Zealand for diverse learners, with a broad definition of diverse learners, including aspects such as ethnicity, socio-economic background, home language, gender, special needs, disability, and giftedness.

Five of the characteristics of quality teaching identified by Alton-Lee are of relevance to this research. First, Alton-Lee identified that quality teaching is responsive to student learning processes. She argues that it is important for a teacher of any curriculum area to have knowledge of and be responsive to the student learning processes.

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A second finding of the synthesis is that tasks and classroom activities require scaffolding with appropriate feedback on students' task engagement. Within this Alton-Lee highlights the teaching of information skills as an important aspect of the teaching process. This should ensure students are able to access information readily when it is needed as part of the learning process.

Alton-Lee also argues that teaching should promote critical thinking. This is achieved through a pedagogy that promotes learning orientations, where the students are able to demonstrate self-regulation. It should also include metacognitive strategies and thoughtful student dialogue. I would suggest that the inclusion of ethical decision-making about contemporary issues is an ideal context for the promotion of critical thinking and thoughtful student dialogue.

And fourth, Alton-Lee's review of the literature argues that teachers and students should engage constructively in goal-oriented assessment. Both teachers and students should be clear about the learning outcomes. Students should be involved in the process of setting specific learning goals. Importantly, teachers must ensure that the assessment practices used impact positively on the motivation of the students.

In addition, the teachers should adjust their teaching to take account of the results of assessment. Recognising ways in which teaching practice could be changed by looking at the results of an assessment is an effective way to improve teaching practice.

2.4. Socioscientific Issues

This section is included within the literature review as socioscientific issues provided the teaching context within which the self-study occurred. The literature review of socioscientific issues does not attempt to the full extent of the issues or the teaching of them. It is included to support the context within which the self-study was situated.

Socioscientific issues are those which sit at the interface between society and science or technology. They are often described as social dilemmas, which link to concepts in science or technology (Sadler, 2004). The can also be described as "complex social issues with links to science concepts" (Lenz & Willcox, 2012, p. 551). Examples of such issues include cloning, stem cell technology, global warming, medicinal use of illegal drugs, and the relationship between diet and cancer (Bell & Lederman, 2003; Sadler, 2004; Zeidler, Sadler, Applebaum, & Callahan, 2009). As technology and science advance, these social dilemmas are likely to become more significant.

Ratcliffe and Grace (2003) identified the multifaceted nature of socioscientific issues. They noted that as well as having a basis in science, they involve the formation of opinion and making choices at the level of society, and often attract media attention. A lack of complete scientific knowledge means that those encountering these issues often deal with incomplete information, and in order to reach a resolution they require complex understanding of probability and risk as well as applying values and ethical reasoning.

Science educators have attempted to include socioscientific issues in Science curricula (Kolstø, 2001), recognising that science cannot be separated from the society in which it is embedded. By including socioscientific issues in the classroom, the view is that classroom Science would become a better reflection of society (Sadler, 2004).

There have been earlier attempts to integrate science and society within the education system. The science, technology and society (STS) movement arose in the late 1970s. It was developed as a way to look at the interdependence of science, technology and society. At the time it was embraced by the science education community, with the National Science Teachers Association (NSTA) publishing a year book in 1985 dedicated to the STS teaching (Zeidler, Sadler, Simmons, & Howes, 2005). Over time the STS movement has become discursive. It has largely been reduced to the state where isolated courses are based on particular issues with an STS foundation, and Science textbooks have small text boxes relating to issues as a part of their text (Sadler, 2004; Zeidler et al., 2005). This is contrasted with the socioscientific issues movement. Rather than simply investigating a scientific issue that impacts upon society, the socioscientific issues movement seeks to empower students to make informed decisions about socioscientific issues that affect them now or in the future (Kolstø, 2001).

Sadler, Barab, and Scott (2007) explored the benefits to students of engagement in socioscientific inquiry. They interviewed 24 school students whose classes were engaged in this activity. The students were asked questions about two fictitious scenarios, one which mirrored issues faced by the students in a fictitious context they had been exploring in class, and a second which relied on a context more distant from that which they had been studying in class. The paper suggests that there are four aspects of socioscientific reasoning. These are "recognising the inherent complexity of SSI, examining issues from multiple perspectives, appreciating that SSI are subject to ongoing inquiry, and exhibiting skepticism when presented potentially biased information" (pp. 387-388).

These four aspects have been derived from previous studies investigating within the context of socioscientific issues the most significant practices for decision-making (Sadler & Zeidler, 2005). When these aspects were related to

the data gathered from the students, the study concluded that the complexity and inquiry aspects could be used as a measure of scientific reasoning. However, as a tool it would have limitations, as it was likely to fail to gather the full scope of negotiation that occurs when exploring socioscientific issues (Sadler et al., 2007).

Böttcher and Meisert (2013) investigated decision-making in relation to the socioscientific issue of genetically modified crops. Their results indicated that students were better able to understand the decision-making process, and create their own decision making strategies when they had been indirectly taught decision-making. The students directly taught decision-making exhibited a less sophisticated level of decision-making, and had a poorer understanding of the decision-making process (ibid., 2013).

2.4.1. Scientific Literacy

There are an increasing number of calls for science education to not just prepare students for a future as scientists, but to work towards educating a more scientifically literate society (Bull et al., 2010; Gluckman, 2011, 2013; Tytler, 2007; Tytler, Osbourne, William, Tytler, & Cripps Clark, 2008; Wieman, 2007). Scientific literacy is an important skill for understanding an ever more complex world. It has been defined by the Organisation for Economic Co-operation and Development (OECD) as "the capacity [for young people] to draw appropriate and guarded conclusions from evidence and information given to them, to criticise claims made by others on the basis of the evidence put forward, and to distinguish opinion from evidence-based statements" (OECD, 2004, p. 39).

Scientific literacy is deemed to be of fundamental importance to society. In a democratic society it is essential that the general public understand the issues facing them, both as individuals or as members of society (Sperling & Bencze, 2010). Where these issues are socioscientific issues, individuals must

understand the science involved within the issue, and have a broad understanding of the characteristics of scientific knowledge in general. That is, society must have a degree of scientific literacy (Jorde & Mork, 2007; Kolstø, 2001).

Functional scientific literacy has been described as the "science knowledge needed by individuals to enable them to function effectively in specific settings" (Ryder, 2001, p. 3). Ryder examined previously published case studies of individuals who were interacting with scientific knowledge or interacting with science professionals, but were not themselves science professionals. He carried out an exhaustive literature search and analysed 31 studies.

The methodologies used in the case studies were varied, and included a mixture of both qualitative and quantitative research. The contexts were highly varied. However, Ryder's meta-analysis brings together a significant amount of research data, and draws some significant findings from that data (Ryder, 2001).

Ryder concluded that engagement in many science issues requires an understanding of the relevant science knowledge. However, this was not found to be the most significant factor. The study found that knowledge about science was more important than the content itself when it came to having functional scientific literacy. In particular, the epistemology of science (how ideas in science are developed and justified) and the sociology of science (how scientists interact with each other and those outside science) were found to be highly significant for engagement in science issues (Ryder, 2001).

Bybee (1997) developed a four-level hierarchical scientific literacy framework. The framework ranged from *Nominal literacy* (ability to associate scientific terminology with broad areas of science) to *Multidimensional literacy*. Individuals operating at this level:

"understand the essential conceptual structures of science and technology as well as the features that make that understanding more complete, for example the history and nature of science. In addition, individuals at this level understand the relationship of disciplines to the whole of science and technology and to society." (Bybee, 1997, p. 85)

2.4.2. Literacy, Socioscientific Issues and New Zealand

Dealing with socioscientific issues is a critical component of scientific literacy (Bybee, 1997; Colucci-Gray, Camino, Barbiero, & Gray, 2006; Ryder, 2001). The New Zealand Curriculum (2007) has made this explicit for educators in New Zealand. It states that as a result of studying Science students will "use scientific knowledge and skills to make informed decisions about the communication, application, and implications of science as these relate to their own lives and cultures and to the sustainability of the environment" (p. 28). "In Science, students explore how both the natural physical world and science itself work so that they can participate as critical, informed, and responsible citizens in a society in which science plays a significant role" (p. 17). As a whole, one of the visions of the curriculum is for young people to be "lifelong learners", with part of this vision being that they are "informed decision makers" (p. 8).

2.4.3. Teaching Socioscientific Issues and New Zealand

Whilst there is a considerable body of international research on the teaching of socioscientific issues and bioethics, until recently there was very little in a New Zealand context. Macer and colleagues, in a range of studies (Macer, 1994; Macer, Asada, Tsuzuki, Akiyama, & Macer, 1996), reported on surveys of both teachers and the general public, looking at attitudes towards bioethics and the teaching of bioethics. Conner (2002, 2010) investigated senior Biology classes, and the impact of the implementation of a bioethics programme. She identified that students needed to develop critical thinking skills within the context of

essay writing about cancer. Students would then be more confident and proactive when making decisions about issues outside of the school setting. Saunders (2009; 2010) surveyed teachers to identify their needs around the teaching of science issues in the classroom, and developed a professional learning programme and ethical inquiry model to support teachers. The Ethical Thinking Frameworks resulting from Saunders' work (and others such as McKim (2010) are published on the Biotechnology Learning Hub (University of Waikato, 2009).

2.5. Ethical Inquiry

One of the critical considerations in the teaching of socioscientific issues and decision-making is not what decision is made, but rather how the decision is made (Levinson & Reiss, 2003b; Saunders, 2009). School science education has changed in the last 20 years from preparation for further study to recognising the significance of preparation for citizenship, and the associated need to teach about socioscientific issues, scientific literacy and ethical decision-making (Jones, McKim, & Reiss, 2010; Saunders & Rennie, 2013).

The teaching of Biology in New Zealand has changed, in line with the changing ways in which organisms and biological systems are being used for biotechnology. Changes in the curriculum have motivated this change in teaching. Bioethics has also been a part of the assessment system for senior Biology in New Zealand since the mid-1980s (Conner, 2010). Conner provides four justifications for the inclusion of bioethics in senior Biology classrooms.

1. Individuals need to be able to how they will act based on their knowledge, beliefs and values.
2. Discussion of the reliability and validity of evidence that is presented in relation to bioethical issues will hopefully lead to the development of a critical eye when evaluating issues in the future.
3. An increased awareness of varying cultural perspectives leading to tolerance and appreciation of the viewpoints of others.
4. Future citizens become 'prosumers' of knowledge through the development of critical thinking skills and critical evaluation of different decisions.

McKim (2010) describes the development of the Ethics Thinking Tool. The toolkit, published on the Biotechnology Learning Hub (University of Waikato, 2009) and so therefore freely available for teachers, considers five ethical decision-making frameworks:

- consequences, harms and benefits
- rights and duties
- autonomy
- virtue
- multiple perspectives

The inclusion of four of these frameworks, namely consequences, rights and duties, autonomy and virtue, is heavily influenced by the work of Reiss (2007). The inclusion of the fifth framework, multiple perspectives, was provided to reflect the fact that New Zealand society is increasingly pluralistic (Saunders, 2009; Saunders & Rennie, 2013). Article 12 of the Universal Declaration on Bioethics and Human Rights calls for respect for cultural diversity and pluralism (UNESCO, 2005). Saunders believes that a "richer view on ethical perspectives" (2009, p. 28) will arise when pluralistic aspects are considered.

Saunders (2009; 2010; Saunders & Rennie, 2013) developed a professional development programme that supported the development and implementation of the Ethics Thinking Tool. Saunders used both surveys and interviews to develop an understanding of the status of issues education in New Zealand schools, and to identify the support that was required to address this. From this information, a professional learning programme was established, implemented and assessed for effectiveness.

Saunders' findings included the need to shift the focus of science education away from content to ethical inquiry if engagement with controversial issues was to be effective. When teachers were provided support in the form of strategies and appropriate approaches to achieve this, both teachers and students reported positive outcomes. The model for ethical inquiry on the Biotechnology Learning Hub was critical for the change in practice (Saunders, 2009; Saunders, 2010; Saunders & Rennie, 2013).

2.6. Summary

This literature review has focussed on some of the key publications in relation to the subject of this thesis. An exploration of the literature based around the self-study methodology provided a strong background from which definitions and understanding of the nature of self-study could be established. Whilst there was some disagreement as to the exact components of self-study, there was clearly some agreement about some aspects, in particular the focus on self and on improvement in practice. Other features that were evident across multiple definitions were the suggestion that self-studies should be both critical and collaborative.

Critical reflection was identified as an extremely important component of self-study. Self-study arose in part of the reflective practice movement, and thus critical reflection continues to offer much to the methodology of self-study. What separates self-study from reflective practice is the collaborative aspect of self-study, and in particular the use of a critical friend or a friendly critic. Loughran and Northfield (1998) highlight this significant difference with the argument that self-study builds on reflective practice and moves what is largely an internal process to an external one.

The important roles that both student voice and journaling can take in understanding practice were also highlighted. Both of these methods of data gathering have been used previously in self-studies. The literature around critical incidents was also examined. Interestingly, while critical incident analysis has been used in self-studies previously, the research reflected the use of critical incident analysis by the students in the class, rather than the practitioner-researcher themselves.

Examples of self-studies from the literature were discussed, with an emphasis on those that involved science education. The vast majority of published

research using self-study is from within the teacher education field. It is difficult to locate examples of classroom teachers using self-study to reflect on their practice, and even more difficult to find examples with a science education focus.

The elements of quality teaching were considered. This is a vast topic, and in order to keep it manageable only two significant documents were considered. The New Zealand Curriculum provides a framework for teachers who are inquiring into their practice. Lastly Alton-Lee (2003) identified ten characteristics of quality teaching, five of which were described here.

The remaining sections of the review were focussed on the contextual elements related to this thesis. The teaching of socioscientific issues and the need to improve scientific literacy were identified as important issues in science education. In the introduction to the thesis reference was made to New Zealand's Chief Science Advisor to the Prime Minister, Sir Peter Gluckman (2011), and his argument that New Zealand needs an education system that encourages "a strong focus on the science literacy approach" and where "the main emphasis of teaching programmes would be on exploration, critical thinking and discussion of socio-scientific issues" (pp. A-48). Much of the research in the literature on socioscientific issues is from outside of New Zealand. Nevertheless, increasingly work is being done in this country. Much of the work so far has related to attitudes of teachers and the general public to bioethical issues, as well as more recent work by Saunders and colleagues at The University of Waikato around the development of a teacher professional learning model and an ethical inquiry framework to support teachers (McKim, 2010; Saunders, 2009; Saunders, 2010; Saunders & Rennie, 2013).

This literature review thus identified the value those in teacher education have placed on self-study as a methodology to improve practice. However, it highlighted the limited number of published self-studies from classroom practitioner. It also recognised the key role that teaching socioscientific issues

and ethical decision-making may have in the development of a more scientifically literate society.

Chapter Three Methodology

This chapter discusses the research design and the process followed. There were two significant drivers in determining the design of this research. I focussed on self-study as a methodology from an early stage of the process. The reasons for this were my desire to do research that would make a difference to my practice, and the dilemma of being a researcher in a school and addressing the ethical issues that this raises. It was also clear from the formative stages of this study that I wanted to base my investigation in the teaching or assessment of one particular standard. The NCEA Achievement Standard Biology 3.2 (AS90714) is used to assess a unit investigating socioscientific issues in the Year 13 Biology course.

This chapter outlines the self-study methodology before considering the wider theoretical influences. It then describes the methods used and lastly discusses the ethical considerations.

3.1. Self-Study

LaBoskey defines a methodology as 'a stance that a researcher takes towards understanding or explaining the physical or social world (2004b, p. 1173). This describes the nature of self-study. The self-study methodology was developed to understand and improve teaching practice (Hamilton & Pinnegar, 1998a). There is no single self-study method; rather the methodology provides guidelines and a set of possible self-study methods (Samaras, 2011; Samaras & Freese, 2006). The guidelines are described as the methodological components of self-study, and whatever methods are used in a self-study, these components should be evident (Samaras, 2011).

3.1.1. Five Components of Self-Study Methodology

There are five components of the self-study methodology: personal situated inquiry; critical collaborative inquiry; improved learning; transparent and systematic research process; and knowledge generation and presentation (Samaras, 2011).

Personal Situated Inquiry

The focus of a self-study is the self. It draws directly from the researchers own experiences, usually in relation to their teaching. The self-study may identify tensions, and the examination of these provide an opportunity for professional growth and learning (Berry, 2008). The methodology may also provide an opportunity to identify contradictions between what the researcher believes is happening and what is actually happening (Whitehead, 1989).

Critical Collaborative Inquiry

This is one of the key characteristics that sets self-study apart from reflective practice. The inclusion of a critical friend means that the reflective process, which is largely internal, now becomes external (Loughran & Northfield, 1998). The collaboration, feedback, and critique may be essential in helping to extend an individual's understanding (Samaras, 2011).

Improved Learning

As a teacher investigates their practice there can be multiple benefits in terms of improvement to learning. Not only may it improve their work as a professional, it may also improve student learning and inform education and school programmes. Beyond the school there is also the possibility of having influence on policy makers and ultimately education reform (Samaras, 2011). Even without considering the more wide-reaching implications, the focus is on improved learning for both the teacher-researcher and the student.

Transparent and Systematic Research Process

The use of critical friends is important in maintaining the transparency of the research process. A self-study requires the researcher not to be working in isolation, rather to be engaged within a community of practice, no matter how big or small. Critical friends provide an alternative perspective or interpretation to the findings (Samaras, 2011).

Knowledge Generation and Presentation

Finally, a self-study contributes new knowledge. This may be of benefit at a personal level, professional level or system level. Self-studies are made public, allowing others to review and critique the work. This last point highlights the paradoxical nature of self-study. While the name suggests a very personal study, the publication of the research, with subsequent critique and reflection by others, leads to an almost collective task (Elijah, 2004; Samaras & Freese, 2009).

3.1.2. Nature of Data in Self-Study

Frequently much of the data collected in a self-study is qualitative, and as such the analysis follows the same sets of rules and guidelines as any qualitative data. The process is recursive rather than linear, and the pattern of data collection – data analysis – data interpretation is repeated (Pinnegar & Hamilton, 2009; Samaras, 2011). Samaras points out that as the researcher collects the data meaning starts to be drawn from it immediately. Consciously (or unconsciously) connections are made, and the data start to be arranged. This can then lead on to the processes of more formal analysis such as coding and identifying themes and trends (Miles & Huberman, 1994; Ryan & Bernard, 2000).

Berry (2008) conducted a self-study to understand herself better as a teacher educator. She worked with numerous data sources including journals, videotapes of teaching sessions, field notes, student responses and interviews,

and documented conversations and emails with colleagues and students. Berry initially analysed her data, identifying problems or tensions that were recurring. She then used these tensions as a framework, coding her data according to the tensions, leading to these tensions being used as a conceptual tool as well as an analytic tool. The identification of these tensions then gave Berry an avenue to better understanding of herself as a teacher educator and therefore to improved practice (Berry, 2008).

3.2. Theoretical Frameworks

The methodology chosen for this research is self-study. Self-studies can be described as hermeneutic in nature. The researcher is immersed in the data, moving back and forwards through it without predetermined assumptions. This may result in unrelated ideas emerging, or clarity being gained by the emergence of parts-whole relationships (Garbett, 2011; Hamilton & Pinnegar, 1998b; Samaras, 2011; Samaras & Freese, 2006). Shane (2007) describes hermeneutics as "the art of understanding" (p. 108). This definition aligns with the principal aim of self-study to understand practice.

Hermeneutics originated in the interpretation of sacred texts such as the bible. However, now it is used in qualitative research to describe how meaning is constructed by individuals and groups within a context (Crotty, 1998; Patton, 2002; Shane, 2007). Mertens argues that hermeneutics is the study of interpretive understanding, or "as a way to interpret the meaning of something from a certain standpoint or situation" (Mertens, 2005, p. 16). In self-study it is not possible to separate the 'self' from the 'study', so the researcher is making meaning from their perspective, but in a way that recognises his or her values and beliefs. This recognition will at the same time challenge the values and beliefs.

Hermeneutics can be used more practically, as an analytic tool in qualitative research (Shane, 2007). Bodner (2004) describes how a hermeneutic cycle or spiral can be used to facilitate understanding and derive meaning from qualitative data. The process of self-study is not a linear research methodology, rather it is more accurately described as a hermeneutic spiral whereby ideas are questioned, challenged and continually revisited. The researcher is led by what he or she discovers towards deeper understanding of their practice and to ultimately improve their practice (Samaras, 2011). This is reflected in the recursive nature of the data analysis in this research, where the data are considered and reflected upon. Priorities are then considered in far greater depth to construct meaning from it.

It is also important to acknowledge the role of constructivism as it informs this research. The constructivist epistemology grew from work on both phenomenology and hermeneutics (Mertens, 2005). Constructivists are guided by the assumption that knowledge is socially constructed by participants in the research process. There is also an assumption that the researcher attempts to understand the experience from the viewpoint of those who have lived the experience (Mertens, 2005). This resonates very strongly for me with my focus on self-study. I am the researcher seeking to understand my practice. I am doing this by thinking critically, reflecting, interviewing and having discussions with others to understand what is happening in my classroom. Most importantly, I am interviewing the students who have lived the experience, to gain their viewpoint.

3.3. Methods

Context

This study was carried out in a co-educational decile 9[4] New Zealand urban high school. The school is a multicultural community, made up of European (New Zealand or other) 46%, Maori 11%, Pacific Island 8%, Asian 18%, Indian 8%, other 4% and International fee paying students 5%[5]. The school enrols students from Year 9 (approximately 13 years) to Year 13 (approximately 17 years). The class that participated in my self-study was my Year 13 Biology class in 2011. Year 13 Biology is a course designed to prepare students for their first year of tertiary study in this subject. However, not all students from the course proceed to tertiary science courses, or even necessarily tertiary study[6], so an additional aspect of this course is preparation for citizenship.

Participants

The Year 13 Biology class that was part of this study was made up of 28 students, 11 boys and 17 girls. Of these students 24 consented to be part of the study (one did not give consent and the other three were absent on the day the study was explained and consents gained). A smaller group of 10 consenting students were selected for the interview process as is discussed later.

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[4] School decile ratings are assigned by the Ministry of Education for funding purposes. They indicate the extent to which schools draw students from low socio-economic families. A decile rating of 10 is the highest (ie lowest number of low socio-economic families) whereas a decile rating of 1 is the lowest (Ministry of Education, n.d.).

[5] Based on 1st July 2011 return made to Ministry of Education

[6] Although it is difficult to gather definitive data (due on privacy laws in New Zealand) it is generally accepted that approximately 25% of Year 13 students at the school where the study was conducted, would continue to tertiary study. The number continuing to tertiary study from the Biology class is greater than this, but is by no means 100%.

Data Collection

When I first started this self-study, I planned to use written work from students and explore how ethical decision-making changed over the course of the unit. As I became more familiar with and confident about the notion of self-study, I recognized a significant flaw in my logic. Student work told me more about the students rather than myself, so the focus needed to change.

Several significant sources of data were used in this study. First, a professional journal was used to document both events and reflections on a regular basis. This journal was a handwritten series of notebooks. The handwritten nature of the journal was important to me. I enjoy working in that medium, and often find that I think with more clarity when I handwrite. It also did not rely on a functioning computer or internet connection which would have been needed for an electronic or online journal. When I struggled to write I sought inspiration from both Holly (1997) and Bolton (2010). Use of a journal is common in self-study, with both electronic journals and paper based journals being used (Garbett, 2012; Olsher & Kantor, 2012; Samaras, 2011).

As well as writing about and reflecting on events as they have happened, my professional journal also contains reflections based on previous entries. As the research and teaching progressed, from time to time I would look back and reflect upon the events to that point or in a series of lessons. This strikes me as the beginning of the hermeneutic spiral Samaras describes of "questioning, discovery, challenge, framing, reframing, and revisiting" (2011, p. 81).

Within Chapter Four Results, the journal is referenced by volume, page number, and date of entry. For example, "Journal B, p. 12, 1 June 2012" refers to page 12 of my second journal (B). The journal entry is dated as shown.

A second significant source of data were the transcripts of interviews conducted with nine of the participants. These interviews were semi-structured in that there was a set of questions used (see Figure 2), but the conversation was led

by the answers the students gave. The only physical prompt used was a print-out of the Ethical Thinking Frameworks from the thinking tool to help students remember which framework(s) they had worked with.

The questions used in the interview (see Figure 2 below) were developed to ensure that the students were at ease in the interview. I began by asking questions that were not challenging to them, but that helped them to remember back to the unit of work. Once the interview was well underway it was much easier to ask them about my own practice, and they seemed very willing to answer the question openly. I also found that depending upon how open the student was the conversation flowed on to questions and conversation beyond the list above.

What did you find interesting in this unit?

What did you find helpful in this unit?

Was there anything that surprised you?

What could you use later, in a different context?

What do the frameworks tell you?

How did they help?

Describe a scenario where you think you could use Ethical Thinking Frameworks.

What really got you thinking in this topic?

Was there anything in this topic that stopped you thinking?

Did you notice anything new or different about the way I taught this topic?

What did I do that helped you?

Can you think of things I should change if I use these frameworks again?

What advice would you have for next year's students at the start of this unit of work?

Do you think that the fact that this work was part of a research study influenced how you worked? How?

Figure 2: Questions used in the interviews

The process for conducting these interviews was determined largely in consultation with the Massey University Human Ethics Committee (MUHEC). The issue the Committee had was that I was in a power position with these students, as I was also responsible for assessing their work for high stakes internal assessments for NCEA, and the fear was that the discussions in the interview might influence the way I assessed their work.

There were several options open for consideration. One was to not use interviews as a data source. However, interviews are often used by self-study researchers as they allow gather data which is both in depth and specific (Kosnik et al., 2009). It was also an important way to triangulate the data I was gathering so that comparisons could be made of my experience of the classroom and my teaching with the students' experiences, and as data sources to be used for discussion with a critical friend and compare them to the literature. Also a consideration for me is the sizeable body of research about the importance and value of student voice as a tool to improve learning (LaVan & Beers, 2005; McIntyre et al., 2005; Roth, Robin, & Zimmermann, 2002; Rudduck & McIntyre, 2007; Wilson & Corbett, 2007). For these reasons I felt justified in insisting that interviews be part of the data gathered.

Another option was that someone else should conduct the interviews. I felt very strongly that as the interviews were forming a significant data source for my self-study, consequently I should be conducting the interviews. There has been considerable research carried out on the art of interviewing. Kvale (2007) describes six criteria by which to measure the quality of an interview:

- The extent of spontaneous, rich, specific and relevant answers from the interviewee.
- The shorter the interviewer's questions and the longer the subject's answers the better.
- The degree to which the interviewer follows up and clarifies the meanings of the relevant aspects of the answers.

- To a large extent the interview is interpreted throughout the interview.
- The interviewer attempts to verify his or her interpretations of the subject's answers in the course of the interview.
- The interview is 'self-reported', it is a self-reliant story that hardly requires any extra explanation (p. 80).

Kvale also describes interviewer qualifications, one of which is knowledge. He suggests the interviewer should have 'an extensive knowledge of the interview theme and can conduct an informed conversation about the topic; will know what issues are important to pursue, without attempting to shine with his or her extensive knowledge' (Kvale, 2007, p. 81). When this quality of the interviewer is considered in relation to the qualities of a good interview, in particular the last three bullet points, it makes sense to me that in a self-study it is appropriate for the self-study researcher to conduct the interview. The researcher will be ultimately interpreting the interview, and is best placed to clarify with the interviewee any lack of clarity or confusion that may arise at the time of the interview.

In describing aspects of her own self-study research, Kosnik and colleagues (Kosnik et al., 2009) found students to be very forthcoming when the teacher-researcher (Kosnik) interviewed them. They argued that this is due to the good relationship that already existed between her (Kosnik) and the students and their acceptance that she wishes to learn from them. However, she has also used a second interviewer in one self-study, and compared their data. They were unable to detect a difference in the data each interviewer collected about Kosnik's course (Kosnik et al., 2009). This provides support for the notion of conducting the interviews myself.

The final consideration was the timing of the interviews. With acceptance that I would be conducting the interviews, and still facing the ethical dilemma around power relationships, this meant that the interviews could only be conducted after the students had finished their assessed work for me. However, the timing

was very close to when they were due to sit high stakes external examinations for NCEA, so it was agreed that the interviews would be conducted only after all of their examinations had been completed. This, therefore, required the students to make an additional trip to school. It also left a very narrow window of opportunity for conducting the interviews, as I wanted them completed before school closed for the year. It was important that there were other people around when the interviews were being done, to ensure the safety of all parties. As a consequence I had just one week in which to complete all interviews.

At the time I felt it was not ideal to conduct the interviews so far removed from the teaching sequence (there was a gap of approximately 3 months from the completion of the final assessment). However, this was necessary to manage the ethical issues. Upon reflection the delay could be seen as beneficial, as it allowed me some time and head space to think about what had happened in class, and to have really considered what I hoped to gain from the interviews.

Purposive sampling was used to select the students to be interviewed. Purposive sampling is non-random sampling, whereby the researcher relies upon their previous knowledge of the population being sampled and the purpose of the research (Fraenkel & Wallen, 2009). I chose the students to ensure that I had a range of levels of achievement in the final assessed grades, and chose those that I felt were most likely to be able to articulate ideas about the teaching and learning in the classroom. A total of 10 students were invited to be interviewed, and nine interviews were completed. This represented approximately a third of the class. Of the completed interviews, two of the students were male and the remaining seven female. Of the nine completed interviews, one transcript was not released, so has not been used in the research.

The interviews were conducted in a room with windows and a door with windows in it so that participants were visible to passing staff. Each interview

was recorded electronically, and then after all of the interviews were completed I transcribed them. The transcripts were then sent to the students for release, ensuring that they were satisfied that I had accurately recorded and transcribed the conversation.

Finally, I was also able to gather data from my teacher plan book and research notebook (referred to in Chapter Four Results as 'Notebook' to distinguish it from my professional journal entries). These sources were used largely to remind me of the timing of events, as most of the relevant data was recorded in my journal.

3.4. Framework for a Self-study into Teaching Practice

In this research I developed (see Figure 3) and tested a framework for my own self-study. Part of the rationale for development of the framework was to create a tool that other classroom teachers could easily use. Having conducted a self-study (and from early on in the process) I recognised the power of self-study in relation to practice improvement, and I wanted to be able to share this. The framework merges ideas about self-study by Samaras and colleagues (Samaras, 2011; Samaras & Freese, 2006) with ideas about critical incidents by Tripp (1993), Brookfield (1995) and colleagues, synthesizing them into a single process.

I chose to explore my practice from the perspective of critical incident analysis because critical incident analysis is something with which teachers are already familiar. One consideration throughout my self-study has been to try and create a framework for other teachers hoping to complete their own self-study. As such I wanted to work with techniques that teachers may already be familiar with. Tripp's (1993) work has been referenced widely in the literature, and taught as part of some university education courses. Tripp's and Brookfield's use of critical analysis is easy to grasp and encourages deep reflection, something critical for self-study (Brookfield, 1995; Tripp, 1993). The framework, which can be seen in Figure 3, is divided into five sections.

Figure 3: A framework for a self-study into teaching practice

Research Question		The question you develop should reflect an interest in improving t
		should be feasible, clear, significant and ethical.
Data Collection	Data should be relevant and timely	Reflective journal, interviews, documented conversations with me
Analysis	Identify significant critical incidents and reflect upon them	The critical nature of an incident is determined by the impact it ha
		point in awareness? Does it make you rethink some implicit belief,
		readily come to mind and therefore need exploring?
	Determine which of these incidents are most likely to inform practice	Keep in mind two essential components of self-study. First, self-st
		requiring the researcher to reframe their thinking and transform t
		evidence to support these changes. Second, self-study is interactiv
		perspectives. Interactions could be with colleagues, students, liter
		previous work, to help confirm or challenge understandings as the
	Analyse these critical incidents	For each critical incident use this framework:
		• Status – provides an outline of the situation
		• Insight – what understanding can you draw from the critic
		• Reflection – carry out the analysis
		• Insight – what new insight can be drawn
		• Implications for practice – what will this look like in my te
		Suggestions for reflective analysis (see Tripp (1993) or Brookfield
		• Use of thinking strategies such as: PMI; alternatives, poss
		• The Why? Challenge
		• Dilemma Identification (Berlak & Berlak, 2012)
		• Personal Theory Analysis
		• Ideology Critique
Discussion	Relate the critical incident and its analysis back to literature	Discussion is important to help maintain a perspective on what is
Practice	Put changes in to place	The changes that can then be put into place are evidence based.
		rather than change for change sake or rash changes. It is quite co
		start again, either to look at how the changes impact the teaching
		another aspect of teaching practice.

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Research Question

Without a research question it is difficult to determine the direction in which the researcher should take. In a self-study it is important that the research question reflects an interest in improving teaching practice. The research question may relate to one class, one group of students, one subject or it may be broader. However, key to the success of the research is the requirement for the research question to be feasible, clear, significant and ethical.

The development of the research question is something that should be discussed with a critical friend or mentor. This conversation is critical as it may illuminate ethical issues or issues of feasibility that the researcher had not considered.

Data Collection

The scope of data that can be collected for a self-study is vast. Before beginning the self-study it is important to think carefully about how the data might be analysed and used, and how it informs the research question. Again, these are topics for discussion with a critical friend. Of utmost importance is the fact that the data must be relevant to the research question and timely. Figure 3 contains some examples of data that could be used, but there are many more examples that may be more relevant to other research questions.

Analysis

The framework developed as part of this research use critical incidents analysis as a method to reflect upon practice. The first step in this process is the identification of critical incidents. Incidents are deemed to be critical when they are a turning point in awareness (Mason, 2002). This could relate to either the teaching or research, and again this reflects the nature of the research question. Importantly, they are incidents the researcher deems significant (Tripp, 1993).

Once identified it is important to consider each critical incident, and decide which of the incidents is most likely to inform practice. To ensure that the research is still meeting the requirements of self-study, it is essential to remember the five components of self-study, as described by Samaras (2011). Talking this through with a critical friend is important, as well as considering any data that has been gathered so that an evidence-based decision can be made. In the case of this self-study, this part of the research is what makes up Chapter Four Results.

The critical incidents that have been selected as those most likely to inform practice are then analysed. Each critical incident is analysed using the same framework, but the method of analysis may vary. The framework is derived from Brookfield's work on using autobiography to understand oneself as a learner (1995, pp. 58-66).

1. Status
   This provided an outline of the situation.
2. Insight
   This was where I drew some initial understanding from the critical incident.
3. Reflection – carry out the analysis
   At this stage I carried out the analysis using the techniques described by Tripp (1993) and Brookfield (1995).
4. Insight
   This was a second opportunity to draw out understanding, this time after the reflection process.
5. Implications for practice
   The last, and in my view one of the most critical steps, was to consider how it related to practice. How might my practice change as a result?

The third step in the framework is where the analysis is carried out. The techniques described by Tripp (1993) and Brookfield (1995) include: the use of

thinking strategies; the 'Why' challenge; dilemma identification; personal theory analysis; and ideology critique.

Discussion

In the discussion section the findings of the critical incident analysis are related back to the literature. This is in essence the forth critically reflective lens described by Brookfield (1995), the others being the teacher researcher, the students and colleagues. It is important to consider the literature as it may help make sense of the experiences, and importantly it helps maintain a sense of perspective on what is happening outside the researcher's classroom or school.

Practice

This, in my opinion, is one of the most critical aspects of a self-study. It is the returning to practice and putting the changes in place. The changes that are put in place are evidence-based, the result of a critically reflective process. At this point the process may start again, either considering how the changes being made impact on the teaching and learning, or to investigate another aspect of teaching practice. Discussions with a critical friend will help with unravelling the direction of further self-study.

3.5. Data Analysis

Transcription

The first aspect of the data analysis was the interview transcription process. I include this as data analysis rather than part of collection as it was the first step of the reflective process, truly looking back over the events of the teaching programme. As I transcribed I wrote reflective comments along the side of the transcript. It was suggested to me that I should get someone else to do the transcribing as it was such a time-consuming process. However, being immersed in the data relocated me back in the interview. It allowed me to very quickly and early on formulate some emerging themes and ideas.

The transcription process I chose to use was to simply transcribe the words spoken, including the 'ums' and 'ers', but not to focus too much on details such as pauses. The oral communications were of far more significance than the non-verbal cues. This is because the transcripts were not going to be used for narrative analysis; rather they were a record of the conversation. The transcripts were important to give the students an opportunity to check what they had said and release once they were happy with them.

Identification of Critical Incidents

Once the interviews were transcribed I had two significant sources of data to work with: my professional journal and the interview transcripts. Going back through these I identified ten critical events or incidents.

Reflection

Once identified, I placed the incidents into a table format, simply because that is a way that I have found best for me to organise and process information. For each incident I:

- outlined the situation
- identified why I had chosen it as a critical incident
- identified the key ideas and some relevant references from the literature
- found some evidence directly from either interview transcripts or my professional journal
- thought about and wrote a reflective commentary.

This process was particularly insightful, as it gave me a framework within which to organise my thoughts. It forced me to think about why each critical incident was of interest to me, and how that interest manifested.

Critical Incident Analysis

The critical incident analysis became the crux of the self-study. From the ten critical incidents I identified there were initially three (and finally five) that I wanted to analyse more fully. Each of these five critical incidents was particularly important in terms of my teaching practice, and seemed to offer the most in terms of an opportunity for change and improved learning. I felt that this point was vital, as improvement of learning is one of the five components of the self-study methodology, as discussed earlier in this chapter.

Four critical incident analyses were completed. Two of the five critical incidents selected were analysed together, because both of them related to aspects of the use of the Thinking Tool, and the Ethical Thinking Frameworks contained within it, from the Biotechnology Learning Hub (University of Waikato, 2009). For each critical incident a different method of analysis was chosen. The rationale for each can be found with its analysis. I used a variety of analysis techniques so that I could use the technique that best suited each situation. The techniques were described by Tripp (1993) and Brookfield (1995), and I have then in some cases gone back to the original sources for further clarification.

3.6. Ethical Considerations

The main ethical concerns in this self-study related to the use of informed consent, minimisation of harm to participants, researcher and institution, respect for privacy and confidentiality and avoidance of conflict of interest. Each of the ethical considerations outlined in this section were attended to, and the research received ethics approval from the Massey University Human Ethics Committee: Southern B (application number 11/14).

Informed Consent

Participants have the right to freedom and self-determination, and from this arises the need for informed consent (Cohen et al., 2007). Diener and Crandall (1978) define informed consent such that four elements are involved.

Competence

All the students involved in my self-study were over the age of 16 and had enjoyed a degree of academic success to get them to that level of study. I consider all of them competent to make an informed decision about participation.

Voluntarism

There were students who elected not to be part of the research. In these cases I ensured that I removed references to them from my reflective journal and did not invite them to be interviewed. This process occurred after the coursework was completed, so did not impact upon my teaching of the students, as I was unaware of who had and had not given consent until after they had left for study leave. Students were aware that this would be the situation from the outset.

Full information

As best I could, students were fully informed on the day that they gave consent. A third party explained the research to them, informing them of the nature and type of data that was to be collected. At that stage they were not informed of how the data would be analysed as this was still to be determined. However they knew how the data was collected and what use it would be put to. It was made clear to the students that they had the right to ask questions and withdraw from the research at any stage.

Comprehension

The nature of this research made it easily comprehensible for the students. As already stated they had achieved some academic success to be in the class, so were competent. This meant that they were therefore able to understand the research as it would impact them. The only requirement for some of them that was additional to normal class was an interview. It was made clear to them that if they were selected to be interviewed this would be done in such a way as to minimise impact on their study. The students were capable of comprehending this, but also had the option of seeking clarification from myself or a third party at any stage.

As part of the process the college within which the research took place also gave informed consent. In this case a letter and information sheet were given to the Principal and Board of Trustees.

Minimisation of harm

An issue of significance in the research was the fact that, in the relationship with the students, I held the power. A concern of the Massey University Human Ethics Committee was how their participation (or not) in the study might impact on our teacher-pupil relationship. Could this impact upon how I assessed their internally assessed work?

To minimise the impact of this power relationship, interviews were conducted after the students had sat their external examinations. At this time all of their grades had been submitted and were no longer able to be appealed. Moreover, I was unaware of who had and had not consented to be part of the research until after their course had finished. This ensured that the research did not impact the day to day relationship with the students in the class.

Further minimising the harm, a third person introduced the research to my class. Ms Deb King was another senior teacher at the college. She has a background in education research, so understood the ethical issues involved in the study. She was able to hold the consent forms in a secure location until they were released to me. Deb was also a person that the students were able to go and see if they had any questions or if they wished to withdraw their consent. She was not teaching any of the students involved.

Privacy and confidentiality

Participants in the research have also been protected by both privacy and confidentiality. Privacy is more than confidentiality. The right to privacy means that the students have the right to refuse to participate, not be interviewed, not answer questions and not answer phone calls or emails (Cohen et al., 2007). The right to not participate, either entirely or just the interview was made very clear to the students at the onset. Their rights were re-read to them at their interview, to remind them.

Anonymity was also guaranteed to the students. Anonymity means that any information that they provide should in no way reveal their identity (Cohen et al., 2007). The college remains unnamed in this thesis. Where appropriate students are either unnamed or have been given a pseudonym. This is to ensure that the students are not able to be identified.

Conflict of interest

The greatest obstacle to navigate with regards to ethics has been the power relationship between myself and the students involved in this research. From the formative stages of this research I knew I wanted to work with a Year 13 Biology class and investigate some aspect of the NCEA Achievement Standard Biology 3.2 (AS90714). The standard required students to research a contemporary biological issue and then report back on the biological concepts and processes relating to the issue, implications of the issue, which can be biological, social, ethical, economic or environmental and differing opinions or viewpoints.

Initially I considered investigating students' responses and researching with a very student focussed lens. Very quickly I realised that this was going to be exceedingly difficult to do if I was to adhere to the principles of ethical research. Therefore, the first step taken to addressing the ethical issues, and in particular conflict of interest, was to use a self-study methodology, putting myself as the focus for the research.

Other ways in which I have addressed the power imbalance have already been discussed. Interviews were conducted after the course was completed; I was unaware of who had and had not consented until the end of the course; a third party was used to explain the research and the research process, and manage the consent process on my behalf.

Finally, after the interviews had been transcribed they were returned to the students to check them and release. At this point they were able to make any changes they wished. Again, this ensured that some of the power remained with them, and that they did not feel powerless in the research process. Once this research is complete, the students will be able to access a summary of the research if they wish.

3.7. Summary

This chapter of the thesis has outlined the methodology used for this thesis. The use of self-study as a methodology meant that the focus of the study was me and my practice. As a consequence, this determined the types of data that were most likely to be of value. The most significant sources of data were my own professional journal and the transcripts from interviews with a number of students from the class.

A framework was developed and presented. This framework could be used by other classroom teachers wishing to conduct their own self-studies. The framework outlines each of the steps needed, including the analysis of critical incidents as a means to achieving critical reflection.

The following chapter presents the data from ten critical incidents identified as being important in terms of either my teaching practice or the research process.

Chapter Four Results

4.1. Introduction

The data that have been presented in this chapter come primarily from the professional reflective journal kept as part of the on-going research process. The data also include the transcripts of interviews conducted with students at the end of the teaching process. The analysis is made up of ten events. These events were selected as part of the reflective process by first considering the question "Which events within the process can best inform my practice?". In the early stages of analysis these were referred to as critical incidents. Tripp (1993) described critical incidents as episodes which become avenues for critical reflection. Tripp described a critical incident as being personal to the individual. These incidents were individual, however, they were also described as significant episodes rather than routine occurrences. Brookfield (1995) used Tripp's framework to demonstrate how critical incidents could be analysed, but again used events that were significant episodes although they were grounded in common practice. Nevertheless, in thinking about the ten events I have analysed not all felt as if they had the gravitas to each be considered a critical incident. I have ended up travelling full circle in this argument, after considering Bolton's point of view that " a problem has arisen with the term [critical incident], leading many reflective practitioners to think they must focus upon the dramatic, disturbing or otherwise seemingly significant. We need to be critical about incidents" (Bolton, 2010, pp. 8-9). This analysis of the nature of a critical event is closely aligned with the type of event chosen here for reflection.

The critical incidents are numbered in the sequence in which they occurred. Critical incident one is not of greater significance than critical incident ten (or vice versa) by virtue of its numbering. The numbering of each reflects the temporal nature of teaching and the analysis, and each simply reflects a

moment on the teaching journey for this unit of work. Some of those moments are longer than others.

For each critical incident a justification is given as to why it is significant to practice, with a particular focus on self-study and potential for practitioner change. Evidence has been gathered from student interviews and reflection in my professional journal. This has then led to further considered reflection based on the evidence collected.

4.2. Critical Incident One: The Situation

I have taught NCEA Achievement Standard Biology 3.2 (AS90714) since it was developed in 2004. The standard required students to research a contemporary biological issue and then report back on the biological concepts and processes relating to the issue, implications of the issue, which can be biological, social, ethical, economic or environmental and differing opinions or viewpoints. For Excellence, students were required to state and justify their own opinion on the issue. As part of the standards alignment associated with the implementation of a new New Zealand Curriculum in 2008, this standard was replaced with Biology 3.2 (AS91602) in 2013. In the new standard the ability to form and justify an opinion is even more critical, as it is required at all levels of achievement in the new standard.

I had already made changes in the timing of the assessment, recognising that it needed to be completed later in the year to give students a better chance of understanding all of the background material, but I still was not satisfied that I was preparing the students as well as I could. This was particularly evident in the opinions aspect of this Achievement Standard. Some students struggled to state an opinion, but of those who did many had difficulty providing a sound justification for the opinion they held. This was the only aspect of their work preventing some of the students from gaining Excellence, the highest grade.

Rationale

Very early on in the process of determining what research I wanted to do, I identified this standard, and the difficulty that students had with forming and justifying an opinion as an area of considerable interest to me. This has been chosen as a significant event as it was a critical pathway in to this research. Without recognising that there was a 'problem' with the way in which the students were forming and justifying opinions, I would not have identified this as an area for change in my practice. Improvement of practice is a pivotal idea in self-study, and this was readily identifiable as an area where I wanted to improve practice.

Teaching this standard effectively is also important as, in my opinion, it is the best standard (in Biology) for preparing students for citizenship. Many students from my Biology class do not go on to study biology at university, but all of them become members of society, tasked with the job of making decision on socioscientific issues. The idea of preparing students for citizenship is therefore of importance to me.

Reflections and Evidence

There were some aspects of this unit that I felt I was already doing well. I had spent some time thinking about how to actively teach my students the skills that they needed to do the research. BEANZ (Biology Educators' Association of New Zealand), National Library of New Zealand and other teacher professional learning and development providers had provided some guidance. With my colleagues I had applied some of the learning from these courses, and I felt that we were doing some aspects of this Achievement Standard well.

Aspects of preparing the students to sit the assessment that I do well include introducing them to EPIC[7] and research, using dot-jot forms, distinguishing between B[iology], I[mplications] and O[pinions] and aiming for Merit and Excellence in B[iology] and I[mplications] (Journal A, p. 1, December 2010).

When I think back to early essays (prior to 2011) I read for this task, two really stand out for me. One student had written an essay on stem cell research, and was against the use of foetal stem cells. Their supporting argument was along the lines of 'I'm Catholic and the Catholic Church doesn't approve of abortion'. I remember thinking to myself that here was someone who clearly had some strong beliefs and faith, but that these alone did not form a reasoned opinion of the type needed to get Excellence in this assessment. The second student wrote an essay on the use of genetically modified crops and animals. I cannot remember whether they were for or against GM in their opinion, but I remember their justification – 'I asked Dad, and that's what he said'.

These two students were in the same year group (2008). I remember sitting there marking, thinking to myself have I somehow failed my students? Am I not teaching this properly? Is it my fault? I realised that it probably was not my fault per se, but that I could definitely change the way I taught this aspect to improve the outcomes for students. I had spent a lot of time getting the 'biology' and 'implications' parts of the assessments to the point where I thought I was teaching well, but the 'opinions' part was lacking. We talked about justified opinions and including the opinions of others (on both sides of the argument) but there was little active teaching time given to it. I just wasn't sure of how I could improve my teaching. What could I do that would make a difference?

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[7] EPIC is an electronic database of journals, accessed via the National Library of New Zealand.

Opinions is trickier. I think I have worked hard to get students to engage with the opinions of others. However, I have found it much harder to prepare them for making decisions about their *own* opinion and then the justification for this. I think that this is an essential skill, and that I have done my students a disservice. This is one area where I would like to explore my practice and strengthen my delivery (Journal A, p. 1, December 2010).

In 2008 I had enrolled in the EdD programme, and throughout 2008 and 2009 had been thinking about possible areas to research. This seemed like an obvious aspect of my practice to research, an aspect where I thought I could make change leading to improvement.

4.3. Critical Incident Two: Approach to take to research

One of the issues that I had was working out how to do research in a school where I was both a teacher and a middle manager. This raises issues to do with ethics, particularly in connection to power relationships, and these considerations needed to be addressed before applying for and gaining approval from the MUHEC for my research. In addition, I had a strong desire to do something practical, which would make a difference to my practice.

There were two obvious solutions to the issue of gaining ethics approval. I could have worked on a purely theoretical research topic, or I could have conducted my research within a different college or educational setting. However, neither of these options would have addressed my desire to focus on practice, and more specifically my own practice.

Rationale

This has been chosen as significant as finding a way to navigate ethics and feel satisfaction as a researcher were key issues for me. This method of research links clearly back to the research question, in that it allows me to learn more about *my* practice.

Reflection and Evidence

I can remember very clearly a conversation I had with RH[8] during my second year of the EdD course (4/6/10). I was working away at my course work, focussing my thinking around informal reasoning and argumentation theory. I had talked to her about what I was doing and what I hoped to do. These two points were far removed from each other. I remember her looking at me and saying 'If you want to do something psychology based, that is where you are

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[8] RH refers to my mentor, a senior researcher at NZCER

heading. However, you are telling me you want to do something practical'. I remember feeling deflated, as if I didn't know what I was doing. However, at the same time I remember feeling this little bubble of excitement as we started talking about ethical decision-making and she told me about self-study. Suddenly I felt like a door opened in my brain and a tsunami of new possibilities flooded me. We got to talking about the Ethical Thinking Frameworks on the Biotech Learning Hub, and I could instantly see the possibilities. I left our discussion almost floating down Willis St, filled with a new vigour. I downloaded an e-book about self-study (Samaras & Freese, 2006) and borrowed the International Handbook (Loughran, Hamilton, LaBoskey, & Russell, 2004) from the library. This was a real 'aha' moment - a way to do something practical *and* something that may be more ethically appropriate.

> I have intended to work with Bio3.2 since very early on [in the EdD process]. However, my initial ideas involved looking at the students' decision-making with regards to SSI. I realised that this was going to be an issue, in terms of gaining ethics approval. I would always have been in a position of power, teaching the students I was researching. I realised this would not work (Journal A, p. 2, January 2011).

> In a discussion with [RH] one day she suggested self-study. This is a methodology we had not encountered in our course work, so I was unfamiliar with it. I quickly discovered John Loughran et al.'s work in the International Handbook, and things started to click into place (Journal A, p. 2, January 2011).

4.4. Critical Incident Three: Why is this important?

When I started this process, I felt very strongly that this standard, more than any other in L3 Biology, prepared the students for citizenship. Approximately 20-25% of Year 13 students from the study school go to a tertiary provider when they leave, and I am realistic enough to know that most in my Biology class do not go to study biology, even if they do go to university. Everyone who leaves my class is, and will continue to be, a member of society. Preparation for citizenship is an important aspect of the New Zealand Curriculum (NZC) (New Zealand Ministry of Education, 2007) has the vision that students "who will be confident, connected, actively involved, and lifelong learners", elaborating further that they will be "participants in a range of life contexts", "contributors to the well-being of New Zealand – social, cultural, economic, and environmental" and "informed decision makers" (p. 8). I have always felt that of all the standards available in Biology, this standard best prepares them for this, allowing them to explore an issue from the perspective of the science, its implications and then opinions, and lastly, to come to their own conclusion. However, it transpired that what I thought I was doing and what the students thought I was doing were two different things.

Rationale

Preparation for citizenship is a key justification for doing this standard. This is also the source of greatest insight for me as it revealed dissonance between my expected outcome and that of the students.

Reflection and Evidence

I imagined when I was writing the questions that their response to this would be along the lines of how useful the Ethical Thinking Frameworks were and how they could use them again for making life decisions. Perhaps that is a little

naïve, nevertheless, I had hoped that there would at least be recognition of something to do with citizenship. Instead the focus for the students was largely on academic preparation. They focussed on the fact that I had taught them research skills, and that these would be useful at university. One (BR) didn't focus in this part of the interview on research skills, but on the teaching around opinion formation. However, it was not in relation to citizenship, but rather for Geography, another academic connection.

> Responses to the question "Is there anything that we did in this unit
> or that we learnt in this unit that you could apply in a different
> context?"
> CR: I found out that the way to like write a report and like how to
> reference it and how to dot jot it because those will be helpful
> whatever we do after this and those sorts of skills you just need
> regardless of what you do (p. 4).
> DR: Um, I think just the skills to research really. Yeah (p. 8).
> DN: Um, probably the whole research component of it I think. Coz
> I'm doing uni next year that'll kind of help with that. I know how to
> look at people and then how to reference and that kind of thing (p.
> 4).
> BR: Like understanding different opinions and...coz since it's a
> contemporary issue you can relate it to anything. Like I mean even
> doing geography it helped coz for Geography we learned about
> different opinions and views and why people perceive things
> differently and then Biology was quite similar to that so I found
> it...That's where I found it really overlapped (p. 11).

When I raised this as a point in my conference presentations at SCICON[9] in 2012 there was discussion around the fact that students see what they are

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[9] SCICON is the New Zealand national science teacher conference, organised by NZASE (New Zealand Association of Science Educators).

doing as academic, set in an academic setting, with university or further tertiary study as a target.

To a degree I can see this point. I know for instance at school there is a real focus (top down) on Scholarship and gaining University Entrance, so it is no wonder that students end up thinking that this is the purpose of an education. However, you look at the NZC (New Zealand Ministry of Education, 2007), and its vision is to produce "Young people who will be confident, connected, actively involved, lifelong learners." I do not believe that the intent of the NZC is that lifelong learning is formal, in a tertiary provider, but rather learning within life. In fact, when the statement is broken down further (p. 8) it suggests students who are lifelong learners will be: literate and numerate; critical and creative thinkers; active seekers, users, and creators of knowledge; and informed decision makers. I still maintain that that is why I teach this standard (AS90714). It is helping the students to seek and use knowledge to make informed decisions. However, the reality is that they see the purpose to be preparation for university, while I see it as preparation for life. Are the two mutually exclusive? I am not convinced. After the 2012 FYHE[10] conference presentation there was discussion about this. We ended up with the suggestion that preparation for university is like a subset of citizenship. That feels like a comfortable way to think about it. I still think there is room for more explicit explanations of teaching decisions to students, but for now I will sit with this idea - there is no mutual exclusion between the two.

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[10] FYHE is the International First Year in Higher Education conference.

4.5. Critical Incident Four: Teaching research skills

These are the steps I took to teach students how to research:
- introduced the topic
- introduced the portfolio that would be used to collect research
- introduced the use of EPIC[11] to find articles
- worked through how to read a science journal article and then
- worked out how to dot jot the article
- looked at the validity of information
- briefly looked at how to plan an essay and structure it

Rationale

Upon reflection after interviewing the students, teaching research skills was highlighted by them as an important aspect of what I do. It is something that I have worked on before embarking on my study, and is something I think I have been doing well.

Reflection and Evidence

I have always had a belief that by the time a student reaches Year 13, they know how to research a topic. I assumed that they understood the mechanics of a search for information, how to process and record that information, how to write a reference list, how to assess the validity of information...all of these are things students understand...are they not? Surely these students have done research since they started school? Each subject has a research standard, so that research is done to death, is it not? It seems I was wrong.

When I interviewed students a number of them stated that they found the research component of the teaching really useful. In the case of CR, she

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[11] EPIC is an electronic database of journals, accessed via the National Library of New Zealand.

specifically stated that much of this is not taught in other subjects, at least not in the depth in which we did it. Dot jotting[12] came up from many students as a useful tool. I think I first came across dot jots when Terry Burrell was the Senior Subject Advisor for Biology. It certainly is not a novel idea, and it surprises me that they have not encountered them before. Also MH mentioned specifically the work I did, showing them specific sites such as EPIC to find useful data.

MH: Um, most helpful would have to be the dot jot sheet. (p. 3)

KF: What did you think that I did that really helped you?
MH: Well, as I said before the checkpoints and the resources. I mean if I remember correctly you went through how to find the information.
KF: Yeah
MH: So I mean I remember most of my research came from those sites.
KF: From places like EPIC…
MH: Yeah (p. 13)

KJ: Um, useful was just the research bases and how to do a research at this level coz I know I will have to be doing researches next year as well..
KF: Ahmm
KJ: …so it's like a boost up to the university level. And, and just how to write essays, proper report essays.
KF: So, in terms of the research, what was it that, um, we did that you found particularly helpful in terms of the process of writing, of doing research rather.

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[12] Dot jotting is a technique used to summarise information from a research source to a single page. In a dot jot each key idea is given a single dot or bullet point.

KJ: Hmmm.

KF: Like, what sort of things did I teach you about that, anything?

KJ: Oh, you taught us how to write, ahh, we went over the paragraphs, do you remember, and then you outlined, um, what was it, oh yeah you outlined biology, implications, opinions and that really made it clear what they actually mean...

KF: So was that...

KJ: and...

KF: ...the activity, (cough) excuse me, that we did right at the very beginning looking ...

KJ: Yeah

KF: ...at sample...

KJ: Sample essays, paragraphs

KF: ...sample answer bits. Right, OK. So, the stuff that was on genetic modification...

KJ: Yeah

KF: ...and I got you to go through and look at it and decide...

KJ: and 10...20 or something ...

KF...Ah, 1080. OK, so the 1080 stuff we did was um...oh we might have done a little bit on that with 1080 but we particularly focussed on um, writing a dot jot from a paper about 1080...

KJ: Yeah

KF: ...and understanding how a science journal article works and what are the critical bits of it...

KJ: Yeah, that was really helpful. (p. 3)

KF: Now that's really interesting, because I've always thought that by the time you get to Year 13 you must be sick to death of doing research coz I figured you did it in every subject.

KJ: No, we did one in Year 10, then in English, and that's it.

KF: Gosh, that is really interesting.

KJ: And we did one in Social Studies, but that was on a famous person. Just plain Year 10 stuff.

KF: So in other subjects, what else did you do...Chemistry, Bio, Physics...

KJ: Maths

KF: ...Maths and English this year, and last year same?

KJ: Accounting.

KF: Last year had Accounting as well. So out of those subjects, none of them really went through the research process from start to finish?

KJ: No. We did one in accounting. That was about the cash systems in the school. The lady just told us like what they did so we were just given information...

KF: Right

KJ: ...we had to just write it out. There was no dot jots or anything. (p. 5)

HN: I don't know...I don't know if it was...I mean the dot jot stuff would help later on. That's not something that I would have thought of doing. (p. 5)

CR: I found out that the way to like write a report and like how to reference it and how to dot jot it because those will be helpful whatever we do after this and those sorts of skills you just need regardless of what you do.

KF: So in other subjects I assume, I don't know, I assume you've done research in other subjects.

CR: Yip

KF: Do they teach you those sorts of things there as well or was it...

CR: Not in such detail. Like, they'd show us how to reference it. Like, for an English one they'd show us how to reference for English but

then they didn't help like show us how to properly dot jot it and summarise all of the para...all of the information that we needed.

KF: OK, so you found that really quite a useful skill.

CR: Really helpful, really helpful. (p. 4)

These comments came as a surprise to me. I thought (or even worried) that I was taking too long to do this part of the topic. I wondered if this was an area where I could steal back time so that I had more time for teaching the ethical decision-making part. Clearly however, this has to stay. This is not something that I can take time back from - if anything I could give it more time...

I spoke to RH about this. What she has found in research has reflected this same idea - teachers are not teaching students *how* to research. She told me that this realisation was the motivator behind the book 'Learning to Do Research' (Hipkins, 2006). I remember being a bit relieved that the issue was not confined just to my classroom, to my school, but also being a bit shocked that it was such a prevalent issue. When I started this project I thought that the research bit was the least problematic, now suddenly I had discovered this big idea. It almost felt like uncovering teaching's dirty secret.

> Research was another hot topic [in my discussion with RH]. She was not surprised that the students had not been taught the process of research. It fits with research that RH has done. (Journal A, p. 69, 12 April 2012)

So for me this provides some really clarity - teaching research skills is essential. Being able to research, process and evaluate information are vital to success in this standard, and more than that they will help enable scientific literacy outside of school. If I need to steal time from somewhere, it will not be from here.

4.6. Critical Incident Five: Formative Task

The formative task was completed before any of the other work for the unit was done. The task was written around the use of 1080 in New Zealand as I felt it was something that they would all be familiar with from a task completed in Year 10 on control of introduced species. Students read some information on both sides of the argument and then had to write and justify their opinion. The point of the exercise was to gather baseline data.

Rationale

The students completed this task very early on in the unit - it was the first thing that they did. They had very little introduction from me. It was designed as a way to get baseline data about their ethical decision-making, so that I could see if I had made a difference.

Reflection and Evidence

When I started this study I imagined it being somewhat like the following: gather baseline data (formative task), gather final data (summative essay), interview students, analyse data and write up. Now, obviously this is a very simplistic view of what I was doing, but I imagined that the written student work would be really important in informing my practice as part of this self-study.

Having been through the process I now have a much better idea of what is/is not useful. By far and away the most informative of the data sources described (in terms of self-study) was the student interviews and my professional journal. However, the formative task is not a waste of time. As a teaching tool it proved to be quite useful. It gave me an opportunity to see where the students were at in terms of their ability to form an opinion on an issue and justify it, thereby

determining how much work we needed to do as a class. I collected them in and gave them back to the class towards the end of the unit. They could then see how far they had come. With the knowledge that they now had from the unit I taught them to think about what they could have added to their written piece to improve it. What were the strengths/weaknesses of what they had written? Which parts needed to improve if they were aiming for Excellence?

In terms of my research the formative task does not tell me much about *my* teaching practice, the whole focus of this self-study. I learnt about what the students could and could not do, thereby adjusting my teaching. However, the content of the written work told me little about myself, rendering it of little use for a self-study. I still rate this as a useful task for what the students can gain from it and for assessing prior learning of the students. For these reasons it will remain within my coursework, but the students' written work was not informative about my practice.

> How the students responded was really interesting. The class sort of divided into 3 categories:
> 1. Got on with it, accepted it was a useful, meaningful task and quietly worked on it.
> 2. Were challenged by it. Part of this, I think, is their fear that they will do something wrong. Not in reference to my research, but just generally. These are students who are sometimes insecure about their other work also. For example MH made a statement that "there are no opinions in here" so therefore (I assume) he couldn't state one. I found this really interesting as half the reading was effectively opinion, and I would have loved to quiz him further.
> 3. Can't be bothered. This group also made statements about "this is too hard", "do I have to do this?", "what is the point of this?".
> (Journal A, p. 12, 13 May 2011)

KF: So is it useful to do something like that? To do a piece of writing at the beginning where you just kind of go in cold and then we do some work on things like the Ethical Thinking Frameworks and all of that sort of stuff and look at something we've written to see that we have actually made a move. Do you think that's useful?

MH: Yeah because I mean it kind of gave me a baseline. I mean it showed me how much I've changed at all. (p. 15)

One aspect of the formative task that was interesting to me from the practice perspective was the actual writing of the task. I found it really challenging to write a piece that did not demonstrate bias.

I felt it important to give equal space (physically) to each side of the argument. This was to try and ensure I did not introduce bias. Usually I put images onto worksheets I give students. In this case I didn't as I realised that the addition of images may in fact introduce bias. The more I looked at the images on websites, the more biased I realised they were. Maybe 'emotive' is a better term here. (Journal A, p. 9, 8 May 2011)

This proved to be an interesting process to go through, as I realised that even the websites I consider to be relatively bias neutral do in fact show bias in the images that they contain. Even if the scientific information is written in a neutral way, the images used to support this can make bias more evident. As a teacher we usually produce worksheets for ourselves (if something appropriate does not already exist), and usually I would not think twice about it. However, producing this document (which at the time I thought was to be critical to my research) was a challenge because I thought far more than I usually do about all aspects of the content, and this highlighted the issue with images.

4.7. Critical Incident Six: Selection of Ethical Thinking Framework

Prior to 2011 I had not specifically taught students how to make decisions about ethical or socioscientific issues. This was identified by me early as a weakness and I recognised that the use of some framework to teach it would be useful.

Rationale

The Ethical Thinking Framework became an important foundation for the teaching of ethical decision-making. How and why I chose it is therefore an aspect of this unit that needs exploring.

Reflection and Evidence

When I started this study I knew that the teaching of decision-making, i.e. getting the students to decide on a view point and justify it, was a real weakness. I knew that I needed to do something to improve this aspect of their learning, but I really struggled to know what to do. All I could think of was giving them more practice, but the practice had no learning in it about decision-making or helping structure their decision-making, it was more along the lines of students writing and me checking - I did not feel as if I was teaching this with clarity.

In a discussion of this issue, RH suggested the Ethical Thinking Tool on the Biotechnology Learning Hub (University of Waikato, 2009). The tool, and its associated Ethical Thinking Frameworks, seemed like a positive solution, however, I needed to explore them first. What struck me immediately as useful about them was that they were New Zealand focussed and web-based. This meant that they were both culturally relevant and accessible. Both these things

are important. With no money in a budget to buy tools, the fact that these were freely available on the web meant that we could use them in class and that students could access them freely at home. They were written in a depth that was accessible to the students, as they are targeted at school-aged students. Too often students are put off information that seems too daunting because of the language used or they try to use information that is overwhelmingly difficult. I was already directing the students to the sites ('Science Learning Hub' and 'Biotechnology Learning Hub'), so it was not a stretch to look at the frameworks.

It is interesting looking back at the notes I made on the discussion that lead to the Ethical Thinking Frameworks. My project was still very much in its infancy. I was still imagining a project where I compared work between years, interviewed students twice, surveyed other schools: all this came before the notion of self-study. Interestingly, all that went to one side, and what remained were the Ethical Thinking Frameworks.

> ETF - NZBiotech hub (Saunders)
> 1. 2010 -> 2011 compare student's ethical thinking. Evidence student work.
> 2. Survey schools - who does 3.2, why/why not?
> 3. Interviewing students pre/post 3.2. Question around a different issue - how does eth. thinking change?
> (Notebook entry 17/08/10)

The notebook entry above captured a discussion that occurred before self-study evolved as the appropriate methodology to use, and hence the ideas of surveying schools and exploring the ways students make ethical decisions more in line with argumentation theory or informal reasoning (Dawson & Venville, 2009; Sadler, 2004) simply lost their relevance in a self-study. More specifically, they do not inform practice in a way that leads to change. The focus of the interviews changed, but as a source of data they remained important.

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4.8. Critical Incident Seven: Teaching Ethical Thinking Frameworks

The use of the Ethics Thinking Tool and Ethical Thinking Frameworks was new in 2011, as I had never previously taught the students how to make an ethical decision. Previously the only focus had been on making sure that they did form an opinion and justify it, but no time was given to this process. My hope was that by teaching about the Ethical Thinking Frameworks using the Ethics Thinking Tool on the Biotechnology Learning Hub, the students would be in a better position to form and, more importantly, justify their opinion.

We used the issue of vaccination as a full class focus, and used a continuum activity to explore opinions. Then I asked the students to use printed copies of the Ethical Thinking Frameworks to try and look at the issue of measles vaccination.

Rationale

By reflecting on my teaching of the Ethical Thinking Frameworks I hope to gain insight into my teaching practice and a better understanding of how I can improve the teaching of this aspect.

Reflection and Evidence

Teaching using the Ethics Thinking Tool and the Ethical Thinking Frameworks embedded within was both frustrating but exciting at the same time. One of the recurring issues in school (maybe all schools) was gaining access to computers for class activities. The time I wanted to teach this coincided with some other classes using computers for extended periods, so we were out of luck. Lack of access was frustrating when you have a web-based tool that you are wanting to use.

Rather than simply giving up I had to resort to the old paper method (no chance of that crashing!) and printed out each of the frameworks with their relevant focussing questions. We had already done some work on measles vaccination, and it was featuring in the press at the time, so that became our context for looking at the frameworks. The teaching of this took place at a time when a measles epidemic was having an impact on Auckland, and a number of schools had asked unvaccinated students to remain at home. This provided a rich real-life context for discussion. I printed two copies of each of the frameworks, and the students divided themselves into groups to look at them. Some of the students chose to work independently, and others chose to work in groups. Some looked at more than one framework. Others looked at only one. All of them knew how to find them (the frameworks) again, and I encouraged all of them to go through this process for their own research topic and print and stick the relevant pages into their portfolio (no one did this).

> DR: Um, maybe like we could have looked more into the topic of what we were answering questions about [when working with the Ethical Thinking Frameworks]. I mean I know that we don't want to waste time and…I think that if we had I guess more time to discuss what the topic was about it may be easier to answer these questions. (p. 10)

> DN: Um for me personally I find it more helpful to look at all of them [Ethical Thinking Frameworks] for myself rather than, you know, share your think with the class to get everyone else's coz the one you do is the one you learn most about I think.
> KF: So would you…would you have done that…would you have looked at all of them in a group or would you rather have looked at all of them just as an individual?
> DN: Um, I think both. I think in a group and individually.

KF: What would be the advantage of looking at it in a group as opposed to just as an individual or vice versa?

DN: Um like in a group you're like sharing everything so you get more things that you didn't think about but then individually you kind of think without having everyone else's opinions there.

KF: So it gives you more time to explore these in terms of your own thinking rather than being clouded by what other people are saying.

DN: Yeah (p. 5)

CR: It [Ethical Thinking Frameworks] sort of focussed...like...It gave us a way to look at the information we had got for our topic but then other times it was like I can't think of how to do it for all of them. (p. 7)

CR: Yeah, it [Ethical Thinking Frameworks] gave us a sort of a way to start. Like if you can apply it to this one then you can apply it to...it will be easier to apply it to our ones. So it gave us a baseline of how to do things. (p. 7)

KF: If I was going to use these frameworks in class again, what should I do differently do you think?

DR: Um, I guess maybe a PowerPoint presentation, make it fun. Like have one question up so maybe not have all the questions displayed at one time, have just one. And so we just focus on that and then we could talk about it.

KF: OK, so within each framework, so say the virtues ethic, just look at question one rather than being overwhelmed...so did you...even though...coz I...initially I got you to look at all of the frameworks and then I thought oh my goodness you are going to be so overwhelmed with stuff there. So I thought, break you in to groups and have you look at one framework, but you found even that much a bit overwhelming?

DR: Yeah, it wasn't too bad, coz it's not much writing in the questions, but I think maybe just focusing on one question and just looking at it and you know, dissecting it instead of, yeah.

KF: OK

DR: It could be like, I don't know, you just pick out questions from each section and put it into one.

KF: And then to think about how they all sort of fit together?

DR: Yeah (p. 21)

My big wish for teaching using the Ethical Thinking Tool and Ethical Thinking Frameworks is more time. When I spoke to students, this was what they wanted - more class time generally, but more on activities rather than simply researching. I found this reassuring and daunting at the same time. I am glad that they do not want more time simply to spend on library-based research. However, I am daunted by the fact that I do not know where the time can come from. I had hoped that the Achievement Standards Review would resolve some of that, but now I am not so convinced. It comes down to priorities, and I feel like I need to make this my priority. I have a mandate, as that is what the students have expressed they want. I almost feel now like I need to extend the work using vaccination or 1080 and spend more time doing the Ethical Thinking Frameworks activities and practising structuring an essay.

4.9. Critical Incident Eight: Summative Task

The summative task is the essay written for AS3.2. The task is derived from the exemplar on Te Kete Irirangi[13]. There is a limit to the flexibility a teacher can have with the task as it must still reach the standard. Initially I thought that this would be a good data source.

Rationale

Their final essay is the culmination of this unit of work. It is to a large part determined by NZQA, as they set the standard, but aspects can be determined by the teacher (topic, timing, etc). This may also be a place where I see the students making a decision and justifying it, the crux of this research.

Reflection and Evidence

Like the formative task, when this research first started to come together in its current form, I was sure that the essay written by the students would be a really important source of data for analysis. However, as the research has gone on, and with my new understanding of what a self-study is and the scope of such studies, my view has changed significantly. I no longer view this as a significant source of data, as their written work does not really tell me a lot about myself or about my practice.

Having said that, it is still an important part of this process. It is where the students get to show me what they have learned and demonstrate their ability to decide on a point of view and justify it. There was still the opportunity for me to reflect on what I have done, why, and whether I think it was helpful. This was the first year since I had decided to move the essay writing to later in the

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[13] http://ncea.tki.org.nz/Resources-for-Internally-Assessed-Achievement-Standards/Science/Biology

year. A few things motivated that decision. First, they sometimes struggled with the biological content of their topic, so moving the essay resolved their lack of biological knowledge, as we would have covered all of the genetics and biotechnology topics before they began the essay. Also, I got frustrated marking poor attempts at the practice exams because students had decided to focus on their internal assessments - a wise decision for the students perhaps but not such effective use of my time. I hoped that by moving the final essay task to later in the year, specifically during the school examination period, I would address both of these issues.

In the interviews one student talked about wanting to do the essay topic earlier in the year. When I explained why we had moved it, it made sense to her, and she was happy with the placement. This made me think about the value in sharing teacher decisions about teaching and learning conversations with students (see interviews).

> I guess the big question for me, apart from the ethics drive, was moving the essay to exams the best idea. Lots of things say it was…didn't take them out of other classes, gave them time to cover the content that is useful for the essay, meant it was quiet for the whole time, etc. However, a significant disadvantage is that they didn't get a chance to practice their externals, and some may find this a disadvantage. To be fair, of the four students who failed to submit, three of them didn't take the opportunity for exam practice, so maybe I am being idealistic. (Journal A, p. 37, 11 September 2011)

4.10. Critical Incident Nine: Interviews

The interviews were the final piece of data gathered from students. I interviewed a total of nine students, including males and females and every possible grade (Not Submitted, Not Achieved, Achieved, Merit and Excellence). The interviews were conducted at the conclusion of their academic year.

Rationale

I chose to reflect on the interviews - not for their content and what it can teach me about my practice, but for the process - what specifically about this process was useful? Did the process make a difference to my teaching practice? To some extent this of course relied on the content, but by thinking more holistically about the interview process I hoped that this would provide insight into my practice.

Reflection and Evidence

Initially I was really frustrated that the MUHEC[14] would not allow me to interview the students closer in time to when they actually did this assessment work. Almost three months passed between my assessment of their essay and me being able to interview them. I was really conscious of this at the time, but tried my best to minimise the impact by having the Ethical Thinking Frameworks on paper as a prompt. In a perfect world, the teaching would be completed, students interviewed and transcripts completed, more interviews done and transcribed and so on. But, the world is not perfect, and we work with what we have got. It was hard squeezing all of the interviews into basically a three day period. I needed to fit them between exams ending and school ending. I did not want to be interviewing after school had closed, as I think that

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[14] Massey University Human Ethics Committee

there is security in knowing that there are other staff about. This was also a requirement of my ethics approval.

I really enjoyed the interview process, and also surprised myself by enjoying (for the most part) the transcribing of the interviews. It was great to be able to chat one on one with students, in a space where they could say what they wanted without the fear of being overheard. I felt as if they spoke honestly and without inhibition. This was really important - there is little point in interviewing students if they only say what they think you want to hear or if they are simply oppositional. When selecting the students to interview I deliberately chose those who I thought were most likely to be reflective and contribute something - I did not want to go through the process only to end up with nine interviews of monosyllabic responses.

There are three key ideas that have come from the interviews with students:

1. The students do not see this as preparation for citizenship. Rather, they see it as preparation for university. (*see* Why is this Important)

2. It is really important to teach not just subject specific research skills, but just research skills in general, as not a lot of this is being taught by other subjects. (*see* Teaching Research Skills)

3. There is some value in talking to students about more than simply the content.

The bulk of a teacher's conversations with students are content focussed; in fact, I would go even further than that. Imagine a pyramid. The wide section at the base I think represents the bulk of the time teachers interact with students, where the teacher talks at the student about content. The next level up represents the region where the teacher and the student converse, but the focus is still content. At the top, the thin point represents discussions with a

teaching and learning focus. I would also include in here assessment-focussed conversations. The conversation with KJ is one such conversation.

> KJ: What else stopped me...maybe other subjects had too much load as well. Like, we had English going on in the background, and Maths was there as well.
>
> KF: So there's that kind of tension...
>
> KJ: Mmmmm
>
> KF: ...where you've got so many subjects with internal assessments all kind of happening at once. Hmm.
>
> KJ: So maybe we can do the research maybe at the beginning of the year.
>
> KF: Yeah, we did start it quite early. Term 1 we started it.
>
> KJ: End of term 1.
>
> KF: So, you'd rather have started it at the beginning of term 1. OK?
>
> KJ: And get it over and done with.
>
> KF: OK. Because we shifted it this year. It used to be that we did the research during term 1 and term 2 and sat the essay at the end of term 2, but what we found was that students struggled a bit because they didn't have...we hadn't covered all of the genetics stuff so they didn't have the depth of understanding about the biological content and so they struggled with that aspect of it. So, we shifted it so that they were a little bit more mature and had developed more in their thinking and had a better background of science. Do you think, that having now said that to you, do you still think you'd rather do it sooner?
>
> KJ: No (p. 17)

These conversations are so valuable. KJ's mark does not improve because of our conversation. Her life is not changed because of it, but she leaves with a better understanding of why the course is structured the way it is, and perhaps is less frustrated - she understands. If this conversation with KJ had occurred

sooner, even before the assessment was completed, she would have understood the logic of placing the assessment when it was placed and it may have removed a level of resentment and anxiety. As a consequence of these interviews I have a better understanding of the types of activities my students want more of, where they want the think the time in class is best spent, what I can do to improve their learning - these conversations are empowering for both teachers and students. This level of engagement with students can be attained in ways other than interviews. The use of co-generative dialogue is another more formal process, usually involving discussion on a more regular on-going basis (Grimes, 2010; LaVan & Beers, 2005; Roth et al., 2002; Tobin & Roth, 2005). Nevertheless, simply taking time to talk to students is a first step. However, I suspect these conversations take a very small percentage of teaching time currently - they certainly do in my class.

4.11. Critical Incident Ten: Re-teaching the same unit in 2012

In 2012 I had the opportunity to reteach the course again, making some changes to what I was doing. The standards alignment was not implemented until 2013, so time was still a significant issue, but more time was spent on the Ethics Thinking Tool and Ethical Thinking Frameworks, particularly around trying to get students to use the activity as part of their own planning process.

Rationale

2012 was my first opportunity to repeat this process. It was the first chance I had to make some change, so was interesting to reflect upon how much change was made and the constraints that stopped me from doing what I wanted to.

Reflection and Evidence

It is amazing how easily we forget things. Thank goodness for a journal to provider reminders. I had forgotten some of the changes I made to the way I taught this unit of work in 2012. I suppose that is why a research journal is so useful, but I find myself being slightly troubled. Do I simply reinvent the wheel often because I have forgotten ideas?

I still think I can shorten the task information a bit more. The task itself has changed a bit, because the standard has changed. Ignoring that, I think I can further simplify the referencing information so that it is pithier for the students. They did seem less daunted by the task in 2011, and also seemed to have less difficulty locating the question for their essay. This is in the hand-out that they get at the beginning of the unit, but is sometimes lost in the midst of all of the information. Reducing it to essentials seemed to help.

Doing the formative task in 2012 seemed considerably different to 2011. In 2012 it was not going to be part of a research data set, and the absence of this changed how I dealt with it. We did it slightly later in the unit, and it 'fitted' much better here. I felt like I was teaching it in a context. Even more than that, it felt like it was part of my teaching, not something engineered. In 2011 I was worried about telling students too much and influencing the data I collected. By 2012 that pressure was off, and the task was simply another teaching and learning activity. Because I think it was more in context, students could see more what I was trying to achieve and why. I explicitly told them that I wanted them to be able to see progress in their ability to make and justify decisions. I explained why we were using a context other than their research. It felt a lot more honest and real. I will continue to use this task again the way I did in 2012.

> Yesterday I gave out the task for AS3.2. I have made changes based on the feedback from students. The task itself is shorter - I have left out all of the referencing information. Feedback from students last year suggested that the task hand-out was long and therefore seemed really daunting...I have still given them the information on referencing, just as separate documents. (Journal B, p. 9, 26 May 2012).

> I decided not to do the formative task that I used last year just yet [at the beginning of the unit]. I will do it in the next week or so, but I really just want to get them researching first. This year I am trying to focus more on the timely delivery of skill teaching. That task is about opinion formation and I don't feel like they are anywhere near that yet. (Journal B, p. 12, 1 June 2012)

> Last week (Wed) after the long weekend, we spent a lesson on the 2011 1080 formative task. My feeling is that they wrote more than

last year's group and they certainly complained less. (Journal B, p.
26, 13 June 2012)

Students again seemed to really value the time taken to understand and
complete a dot jot. It seems like such a simply task, but actually it takes them
so long. We started by looking at how to read the article then dot jotting. I
really like doing this task together, as it makes it much easier to work
collectively. I have tried in the past using something simple from 'New
Scientist', but again it was from an entirely different context (not even a
socioscientific issue), and the students struggle to see the relevance.
Interestingly, the 2012 year group had done an unfamiliar text question in
English that was to do with pests, so they were not so fearful of the context.

A whole hour of time in class to dot jot an article that is not related
to their research seems indulgent. However, in the interviews they
expressed that learning how to dot jot was useful. (Journal B, p. 13,
1 June 2012)

Using the Ethics Thinking Tool online was a great idea, but was stifled slightly
by some of the technology on the website. The students appeared to be on
task - there was less off task chatter, but there was less chatter generally as
well. I know from the interviews that some students really valued the
opportunity to discuss with others as they worked on this task, but by each
being at their own computer this seemed to stop. I gave them more freedom to
explore a range of issues, and I had hoped it would be easy to observe their
progress on line, unfortunately the website was not as user friendly as I hoped.
RH suggested getting in touch with University of Waikato, who run the site, and
feeding this back to them. I had hoped that some of them would use this site,
think about their opinion, print out the pages and add it to their portfolio, but
again, no one did. Even though the Ethical Thinking Frameworks were not
explicitly present, I felt that in 2012 I got some really well justified opinions.

This year I have decided to have a crack at working it [Ethical Thinking Frameworks] on line. I have created a profile for each student so that they can individually log in and access it online, saving their responses. I think that this will allow them to work on this at home if they see the value of it, and in theory I will be able to monitor what they are doing. (Journal B, p. 59, 2 August 2011)

4.12. Rationale for Analysis of Critical Incident

When I began the analysis aspect of this self-study I had reflected upon ten critical incidents. I considered each of these ten events to be important, and therefore deemed them critical incidents because they were significant moments in my understanding. They were turning points in my awareness of either the teaching or the research process (Mason, 2002; Tripp, 1993). However, one of the five components of self-study methodology is that self-study is about improved learning (Samaras, 2011; Samaras & Freese, 2006). LaBoskey describes self-study as improvement-focussed, requiring the researcher to reframe their thinking and transform their practice, and to seek evidence to support these changes (LaBoskey, 2004a). Loughran and Northfield (1998) describe self-study as "an option for all those committed to the improvement of professional practice" (p. 8). There is clearly a strong requirement for self-study to be about improvement of practice.

As a classroom practitioner I have always been clear that the focus of my self-study is on improving my teaching practice. Therefore, it was important that the critical incidents chosen for analysis had a focus on improvement of teaching practice. I have outlined below my reasoning behind why I did or did not chose to analyse each critical incident.

Critical Incident One: The Situation

Critical Incident One was about outlining the situation as it stood before I began the self-study. In some ways I think critical incident one fails to meet the ideals of a critical incident, as it does not reflect a single point in time or a single incident. Instead, the preparation of a position statement itself became the critical incident. I chose not to analyse this further, as to me this was a starting point, rather than a critical incident with ideas for future change. In fact the impetus for change here has driven this self-study; I see this as looking to the past not the future, and have, therefore, not analysed this critical incident further.

Critical Incident Two – Approach to take to research

Critical Incident Two has a strong research focus. Obviously this was critical in terms of the development of the self-study, but the focus remains on research rather than on teaching practice. As this self-study seeks to make a difference in my teaching practice, this critical incident was not analysed further.

Critical Incident Three – Why is this important?

I had always considered this unit of work to be of significant value in terms of preparing the students for citizenship. However, when I interviewed the students in my class they explained that they believed it was excellent preparation for tertiary study. This outcome dissonance really troubled me, and for this reason I selected this as a critical incident worthy of further investigation.

Critical Incident Four – Teaching research skills

The way in which I teach research skills is something that I have worked to improve over a number of years. I was surprised at how much value the students I interviewed place on the teaching of these skills, and I also had underestimated how much teaching of this was occurring in other subjects. For these reasons I identified this as a critical incident worth exploring further.

Critical Incident Five – Formative Task

Critical Incident Eight – Summative Task

When I began this process I felt these two tasks would be significant sources of data for my self-study. However as my understanding of self-study grew and I became immersed in the study I realised that the data provided by these two pieces of work told me more about student achievement and less about my own practice. As a result, these critical incidents were not analysed further.

Critical Incident Six – Selection of Ethical Thinking Framework

Critical Incident Seven – Teaching Ethical Thinking Frameworks

I have elected to combine these two critical incidents together, as they reflect a similar idea - that of the use of a particular teaching resource. As I began my analysis I realised that, when I use a new resource in my classroom, I will often reflect on whether or not it has been successful. When I started to think about this process, I realised that while I reflect, the reflection lacks any depth. The absence of critical reflection and the recognition of the need for it meant that this is a critical incident I chose to explore further.

Critical Incident Nine – Interviewing students

The process of interviewing students, and the insight that they provided was more significant than I thought it was going to be. The students interviewed as part of this research were honest and forthcoming about my practice, and as a consequence, I learnt a considerable amount from them. For this reason I decided that this critical incident required further analysis.

Critical Incident Ten – Re-teaching the same unit in 2012

When I retaught this unit of work in 2012 I had yet to complete my data analysis. I made some changes based on my early ideas and recollections from the previous year's data. In some ways I think this is an issue for practitioner research. It can be relatively easy to gather data, but it takes time - time which when under pressure is often prioritised away from research to the seemingly more time critical jobs. From a position of much greater understanding, I am

looking forward to returning to my teaching position at school and implementing what I have now found out.. The ideas for change come from other critical incidents, so I have decided not to analyse this further.

4.13. Summary

This chapter has outlined the ten critical incidents identified as part of this research. The inclusion of each incident has been justified, and this has been followed by some early reflections and supporting evidence. In the final section of the chapter I have given justifications for why each critical incident was or was not chosen for further analysis. More detailed analysis of four of the critical incidents follows in Chapter Five Self-Study.

Chapter Five Self-Study: a critical review of my practice

Previous reflection (in the Results chapter) has considered ten critical events. Each of these ten events was important to consider in terms of practice, and I considered them critical incidents along the pathway of my self-study. One advantage I see in self-study is that you are immersed in the data that you are collecting constantly, so ideas start to appear and develop early in the data handling process. Very early on in my analysis I became aware of three significant ideas that had emerged from the process of interviewing students. The way I have conceptualised these ideas has changed over time, but the essential ideas have remained the same. These three ideas were identified in the previous chapter within the context of the ninth critical incident which was the interviewing of students. However, two of these ideas have their origin within different critical incidents.

Significant Ideas:

1. The students do not see the teaching of this unit as preparation for citizenship. Rather, they see it as preparation for university. (*see* Critical Incident 3: Why is this Important?)

2. It is essential to teach not just subject specific research skills, but just research skills in general, as students do not acquire these during their time at school. (*see* Critical Incident 4: Teaching Research Skills.)

3. There is value in engaging with students about pedagogy and learning, in addition to talking with them about content material. (*see* Critical Incident 9: Interviews.)

These ideas have had longevity. They have sat in the back of my mind, needling away, demanding attention. Equally, when I look back across each of

the ten critical incidents initially explored, the three critical incidents associated with these ideas provide the strongest impetus for change to teaching practice - one of the foundations upon which self-study is built.

When I came to justify why I was or was not analysing each critical incident, two other critical incidents stood out. These were both to do with the use of the Ethics Thinking Tool and the Ethical Thinking Frameworks contained within the tool on the Biotechnology Learning Hub. Initially I decided not to analyse its use further. I deemed it to be one of the everyday teaching decisions a teacher makes, and was not convinced it would contribute to deeper understanding of my practice and therefore change. However, when I attempted to justify why I was not analysing it, I could not. In my experience, classroom decisions are often made with very little considered thought. A new resource (like the Ethics Thinking Tool) is used, and a decision is made as to whether or not it 'worked'. Very little thought is given to why it did or did not work or even how you know it worked. For these reasons I decided I was justified in including these critical incidents in the analysis. I have elected to combine the two critical incidents into a single analysis, and explore them together.

5.1. Critical Incident Analysis and Discussion

In this section of the chapter I have analysed four critical incidents that occurred within the teaching as part of this research. Each critical incident has been analysed using a different technique. These techniques have been drawn from Tripp's (1993) work on critical incident analysis (Tripp, 1993), with reference back to his sources as needed (Berlak & Berlak, 2012; De Bono, 1982).

I chose to use a different technique for each analysis as a way to extend myself out of my comfort zone. In teaching it is very easy to become complacent, relying on the same techniques because in our experience they have worked. I

wanted to explore a range of techniques, so that in the future I would not be tempted to be limited to one. Of equal importance is the notion that some techniques were more appropriate for certain critical incidents than others.

For each critical incident I have followed the same framework, derived from work by Brookfield using autobiography to understand oneself as a learner (1995, pp. 58-66). The analysis of each of the critical incidents has been broken down into five steps.

1. Status: an outline of the situation.
2. Insight: drawing some initial understanding from the critical incident.
3. Reflection: data is analysed using the techniques selected from those described by Tripp (1993) and Brookfield (1995).
4. Insight: a second opportunity to draw out understanding, this time after the reflection process.
5. Implications for practice: this is perhaps the most critical step, considering how the critical incident relates to teaching practice, and how my practice might change as a result.

After this, I provide a discussion that links each analysis with the literature. This provides the fourth critical lens as described by Brookfield, the other three being students, autobiography and colleagues. By considering the theoretical literature, I have examined my practice through all four of these lenses, and therefore have the most complete picture possible (Brookfield, 1995).

5.1.1. Critical Incident Six: Selection of Ethical Thinking Framework; Critical Incident Seven: Teaching Ethical Thinking Frameworks

Status

When I began this study, I did little in terms of teaching the students how to make ethical decisions and justify them. However, this was an important part of their assessment for this unit, particularly if they were working towards an Excellence grade. I needed a framework to assist the students to make decisions and justify them, and the Ethical Thinking Framework provided this.

Insight

The outcomes for students were presumably not going to change unless I changed the way this aspect was taught.

Reflection

I have chosen to use a 'Plus, minus and interesting' (PMI) analysis. This is one of the processes described in de Bono's in 'CoRT Thinking' programme (De Bono, 1982). Tripp (1993) suggests using thinking strategies such as PMI because while the method is simple it can lead to deeper understanding.

I have chosen to use the PMI analysis in this instance because I think it is a simple reflective tool that could be used to reflect upon the usefulness or not of a new teaching tool. It is the sort of analysis that could be done by a classroom teacher with relative ease when considering a new teaching strategy or tool, but at the same time helps encourage deeper thought. I am aware, through discussion with other teachers, that reflective practice often involves simply considering *whether* a teaching tool or strategy worked or did not work, rather than considering *why* it worked or did not work. Being aware of and considering the 'why' aspect makes for a much deeper understanding of practice.

I have chosen to consider both the selection and the use of the Ethical Thinking Framework together, as together they form part of a teaching decision.

Plus

- The online Ethical Thinking Tool[15] is written for students, in language with which they are able to engage and understand.
- The tool is available online, so every student can access it in their study time or at home.
- The Ethical Thinking Framework tool already existed, so I did not need to create it.
- There were examples of how the tool had been used in New Zealand classrooms on line.
- It was a great opportunity to introduce a different context (use of MMR vaccination in New Zealand) to the class, exposing them to another socioscientific issue.

Minus

- When I was using this tool, the computer system was unreliable and the usage was heavily booked. It was difficult to find a time to get into the computer room, with no firm guarantee that the online tool would work.
- I did not have enough time to really go into depth with the framework.
- I found no evidence of the use of the Ethics Thinking Tool in the students' portfolios.

Interesting

- I was able to get around the issues with the computers by printing the sheets. This also made it easier to ensure students were not wandering through the internet, although I could not guarantee their classroom discussions were on task.

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[15] http://www.biotechlearn.org.nz/thinking_tools/ethics_thinking_tool

- Some students found it useful to work in groups when looking at the framework, others preferred to work alone and still others wanted to be able to do a combination.
- Only with prompting from me could the students see how the tool could be used beyond a learning context. For example, they found they could use the tool to consider a local or national issue unrelated to their studies.

Insight

There were both positive and negative aspects to the use of this tool in the classroom. However, three of the negative aspects can be managed differently and may be resolvable. More importantly, using a PMI analysis provides a more robust way of considering other resources used in class to determine their usefulness.

Implications for Practice

I will continue using the Ethics Thinking Tool in class, and attempt to mitigate the issues around time available and computer reliability. Changes to the school computer network and the arrival of ultra-fast broadband may reduce some of these issues. More significantly the use of a simple thinking tool such as a PMI will enable me to explore some of the changes I make in my practice, new resources I use or even teaching strategies I use to give me a more reflective basis upon which to make decisions.

Discussion

The Ethics Thinking Tool on the Biotechnology Learning Hub (University of Waikato, 2009) was developed in response to a perceived need to support the teaching of ethics, including bioethics, in the classroom. The Ethics Thinking Tool itself was based on work by researchers, such as Michael Reiss and colleagues, into ethics and ethics education, and initially contained four approaches (Levinson & Reiss, 2003a; Reiss, 1999; Reiss, 2002):

- Consequentialism
- Autonomy
- Rights and responsibilities
- Virtue ethics

The group at the University of Waikato (and a number of international researchers working with them) developing the tool included a fifth approach: multiple perspectives. They recognise that the previous four are largely based around Western thinking, and the multiple perspectives approach specifically allowed for the inclusion of non-Western perspectives (McKim, 2010; Reiss, 2010; Saunders, 2009).

I found the Ethical Thinking Tool a relatively simple way to engage my class. It provided a way to move easily from content and teacher-centred teaching and learning to very frank and open class discussion. It also provided a model to discuss a range of socioscientific issues effectively. Similar outcomes occurred in the trialling phase of the tool (Saunders, 2009).

A significant frustration with the tool was the online nature of it. In a school with oversubscribed computer availability this proved an issue. However, the issue was solved relatively easily using printed copies. As schools move more and more to having students bring their own devices to school this may become less of an issue[16].

This tool, in my experience, provided a structured way to introduce both the teaching of ethics and socioscientific issues in my classroom. Roth and Barton (2004) describe scientific literacy as being the place where ordinary citizens and experts engage with science issues at both the policy and decision-making levels. I would argue that a starting place for this needs to be an introduction to socioscientific issues and how to make decisions about these issues. The Ethical Thinking Tool provided a forum for both the introduction of the issues

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[16] http://elearning.tki.org.nz/Technologies/Tools-and-technologies/BYOD

and engagement with the decision-making process to happen, so surely on some level starts to make a contribution to scientific literacy.

Sir Peter Gluckman, the New Zealand Prime Minister's Chief Science Advisor has made it clear that he sees scientific literacy as critical for today's youth. He states "I believe that society would be well served if there were more young people engaged in science literacy. I'm not arguing everyone should become a nuclear physicist - I think everybody needs some level of understanding of issues like climate change, and genetic modification and nanotechnology; these thing [sic] are going to impact on these young people's lives" (Moir, 2013). In my experience the Ethics Thinking Tool provided a way for my students to engage with issues meaningfully.

5.1.2. Critical Incident Three: Why is teaching ethical thinking important?

Status

Teaching socioscientific issues has always been about preparation of students for citizenship. Some of the students from my class go on to study Biology, but the majority do not. However, as young adults they will be able to exercise their democratic right by voting or may even choose to stand in both local and national elections. They may live in a community where a wind farm is proposed. They may need to make a choice about participation in social or political action or activism. All of these situations require decision-making.

To help students develop the competencies they need to make decisions I have taught a unit on socioscientific issues. As part of this course they complete an Achievement Standard (Biology 3.2) which requires them to make a judgement on their support or otherwise of a socioscientific issue and justify their decision. In 2011 I introduced the Ethical Thinking Frameworks for the first time, and based some teaching around these. I used these because they would be accessible to students outside of school and into their future.

Insight

I have been preparing students for citizenship, yet the students identify these lessons as preparation for university.

Reflection

For this reflection I have chosen to use 'The Why? Challenge' (Tripp, 1993). This simply requires the analyser of a critical incident to ask 'Why?', or other 'why' questions such as 'Why does it matter?', to try and understand an incident. This process may be done more than once, and does not always lead to the same destination.

My choice of 'The Why? Challenge' for this critical incident stems from a following my presentation of some of my early findings at the 2012 First Year Higher Education Conference. The focus of the presentation was on the transition from secondary to tertiary education, and as part of my presentation I presented this dichotomy: the notion that I felt I was preparing the students for citizenship yet they felt I was preparing them for university. At the time I was feeling quite challenged by the lack of unity between the two positions.

After my presentation someone asked me why did the lack of unity or agreement between the two positions matter? This led into a discussion about the notion of university being a subset of society, and that the two were not mutually exclusive. What really stuck with me from this discussion was the initial question, and in particular the significance of the word 'why'. When I was seeking ways to analyse the critical incidents identified in my practice, this is where I started as the pathway seemed so clear, as if being illuminated by that discussion.

In fact the clarity around the use of this one analysis tool made the whole issue of critical incident analysis far clearer for me. Early in my analysis I had completed much of the reflection that has been presented in the results chapter. However, I was sitting back saying to myself, 'So what?' During a supervision meeting the idea of critical incidents had been discussed, but I was still struggling to see how it could fit with my self-study. In fact, I was generally struggling with the notion of whether my events were critical incidents. Once I accepted that they could be viewed as critical incidents I decided to try an analysis, and chose this event and 'The Why? Challenge'. I was able to feel an immediate shift in my perception of the process, and an awakening of a deeper reflective process. This was a key moment in the self-study process for me, because it allowed me to see where I was heading and how this was all going to tie back to my practice.

Challenge 1

Why is this important?

Because I want to be better at preparing students for citizenship.

Why?

So that they can be actively involved decision makers.

Why?

Because this is important to be a member of society.

Why does it matter?

Because there have been some huge struggles to get everyone to be able to vote, and I don't want to see people waste their vote on ill-informed opinion.

Why?

Because I have to be a member of this society and live with these decisions.

Challenge 2

Why does it matter?

Because preparation for university and citizenship are two different things.

Why?

Because preparation for university has an academic focus and preparation for citizenship has a stronger social focus.

Why does it matter?

I'm not really sure that it does because there are aspects of both social in university and academic in citizenship.

Why?

Because university is like a subset of citizenship – one does not exclude the other.

Challenge 3

Why does it matter?

Because I am worried that my intended outcome is so far removed from that which the students perceive.

Why?

Because we are all in the same classroom so shouldn't we all recognise the same outcome?

Why?

Because I am the teacher, so surely I drive the focus in the direction I want it to go.

Why does it matter?

Because the class is not following me.

Why?

Because I have not articulated my intentions clearly

Why does it matter?

I want the students to know my intended destination, even if theirs is different.

Insight

The three 'Why? Challenges' have taken my thinking to three different places. Why? Challenge 1 surprised me somewhat as I did not think that the need to vote was so evident in my thinking. While this is an interesting end point, in terms of my practice it offers the least.

Why? Challenges 2 and 3 have led me to places that are more focused on practice and therefore they provide more insight with respect to this. The realisation that university is a subset of society is interesting to me. It makes me realise that in my haste to acknowledge the legitimate place of citizenship in my class, I have sometimes ignored the role of university preparation. I feel I have accepted my role in terms of content, but not necessarily in other aspects of teaching.

This idea ties in with the Why? Challenge 3. I realise that perhaps it does not matter if the students perceive a different outcome from the intended one; rather it is more important that both sides are aware of each other's perspectives.

Implications for Practice

The most significant implication for practice from this critical incident analysis is the importance of having conversations in class with a pedagogical element, explaining some of the teaching decisions being made and having conversations with a focus on learning rather than just content. This could be applied to all of my classes, not only my Year 13 Biology class. It is preferable (to me) to have conversations that make explicit links to the long-term outcomes of programmes of study. This is a relatively simple change to make. I do not think this should be the entire focus of lessons, but in the same way that learning intentions are part of a lesson, outcome intentions could be made more explicit. I think it is beneficial to make my intended outcome explicit to the class. This may still lead to dissonance in that what I perceive as the process outcome for a unit may be different from that perceived by students (for example, citizenship versus university preparation). However, by having those conversations and making the links more explicit, all members of the class should be aware of other perspectives.

Initially I was overwhelmed by this realisation. I could not believe that my intended outcome was so far removed from the students' perceived outcome. The Why? Challenge has made me realise that actually the two are not so far apart from each other and that it does not matter that they *are* different. The reality is that I want the students to have skills such as research skills, the ability to make informed decisions and the willingness to engage with issues regardless of whether they are within or outside of university or other tertiary study. However, the inclusion of more explicit links will mean that my personal need for transparency in communication around teaching is sated.

Discussion

The notion that there can be perceived differences in purpose for a lesson, unit or even course has challenged me in a number of ways. After a time of panic and fear that something was very wrong in my classroom (after all how could I

be intending one thing and the students perceiving something so different?), and then an acceptance that maybe the positions (preparation for citizenship versus tertiary study) were not too far removed from each other, I looked to the literature. Attempting to find evidence in the research about this type of dichotomy proved difficult.

Much has been written about mismatches or dissonance, at multiple levels. Misconceptions have been uncovered in textbooks (King, 2010), in the understanding that students have after teaching has taken place (Allen, 2010; Bell & Freyberg, 1985; Larkin, 2012) and those experienced by both teachers and students (Burgoon, Heddle, & Duran, 2010). All of these misconceptions have been at the content level, dealing with a mismatch what the author, student or teacher thinks that they understand of a concept.

Curriculum consonance (or curriculum dissonance, depending upon your perspective) can also be found. This is the correspondence between the goals of a teacher, what happens in the classroom, and what is learnt by the students (Brown, 2009; Thornton, 1985, 1988). Thornton (1988) and Brown (2009) focussed on the learning by the students as a measure for consonance. This is in contrast to the research being discussed here. In this self-study no measure of consonance was taken. What was discovered was a mismatch between my intended learning outcome and the students' perception of it.

In my self-study I was not measuring mismatch or dissonance. My awareness of the dissonance between my intention and the students' perception of the intention came from interviewing the students. To me, this process is of more significance, as it has highlighted the value of conversation with students. Traditionally teaching was carried out very much by a transmission model, whereby 'chalk and talk' was the dominant method of delivery. Teachers held the knowledge and students were expected to learn from them (Hargreaves, 1988; Pratt, 2002). The next step, as I see it, was the introduction of cooperative learning, whereby students worked together and with the teacher

to co-construct elements of their learning. However still, the focus was largely on content, but significantly the student and teacher were now able to engage about the content.

I do not think that this type of conversation will uncover the intention mismatch that I found in my self-study. The next step is to have conversations that have a pedagogical focus, between teachers and teachers, teachers and students, and students and students. I will discuss this further when I consider Critical Incident Nine, later in the chapter. I would like to focus on citizenship, and more particularly, preparing students for citizenship. School science courses have been traditionally designed to prepare students for the next level of science education. The focus has been on the acquisition of knowledge so that students have a good base for the next level. However, in recent years there has been a growing realisation that not all students study science beyond secondary school, and in fact not all follow a career path that includes any tertiary study. For these students the traditional knowledge-focussed Science curriculum did not meet their needs. Rather, science education for this cohort of students should be focussed on preparation for everyday life (Aikenhead, 2006).

A shift towards preparation for citizenship can also be seen in the New Zealand Curriculum (New Zealand Ministry of Education, 2007). The curriculum is divided in two parts, commonly referred to as the front and back ends of the curriculum. The back end of the curriculum provides specific achievement aims and objectives for the various learning areas, while the front end of the curriculum provides the vision, values, key competencies and principles that should be evident in all teaching across the sector.

Within the Science learning area there are eight levels. Curriculum Level 8 is the level relevant for the group in this self-study. In the Nature of Science strand of the curriculum, within the Participating and Contributing sub-strand is the achievement objective "use relevant information to develop a coherent

understanding of socio-scientific issues that concern them, to identify possible responses at both personal and societal levels" (New Zealand Ministry of Education, 2007, bullet point 1). This clearly makes a connection to citizenship, and science beyond the education system.

Equally the front end of the curriculum describes a vision for young people "who will be confident, connected, actively involved, and lifelong learners" and "informed decision makers" (p. 8). The principles describe a curriculum that should be future focused, encouraging 'students to look to the future by exploring such significant future-focused issues as sustainability, citizenship, enterprise, and globalisation' (p. 9). That is, within the New Zealand Curriculum there is clearly a mandate for preparation for citizenship.

This is reflected in the Achievement Standard that I chose to use with the class. This Achievement Standard (AS90714 (Biology 3.2) '*Research a contemporary biological issue'* requires the student to carry out research on a contemporary issue, and present this work to demonstrate an understanding of the biology, the implications and the opinions inherent in the issue chosen. For Excellence students are required to evaluate by:

> -comment[ing] on sources and information, considering ideas such as validity (date, peer reviewed, scientific acceptance), bias (attitudes, values, beliefs), weighing up how science ideas are used by different groups, own opinions, attitudes and beliefs
> – provid[ing] a justified position that supports or opposes aspects of the issue or an implication of the issue. *Justified* means to demonstrate, with supporting evidence, why the position has been chosen. (NZQA, 2006, p. 2)

When I view this standard, I see an assessment tool that is trying to prepare students for citizenship, by assessing their ability to check validity and biases of information presented to them. Students must then use this to form their own

justified opinion. For this reason, of all of the standards assessed in this class, I consider this to be the most important.

Equally the skills that they are learning in this topic and in preparation for this assessment (researching, processing information, checking for validity and bias) are skills that will be useful in a university setting. In fact the students identified these skills as the most useful thing I taught them in the unit of work, because they felt it prepared them for university. The reality is that for the students I interviewed, this was their next destination. All of them were headed for tertiary study in one form or another, so obviously this was going to be the focus for them. I question if some time in the future they may make the connection between this unit of work and citizenship.

5.1.3. Critical Incident Four: Teaching Research Skills

Status

The teaching of research skills is something that I believe I have been doing well. When I initially started teaching this unit I focussed on teaching subject-specific skills: how to use science databases; how to reference for science; and how to organise their information in terms of the assessment at the end, making it manageable.

During the formative assessment for this topic it became clear that students struggled with managing the research process, and that they had difficulty working out how to take the research information and use it to create a coherent and logical essay. We then spent some time in class focussing on these skills. I worried that I was taking too much class time doing this, and that these students really knew how to research. However, when I interviewed the students, frequently this teaching was given as a useful skill I had taught them that they would use again.

Insight

I had assumed that students had been taught and understood the research process. I simply needed to teach them the subject-specific aspects of research. However, during both formative assessment and the interviews I came to understand that the students believe that they are not taught how to research a topic.

Reflection

To reflect on this insight I have chosen to consider it from the perspective of dilemma identification (Berlak & Berlak, 2012; Tripp, 1993). Berlak and Berlak developed a set of 16 dilemmas after spending a six month period observing and working in schools in the United Kingdom. Upon their return to the United States of America, they were struggling to articulate the differences between

the education systems without overlaying their educational or political preferences.

Berlak and Berlak (2012) recognised that one of the stresses in teaching relates to the number and nature of decisions that have to be made daily. Many of the teaching decisions that are made involve mutually exclusive options. For example you can treat the student as an individual or as one of a group of students learning in the classroom. You cannot do both at the same time. Berlak and Berlak state the "dilemmas are intended to formulate the range of tensions 'in' teachers, 'in' the situation and 'in' society, over the nature of control teachers exert over children in school" (Berlak & Berlak, 2012, p. 135). The benefit in looking at dilemmas comes not from identifying those that are already identified, but in checking to see if any dilemmas are present (Tripp, 1993). These 16 dilemmas are divided into three sets, with the 'v.' (versus) representing the exclusive nature of the two options (Berlak & Berlak, 2012):

Control set:
1. 'Whole' child v. child as student (realms)
2. Teacher v. child control (time)
3. Teacher v. child control (operations)
4. Teacher v. child control (standards)

Curriculum set:
5. Personal knowledge v. public knowledge
6. Knowledge as content v. knowledge as process
7. Knowledge as given v. knowledge as problematical
8. Learning is holistic v. learning is molecular
9. Intrinsic v. extrinsic motivation
10. Each child is unique v. children have shared characteristics
11. Learning is individual v. learning is societal
12. Child as person v. child as client

Societal set:

13. Childhood continuous v. childhood unique (childhood)
14. Equal allocation of resources v. differential allocation (allocation)
15. Equal justice under law v. *ad hoc* application of rules (deviance)
16. Common culture v. sub-group consciousness (pp. 22-23)

Reading about the dilemmas identified by Berlak and Berlak brought to mind Berry's work on tensions in teacher education. Her self-study identified six tensions in teaching about teaching, and used the exploration of these tensions to help understand her practice (Berry, 2008). I could see how tensions or dilemmas formed a part of the practice of teaching, and was beginning to see how their exploration could lead to understanding.

By virtue of its nature, teaching is rife with dilemmas or tensions. Teachers are making decisions constantly and these decisions are often mutually exclusive. Tripp (1993) gives the example of making the choice between intervening in a situation or ignoring it. Each situation (or critical incident) may involve several dilemmas – when as a teacher should one step in or out?

Identifying the dilemmas involved in a situation will not necessarily lead to a simple resolution of the situation. However, identification of the dilemmas involved in a situation may make it clearer to deal with the issues involved in a critical incident (Tripp, 1993). For this reason I elected to use dilemma analysis as the basis for exploring my teaching of research skills. To me, the dilemmas were evident, and I hoped that exploration of these dilemmas would lead to clarity around practice, in the same way that identification of tensions did for Berry (2008).

Thinking back on the critical incident I have described here, I can identify a number of dilemmas. All of them are curriculum dilemmas, as described by Berlak and Berlak (2012).

Dilemma 1 – Each child is unique vs children have shared characteristics

The first of these is the dilemma of 'each student is unique' versus 'students have shared characteristics'. I have chosen this dilemma in particular because the insight about the lack of teaching of research skills comes from interviews with a subset of one class. I am also aware that I am drawing a long bow here, as Berlak and Berlak were considering characteristics of students whereas I am considering learning experiences of students. However, these learning experiences lead to the formation of a characteristic or learned capability, that is, the ability to do research, so I believe it fits.

The practicalities of teaching mean that at times students are considered to have shared characteristics, and are taught a skill or content as such. The idea of fully differentiating every lesson for every student in a full teaching load of five classes each with an average of 25-30 students is, whilst laudable, extremely daunting. However, I can also see that for a student who knows and understands the research process, being taught it again would be a frustrating series of lessons.

I think that there are two ways to explore and reflect on the issues raised by this dilemma. First is the idea of understanding whether in this instance there are significant shared student characteristics. If I think about where the evidence for this class comes from, there are two sources. The students indicated during the early stages of the teaching sequence that they were struggling with aspects of the research process. My professional assessment of their prior knowledge indicated that there was a widespread gap in their knowledge about research. Did I specifically ask every student? No, but clearly that was the impression that emerged from teaching this particular class. I cannot assume that for every class this is the case, and good teaching practice would expect that I assess the prior knowledge of my classes, regardless of what I am teaching them, and use this to make changes to how I approach the topic (Alton-Lee, 2003).

The second source of evidence for this dilemma was the interview data. I would always be slightly cautious applying the information from these interviews without hesitation to every class, as they reflect the experience of that particular cohort in that particular course. However, when a number of individuals from a class are indicating the same point, as a teacher it is important to listen and consider what they are saying. It was not possible for these interviews to be conducted earlier in the academic year, so I was not able to apply the findings directly to the class. However, the finding provides food for thought. It provides evidence to support my observations, and it also indicates that I could go even further than I did in the teaching of this topic, more actively preparing students for the final assessment in terms of their research and information management skills. The reality remains that assessing the prior knowledge of each year's class is critical in terms of meeting their learning needs.

This brings me to the second way of considering this dilemma. When a class is assessed for prior knowledge, and a student or a number of students indicate that they are experts at research and I can see evidence of that, how can this be addressed in a classroom? Teaching research skills is a time consuming process, but those who are already capable could use the time to carry out their research. This is a simple solution. It may also be possible to set up mixed ability groups in group work, so that they are still part of the learning, and it may be that while they identify themselves as an expert, there may still be possibilities to learn for them.

Dilemma 2 – Knowledge as content versus knowledge as process
In my opinion, this is a tension that teachers often face. My interpretation of this dilemma is that there can be tension between teaching of content knowledge versus teaching of process knowledge. This is a real problem in the teaching of science subjects, where for many years content has been the curriculum driver. While there is now more focus on the teaching of skills and processes, some see this loss of content as a negative, particularly when

considered in light of external assessments that still focus on content (Cowie et al., 2009). This creates an obvious tension.

My teaching also reflects this tension. Time spent teaching skills such as research skills is time away from teaching content and enabling students to prepare for external examinations. One of the big questions raised for me is this: Is teaching about preparing students for examinations or is it about preparing them for life beyond school, wherever that may be? This is a far bigger question than I would usually consider in my day to day teaching practice, but in terms of unpacking a dilemma like this it is critical. I consider preparation for life beyond school essentially what I am doing. Part of that necessarily must be preparation for examinations, as success in these opens doors for students and potentially allows them to achieve their life goals. Somehow teachers have to manage the tension between content and skills teaching, meeting the needs of all of the students in the class. This is the whole premise of professional judgement, whereby an individual teacher can make decisions based on their assessment of what is best for the students. I can remember as a beginning teacher really struggling with this. The pressures placed on new teachers are huge, and yet they do not have the experience upon which I now rely to make these professional judgements. The interviews with the students made it clear to me that they (some of them at least) understand their own learning and could offer insights into what they needed more or less time on in class. Coupling that with my experiences with them in the classroom, and with previous classes, and with work that I have assessed, it is then up to me alone to try and resolve that tension.

Having said that, I am not sure that the tension can be resolved. Reaching a point of resolution for me may in fact create greater tension for a student. Being aware of the tension and being open about its existence in the classroom goes further towards reaching the point of a resolution. There is no point at which everyone's needs are met and the dilemma is solved. What I have learned from the students is that they wanted more time working through the

research process. Where will that time come from? Some can come from being more efficient with the time we have now. They also indicated that spending a lesson with the computers doing the research was less useful. Once they knew where to go to find information, it was not necessary to do this in class. They can access computers during their study periods or at home. By talking to the students I have found one place where time can be utilised differently. Beyond that it needs to come from time used for content delivery, which for the students and me will mean the need to do a little more preparation before class. This can be challenging, but I hope that long term it does not interfere with how students are doing. The other point I really need to confront is that this was an issue for this class, and may not be an issue in the future. It may be that another curriculum area begins teaching research skills, and therefore the students have already developed research skills before coming to my class. However, that is part of the dynamic ever-changing landscape of the class-room, and is why it is so important to assess (formally or informally) students' prior knowledge.

Dilemma 3 – Personal knowledge versus public knowledge

I have chosen to explore the dilemma of personal versus public knowledge in relation to teaching research skills because I think it typifies why I see self-study as such a powerful model for change. Self-study research is founded on a five foci framework: the research is personally situated; a critically collaborative inquiry; about improved learning; is transparent and systematic; and is about knowledge generation and presentation (Samaras, 2011). These final two foci, the need for transparency and for knowledge generation and presentation, exemplify this dilemma. As a part of self-study it is essential to publicly reveal the knowledge and insight gained, thereby creating an avenue for critique and perhaps further insight. Let me consider the teaching of research skills, and my process of self-study from the perspective of this dilemma.

As a practitioner, one option would be to keep my discovery personal, rather than share it. I now know that the students I teach are ill-prepared for

research. I can do something about that. I can prepare them for the research process, giving them skills and the opportunity to practise these skills. This will involve a lot of preparation time for me, accessing and creating resources to assist in the teaching and learning process. These students will then be in a position to leave school and apply these skills, be it in a tertiary setting, in a workplace or as a member of society investigating an issue of interest. I might feel I have served those students well, and give myself a pat on the back. However, what about the other students in the school, who have not been in my class and do not leave school with well-developed research skills?

The other side of this dilemma is making this knowledge public. The idea that students are poorly prepared for research is not new. The Learning Curves project was a study funded by the New Zealand Ministry of Education and carried out by the New Zealand Council for Educational Research. An important finding was that in spite of research skills being an essential skill to learn, students felt poorly prepared for the process of doing research (Hipkins, Vaughan, Beals, & Ferral, 2004). Therefore, if I were to express to my colleagues that research skills were being taught poorly, presenting my evidence and research evidence from others, this may initiate a conversation. I suspect that first I may offend some people who perhaps think that they are teaching research skills and that they are doing it well. Whether this is the case or not, it might result in the development and implementation of a school-wide research skills programme, and the time I have spent developing my course, specific for my students, is now obsolete or in need of change, leading to more work. This would naturally depend on the approach being taken by the school, and it may be that the school adopts my approach.

One aspect of self-study that I have really enjoyed is the transparent and open nature of the research process. Obviously a degree of diplomacy is needed, but I welcome the opportunity to talk to my colleagues about if or how they teach research. There is much to learn from each other. If I accept that I might put lots of work into teaching research skills now, and that later it may not be

needed, I am still happy to be open and have these conversations. For me, the reality would be that I could then use that time differently in the class.

Of the three dilemmas analysed, this is the one that I can most readily see reaching a point of resolution. I do not think that teaching, and in particular innovative teaching practice, is the place for secrecy and personal knowledge. A big source of professional development and learning is surely the colleagues working with you. If we can accept that we are not perfect, and that we have something to offer as others have something to offer us, this dilemma stops being a dilemma.

Insight

Two insights strike me from these reflections. First, it is essential to know the learners in your class so that the teaching reflects best their needs, whether it is the teaching of research skills or anything else. Second, being open about pedagogy is essential. I would hope that open and collegial conversations about pedagogy may be the first step to school-wide change.

Implications for Practice

In this case the fact that my students struggled with research because they had never been taught the process highlights the significance of knowing the learner in a class setting. I cannot make the assumption that just because students have been taught and assessed on something (content or skill) that they will be competent or confident with it. I also think that as a teacher I need to be aware of tensions in my teaching, such as the balance between skills and content, and find ways to address the tensions mindfully rather than ignore them.

Although sometimes challenging, it seems essential that if change is to occur in an individual's practice, then pedagogical conversation must be a part of it. This is an aspect of my practice that I can improve on, continuing to share my realisations at conferences but also with my close colleagues. I think that

openness and a culture of frank and honest discussion could be helpful. My intention is to return to the classroom and be more open about what happens in there, whether this involves successes or failures.

Discussion

Recognising the value of teaching my students how to undertake research has been an invaluable insight for me as well as my future students. Having assumed for many years that my students knew how to research I have been corrected by listening to the students about whom I had made the assumption.

One of my motivations for teaching socioscientific issues and using this assessment is preparation for citizenship. There are an increasing number of calls for science education to not just prepare students for a future as scientists, but to work towards educating a more scientifically literate society (Bull et al., 2010; Gluckman, 2011, 2013; Tytler, 2007; Tytler et al., 2008; Wieman, 2007). Scientific literacy is an important skill for understanding an ever more complex world, allowing members of society to participate actively in societal decision-making. Scientific literacy has been defined by the Organisation for Economic Co-operation and Development (OECD) as "the capacity [for young people] to draw appropriate and guarded conclusions from evidence and information given to them, to criticise claims made by others on the basis of the evidence put forward, and to distinguish opinion from evidence-based statements" (OECD, 2004, p. 39). Historically, a consequence of a focus on scientific literacy has been, in some cases, an increase in the volume and depth of content (Shamos, 1995).

Shamos (1995) argues for a change in the way a science education is practised, so that we better prepare students with scientific literacy for citizenship. He contends that the current model of providing students with scientific terminology and facts does not produce scientific literacy. Rather, he suggests that a science education should give students an appreciation and awareness of

science, an awareness of the impact of technology on the world and society and an acceptance of the need to use experts wisely in resolving socioscientific issues.

I would argue that this unit of work attempts to do that. Students were exposed to a number of socioscientific issues over the course of the unit. Together we explored why they were issues, how technology could assist, what the range of opinions were, how you could judge the validity and bias of information and opinion. All of this was done under the auspices of teaching research skills. However, the teaching occurred within context, and the contexts I chose were socioscientific issues.

Law, Fensham, Li, and Wei (2000) looked at public understanding of science as a basic literacy. Their research sought to uncover what kind of science related knowledge and abilities does the general public need to know to function effectively as citizens in contemporary society. They asked five 'experts' (two medical doctors, an official in the Consumer Council in Hong Kong, a nutritionist and a youth worker) a set of questions and developed a set of sub-categories. The table below shows the sub-categories for the context of falling from a high place in an industrial accident.

Table 1: The Contextual Science — knowledge, awareness, policy/legislation and values/commitment — for falling from high (a kind of Industrial Accidents [sic]) in Everyday Coping (Law et al., 2000).

Scientific and technological Knowledge	Scientific awareness	Scientific policy and legislation	Scientific values and commitment
• Acceleration of rigid and flexible bodies due to gravity • The effect of impact forces on skeletal structures • Choice of materials and design of safety devices and their proper location on human bodies	• The importance of following safety legislation & wear safety belt at all times • The importance of following the proper way of using safety belt	• Policy and legislation about use of safety devices and their proper location on human bodies • Regulations and guidelines for proper use of safety devices	• Value issues in care needed to train workers in the proper use of safety devices • Value issues in workers' willingness to use them properly as legislated

What is clear from this research is that it is very difficult to look at an issue and separate the scientific knowledge from the context. In order to understand the complexities of the issue, some scientific knowledge is necessary.

Equally I would suggest that teaching research skills in isolation, without a context is equally futile. In the unit of work taught as part of my self-study, students learnt how to read a scientific journal article[17]. To do this they needed a context (in this case the use of 1080 in New Zealand) so that they had some background knowledge to work with. This article was also used to teach the processing of information and the concept of peer-reviewed journals as a way

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[17] Eason, C. (2002). Sodium monofluoroacetate (1080) risk assessment and risk communication. *Toxicology, 181-182*, 523-530.)

to assess validity of information. The context of 1080 was used to engage with a literature search of the EPIC database.

I contend that some of these skills are important for citizenship. Being able to find information on a topic and assess its validity is important for trying to understand a novel issue. Even without knowledge of the context, this skill allows you to try and understand the issue, and make an informed decision as a member of society. Equally, these skills are critical if you want to succeed at university, or in any tertiary study, be it in Biology or not.

Whilst ultimately I think that the skills can be applied separately to the context in which they were learned, the context is important in positioning the learning. How do you learn to read an article with no background knowledge or understanding?

This draws me back to the dilemma discussed earlier (knowledge as content versus knowledge as process), thus highlighting the tensions in teaching. The reality is that the tensions are sometimes bigger than any one teacher's classroom, but recognition of the tensions or dilemmas that exist in teaching is a good step to take in understanding one's own practice.

5.1.4. Critical Incident Nine: Interviewing Students

Status

The interviews were carried out with the students at the end of their academic year. This was the first time I had seriously engaged with students with the sole purpose of improving my practice. Prior to this I had from time to time gathered data from students in end of course surveys, but these often questioned students around the course work rather than my teaching. I found the process of interviewing the students to be extremely rewarding, as the conversation flowed two ways, each party able to seek clarification and elucidate answers. As well as being valuable in terms of learning about my teaching process, I realised that the students also benefitted from the conversation. They were able to understand better the rationale behind some of the teaching decisions I made, thereby resolving some issues for them.

Insight

There is value in talking to students about more than simply content. Conversations of a pedagogical nature have a place in the classroom.

Reflection

For this critical incident I have chosen to use an ideology critique (Brookfield, 1995; Tripp, 1993). The purpose of such a critique is to recognise uncritically accepted ideologies, described by Brookfield as sets of "values, beliefs, myths, explanations, and justifications" that may be entrenched in practice (Brookfield, 1995, p. 87). At the beginning of this self-study I thought the most useful data would come from my journal and the students' written work. As my understanding of self-study deepened and once the interview process had begun I realised just how wrong I was. I had imagined that I would learn from students about my practice, but I had no idea of how much I could learn. Nor did I appreciate that the process could be two way. This new knowledge suggests to me that there are deep seated ideologies that could be worth exploring, and therefore I have chosen an ideology critique. However, I really

want to explore right from my initial position, before beginning this self-study, which was based on limited student input from sources such as course surveys. I think that this will best allow me to unearth the ideologies that are hidden within my practice. I have used the framework as described by Brookfield (1995).

My intended meaning

I want to engage with students to gain feedback into my teaching of ethical decision-making. I want to find out from them what worked well, what did not work so well and any suggestions for change.

Contradictions and omissions

One issue with interviewing students that needed to be considered was the power imbalance. Jamieson and Thomas (1974) argue that the relationship between a student and a teacher is more productive when they have relatively equal power. They were particularly interested in conflict resolution, but contend that the disenfranchisement that students feel in a school system can lead to negative outcomes. I was mindful of the power differential between my students and me. A student can complete a survey anonymously, and be honest without fear of a teacher taking exception to what they say. Anonymity is not possible when a teacher is interviewing students. In an interview the teacher is driving the process, steering the conversation in the direction they choose, highlighting again the power imbalance. Yet at the same time an interview gives students a chance to have a voice and be able to express a point of view without judgement from peers. Of significance to me is the fact that I omitted to consider the possibility that this process may be two way, and that both the students and the teacher may gain insight.

Who benefits and who is harmed by the dominant view?

In the case of both a survey and a very formally structured interview the teacher benefits. They hold the power and can chose what to do with the information that they gather. Whilst the students are not necessarily harmed in

either case, they may feel frustrated if they feel that they are not being heard and worse perhaps if they are being heard but are ignored. Students who are perhaps more introverted may enjoy the opportunity to talk frankly with their teacher, without the fear of judgement by other students. Students benefit ultimately if the interviews result in changes to teacher practice.

Imagine an alternative structure

In an ideal world these types of conversations with students would occur more frequently, more along the lines of cogenerative dialogue (Grimes, 2010; Tobin & Roth, 2005). The conversation does not necessarily have to be about co-constructing the course, but more about developing a shared understanding of the teaching and learning that is occurring within the classroom. I also think that it is critical that the teacher models acceptance of constructive criticism and demonstrates to the students that they take their views seriously.

There is also a place for a teacher simply having frank and open conversations with students that are not necessarily formalised, but are simply part of the class or snatched conversations at the end of class. These may help students to understand their own learning process, help the teacher to recognise the points of stress within their teaching programme, and allow the students to understand why the teacher has made certain pedagogical decisions.

Insight

Engaging a dialogue with students that is of a pedagogical nature is beneficial for both teachers and students. To truly benefit both the teacher and the students these conversations need to occur more frequently than simply at the end of a course.

Implications for Practice

I can now see just how critical these types of conversations are. When handled correctly, everyone benefits. I think that the benefits of this type of pedagogical conversation outweigh the time lost to teaching content. The fact that I was

able to get nine students to return to school for an interview after their coursework had finished suggests that students may be willing to give some of their own time for these conversations, so time from school breaks or after school may possibly be utilised at times.

Discussion

The most significant revelation for me in terms of this critical incident was recognition of the value of conversations of a pedagogical nature. I have come to see that there is value in the conversation occurring between teachers and teachers, teachers and students and students and students. In a more formalised way both coteaching and cogenerative dialogue could be used to manage this process. Co-teaching is the practice of two or more people teaching a group of students for two purposes. The first purpose is to allow the students to learn and the second purpose is to allow the teachers to learn and develop (Roth et al., 2002; Tobin & Roth, 2005, 2006). This process certainly facilitates conversations between teachers, but unlikely though it seems, these conversation may not have a pedagogical focus.

Cogenerative dialogue is the practice of a teacher and a group of students in conversation about the teaching programme. The teacher can assess feedback from the students about what has worked and what has not. It may allow them to identify practices of which they are unaware (LaVan & Beers, 2005; Roth et al., 2002; Tobin & Roth, 2005, 2006). This process is facilitating the conversation between teachers and students, and between students and students. Again it could avoid a pedagogical focus but again, this seems unlikely.

Besides cogenerative dialogue, researchers have looked at other ways to ensure that student voice is recognised. These efforts range from looking at the structure of education systems and school, right down to consultation about the classroom process (McIntyre et al., 2005; Rudduck & McIntyre, 2007).

For me of greater significance than how these types of pedagogically focussed conversations occur is simply an awareness that they are needed and that they are of value. Pedagogy has traditionally related to the art and profession of teaching, with a focus on how knowledge and skills are conveyed through the methods employed (Samaras & Freese, 2006). I would like to extend that idea further, to include not just the art of teaching but also the art of learning.

To be an effective teaching practitioner there has to be a willingness to learn. Continually teaching the same lesson the same way does not work. Therefore embedded within the notion of pedagogy must be the notion of learning, from the perspective of the teacher. Also, within the classroom there is a body of – hopefully - keen and willing learners. I do not think learning can be separated from teaching. After all, is that not the purpose of teaching?

Conversations of this type are not easy. They require courage, particularly when seeking feedback on the teaching. The conversations need to be handled carefully, so as not to become extremely personal. The sorts of teaching and learning conversations that I think would add value include:
- frank discussions with students about how they learn or work best
- explanations for some significant teaching decisions
- conversations about how you, as a teacher, learn
- conversations with students about what is and is not working in the class
- having the students suggest ways to teach something (after all, they have access to many other teachers classes and may have something valuable to contribute)

Most important in all of this is a willingness to listen to the students and acknowledge them as a source of useful information and ideas. They have much to contribute. In a study of Year 8 students in the United Kingdom, six teachers were involved in consulting students about the classroom teaching and learning. The teachers were from a range of subjects (two each from English, Mathematics and Science). After the student consultation, teachers were

interviewed to capture their reaction to the students' ideas. The teachers then were given an opportunity to trial the suggestions that came from the students, and the following academic year (approximately six months later) the teachers were revisited to see what sort of longer term impact the students ideas had had on the teachers' practice (McIntyre et al., 2005).

The researchers found that in the initial phase the students came up with some constructive ideas about learning and could describe what helped their learning. Teachers were positive about the students' ideas and reassured by their insightfulness. In general they adopted the practices that affirmed or extended what was already being done in their classes, most likely for reasons of security and time restraints. However, the impact on teaching practice six months later varied. Two teachers had very quickly accepted the ideas of the students, and they had become part of their everyday practice. Two teachers had taken longer, but the ideas from the pupils were evident in their teaching. The last two teachers had struggled to integrate the ideas of the pupils. One of these, a drama teacher, had initially been extremely enthusiastic. She had set up a student group to be involved in all planning, and simply expected too much of the students. The final teacher was initially defensive about the students' ideas and ultimately they made little impact on her practice (McIntyre et al., 2005).

In these six teachers I see the full range of teacher responses that I would expect. The responses of the first four teachers are the ones that long-term have the most impact on practice and ultimately validate their involvement. As I read this and reflect upon what I have written, this seems a long way from my self-study, but the implications are the same. I am advocating for conversations with a pedagogical focus to improve teaching and learning in the classroom. In my self-study these conversations took the form of interviews, and I have already discussed the use of cogenerative dialogue as an alternative. However, there is also a place for informal conversations, a quick chat at the desk during class or a short catch up out of class time. How the conversation happens is perhaps of less importance than the fact that it happens at all and that the

students are listened to, and can see that they have been listened to. The danger, of course, is that the conversation stops being about content and becomes only about teaching and learning, but I posit that the two will be bound inextricably together, with content being the context for the conversation.

5.2. Self-Study

In the methodology chapter (Chapter Three) I outlined the five components of the self-study methodology as described by Samaras and colleagues (Samaras, 2011; Samaras & Freese, 2006). In this section of the chapter I have considered how this research has addressed each of these components, thus fulfilling the requirements of self-study.

Personal Situated Inquiry

The purpose of this self-study was to explore my practice. My voice (via journal entries) is a significant aspect of the data collection, whilst the analysis of the data is my voice. The inquiry was situated within a context of personal value, my classroom, and was driven by questions that arose in that context. A self-study exploring how I taught my students to make ethical decision on socioscientific issues is a personally-situated inquiry.

Critical Collaborative Inquiry

This is the component of self-study that I feel was my weakest. Due to the position of authority I hold within the school at which I teach, it was difficult for me to find a critical collaborator within the school. However, I was very fortunate to be able to have a critical friend with a breadth of experience both in the classroom and in educational research. She was a senior researcher at the New Zealand Council for Educational Research. Working in differing locations, and both with busy work schedules, we were not able to meet and discuss my research as often as may have been ideal, but the conversations we did have were a rich source of inspiration for me and helped me to clarify my thinking.

Improved Learning

The aspect of my practice under investigation in this self-study was the teaching of ethical decision-making to my Year 13 Biology students. I was motivated to investigate this based on an assessment for an Achievement Standard the students complete towards their NCEA. The assessment requires the students to make a decision on a socioscientific issue and justify their opinion. This is an aspect of the assessment that has not been completed well in the past. Improved learning in this area may also mean the development of a competency (ethical decision-making) that students are able to take beyond school.

Improved learning could also refer to the learning of the researcher, in this case me. This self-study should allow me to better understand my teaching practice, and to have greater clarity about what works and what does not in my classroom.

Transparent and Systematic Research Process

In the case of self-study, transparency refers to being "open, honest and reflective about your work" (Samaras, 2011, p. 80). I have been very open about the nature of my research from the beginning, having many professional conversations with other educators, be they work colleagues, education researchers, teacher educators or friends. These conversations have helped to shape my thinking and driven my reflection, allowing me to think outside of myself when I have needed to.

The research process has been systematic by virtue of the fact that a team of three university supervisors and a critical friend have been following my process and have known my plans. I have documented my process in my professional journal, providing an auditable trail of my process.

Knowledge Generation and Presentation

From quite early on in the research process, the research has been presented publically. I have presented at a number of conferences (Biolive 2011, Scicon 2012, FYHE 2012, ASERA 2013, NZARE 2013[18]) not only to place my knowledge and learning into the hands of others, but to open myself to critique and new ideas. I have enjoyed the paradoxical nature of self-study where despite it being quite personal research there is a requirement to publicly present the research (Samaras & Freese, 2006).

The generation of this thesis is also part of knowledge generation and presentation. The thesis takes what has been a largely private process and makes it publically accessible, as will the publication of any papers from this research.

5.2.1. Self-Study for Initial and Ongoing Teacher Improvement

The framework for a self-study, developed as part of this research, worked well. It meant that I was able to achieve a depth of reflection I do not believe I have reached before. This critical reflection resulted in a greater understanding of what was occurring in my teaching practice, and as a result, I was able to make changes in my practice that were evidence-based.

As I developed the framework for self-study, I was aware of the possibility of other teachers using it. Some of my early decisions, such as the use of critical incident analysis, were made with this in mind. I was conscious of the use and teaching of critical incident analysis as part of some courses in both initial and ongoing teacher training. As such I felt critical incident analysis was a great starting place, as some teachers were already familiar with it.

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[18] Biolive is the Biology Educators of New Zealand conference; SciCon is the New Zealand Association of Science Educators conference; FYHE is the First Year Higher Education conference; ASERA is the Australasian Science Education Association conference; and NZARE is the New Zealand Association for Research in Education conference.

Goodell (2006) examined the use of critical incidents by the students in her Mathematics methods class as part of her own self-study. Over a four year period students completed critical incident reports as part of their course work. Goodell used these reports as one of the data sets for a self-study identifying the critical incidents students were exposed to during their preservice teaching experiences. She was then able to uncover what they learned about teaching for understanding, one of her goals for the course (Goodell, 2006).

While Goodell's research combined both self-study and critical incident analysis, the critical incident analysis was not completed as part of the self-study. Brandenburg and Gervasoni (2012) analysed a single critical incident that had "rattled [their] cage" (p. 183) in an attempt to understand what they had learned from the incident. Their learning related to the ethical dimensions of self-study research, and more specifically the collection and analysis of data with respect to ethical dilemmas (Brandenburg & Gervasoni, 2012).

In their research, Brandenburg and Gervasoni combined both self-study and critical incident analysis, but considered just a single critical incident. This was sufficient to meet the aims of their research. However, I consider that self-study and critical incident analysis can be applied in a powerful way, to comprehensively examine aspects of practice, as has been done in this thesis.

Self-study has been used with both preservice and inservice teachers. Bass, Anderson-Patton, and Allender (2002) had their graduate teacher education students complete self-study teaching portfolios. This constituted one of the assignments in the course. They argue that by extending their own self-study to the point where they are modelling it, and their preservice teachers are conducting their own self-study, the preservice teachers are developing a better understanding of the learning process (Bass et al., 2002).

Brown and Russell (2012) describe the self-study conducted as Brown moved from being a student teacher to a teacher in charge of his own classes. The self-study relied heavily upon the input of Russell, an experienced teacher and teacher educator. However, the benefit for Brown, in terms of the ongoing support and development was invaluable in shaping his early teaching experiences. Ultimately, the self-study allowed him to understand his teaching much better (Brown & Russell, 2012).

Samaras and Roberts (2011) describe a process for teachers to conduct a self-study. Roberts describes the self-study she completed within her English class, while the article provides some guidance in a generalised framework for self-study. The article, written for a teacher audience, does not describe how the analysis was conducted (Samaras & Roberts, 2011).

From the research described in these articles, it is clear that self-study has a place in both preservice and inservice teacher education. It is also evident that critical incident analysis has a place in self-study. The framework (see Figure 3) developed and used for the research described in this thesis combines self-study and critical incident analysis in a meaningful way, providing a pathway that teachers could use. It is simple enough that both preservice and inservice teachers should be able to utilise it to improve their teaching practice.

The use of self-study in a classroom is something that I think should be evident to the students. In education we are teaching students; however, we should also be modelling learning. Self-study provides a way in which learning can be modelled. The use of interviews in my self-study meant that the students were aware of the self-study, and also aware that I was not only interested in their learning, but also interested in improving the teaching and learning in the classroom. Lewthwaite and McMillan (2010) investigated perceptions of learning success in middle years Inuit students. One of the key processes identified as leading to perceived learning success was the teacher demonstrating an interest in the students' success (Lewthwaite & McMillan, 2010). A teacher

demonstrating an interest in the students' success was also identified by Bishop and colleagues as important for achievement in Māori students (Bishop, Berryman, Tiakiwai, & Richardson, 2003; Bishop, Berryman, Wearmouth, Peter, & Clapham, 2012). Both these examples are situated within specific cultural contexts. However, Alton-Lee states that "quality teaching facilitates the learning of diverse students and raises achievement for all learners" (Alton-Lee, 2003, p. 16). By striving to improve practice through self-study, a teacher is working to improve the learning outcomes for students. By making the process apparent to the students there may be benefits besides those of improving teacher practice.

I found that using critical incident analysis in my self-study I was able, for perhaps the first time in my teaching career, to engage in deep, critical reflection. Introducing this to teachers at the beginning of their careers may mean that this process happens earlier for some. Equally, it has a place for those teachers who are more experienced. While critical incident analysis seems simple, I found it redirected my reflection from the superficial to critical, and I think my practice is improved as a result. The framework developed as part of this thesis may allow other teachers, both new and experienced, to similarly investigate their own practice.

5.3. Summary

The process of actively reflecting on my practice through the use of critical incident analysis has been extremely rewarding. While the analysis of each critical incident started at a different place, each analysis has finished with something in common. That is the recognition of the importance of pedagogical conversation. I suspect that this reflects the huge value that I gained in interviewing the students as part of this study, but the analyses have forced me to think beyond just interviewing students. Presented here are some clear implications for practice, and the beginnings of change in my practice when I return to the classroom, not just in terms of teaching ethical decision-making to my Year 13 Biology students, but in every class, with every topic.

Interestingly though, as I reflect on this entire self-study, what has become increasingly evident to me is the significance of self-study and the impact it can have on practice. I have found the process extremely satisfying in the way that it has taken my practice from reflective to critically reflective. It has provided a vehicle for shifting my practice to a level of reflection that has led to and will continue to lead to change. Importantly, the changes that have and will be made are based on evidence, and I see this as the greatest power of self-study.

Chapter Six Conclusion

6.1. Introduction

The purpose of the final chapter is to reflect upon the conclusions, the significance and limitations of the research and to identify implications for professional practice. The question that this project was attempting to answer is:

> Through reflecting on my teaching practice, what changes could I make to the way I teach ethical decision-making on socioscientific issues to better meet the needs of the students?

The research design and research findings are summarised first, and conclusions drawn in relation to the research question. Following this, the significance and limitations of the research are considered. Finally, the implications of this research are considered, both at a personal level and in terms of what it offers to the wider education community.

6.2. Research Design

Chapter three outlined the research design and methodology used in this study. The use of self-study as a methodology was determined early in the research process, and the nature of self-study and its five component parts steered the direction of this research and the way in which it was conducted.

A framework (Figure 3) was developed that combines work on self-study (Samaras, 2011; Samaras & Freese, 2006) with the use of critical incident analysis (Brookfield, 1995; Tripp, 1993). This framework could be used by a classroom teacher to complete their own self-study.

Data were gathered by keeping a professional journal during the research, maintaining research notes, documenting conversations in the professional journal and interviewing students at the conclusion of the course. These data were then considered and reflected upon, and from this process ten critical incidents were identified within the teaching and research process. Each of these critical incidents was reflected on further, and these data and early reflections form the basis of Chapter Four of this thesis.

The ten critical incidents were then reduced to the four that provided the greatest impetus for change in my teaching practice. Each critical incident was reflected on further, followed by analysis using methods described by Tripp (1993) and Brookfield (1995). The inclusion of implications for practice is critical to me, as it is the aspect of the critically reflective process that considers how practice might change as a consequence of the self-study.

In summary, the self-study focussed on gathering qualitative data on the teaching and learning that occurred in my Year 13 Biology class during the unit on contemporary biological issues. I was particularly interested in the ethical decision-making aspect of the standard that was used to assess this unit of work. A framework for the self-study using critical incident analysis was developed and drawn on to consider the data and determine next steps in terms of practice.

6.3. Significance of the research

6.3.1. Significance to self
As a self-study the research is of most significance to me and to my own practice. This is because a self-study, by definition, examines one's own practice, and therefore the findings relate to the self. The significance to my practice is outlined in more detail in Section 6.5.

6.3.2. Significance to colleagues and peers

The findings may also resonate with other classroom practitioners, not just in Biology or in teaching within New Zealand. In discussions with other classroom practitioners at meetings and conferences and within my school, my colleagues have indicated the same surprise as I have at some findings, particularly in relation to the teaching of the research process. It has also been interesting to talk to other teachers about the value I derived from interviewing the students in my class. While many teachers would claim that they have such conversations with students in their class, when I have really challenged them about the nature of those conversations, they are often either content focussed or of a more social variety. Having conversations with a pedagogical focus is not always the norm.

It has only been through the critically reflective nature of self-study that I have really come to understand the assumptions I have been making. I hope that by sharing my findings about my own assumptions and associated practices, I may encourage other teachers to consider these (as well as other assumptions they may make) in terms of their practices.

However, the project is also significant in its methodological approach, with the development of a framework outlining a process to conduct self-study. The framework has been developed to lay out a pathway for a classroom practitioner to follow if they wish to conduct their own self-study. The use of critical incidents as a focus for the study has been deliberate, as many teachers are already familiar with critical incidents and their analysis. The self-study aspect is less likely to be familiar, and I hope others find it to be as powerful a tool for reflection and change as I have. What is particularly significant is that this entire methodology and framework can be applied across the curriculum and at multiple levels within the education system. It is not limited to others teaching in my setting.

One of the great aspects about self-study is that it is not limited by a particular set of methods. However, as someone new to self-study, I found that quite daunting. It is also noteworthy that classroom teacher often have difficulty accessing academic literature, as without access to a university library, much of the published education research is out of reach. The framework developed as part of this study combines self-study with critical incident analysis, a method familiar to many teachers. I see this framework as a framework that a teacher may use to get started with self-study, but that as their confidence and knowledge developed, they may pursue other types of self-study.

I also hope that through on-going discussion with colleagues, there will be an increased recognition of the power of critical reflection to make a change in practice. I would have described myself as a reflective practitioner until I actually started using some of the methods described in this thesis. Too often in the past my reflection has been superficial, and has not ultimately led to evidence based change in my teaching. Now that I recognise the power of critical reflection through self-study I hope others are also able to do so.

6.4. Limitations of the research

As noted earlier, the research findings are of most significance to me and my practice. However, a further limitation is that this research was conducted with a single class in a single year. It is limited by taking place at a particular time and in a particular context.

If I were to consider the results for such a study 15 years ago when I began teaching, it would have been considerably different. I suspect my focus, as a beginning teacher, would have been on management and control rather than the type of pedagogy investigated here. I was unaware of the significance of socioscientific issues and citizenship, both critical in the framing of my research question. Many Biology teachers were just starting to understand the

significance of such aspects. More significantly, I lacked the maturity, insight and confidence to complete a study such as this.

Equally, it is difficult to imagine these results 15 years from now. Will I still be a classroom teacher in 15 years? Only time will tell. However, the issues being faced in professional practice may well be different. I cannot predict what the education system will look like in 15 years, but I do know that there has been significant change in the last 15 years.

The context in which this research has been conducted is also a limitation. It is both subject (Biology) and country (New Zealand) specific. Even within the Biology teaching profession, these findings may be of little relevance to those teaching in other countries with differing curricula.

There were some limitations that relate to practical aspects of the teaching or research process. Access to computers proved to be difficult during the teaching of this unit. This altered the way I was able to introduce and teaching with the Ethics Thinking Tool. I cannot know if this impacted upon the way the students interacted with the tool and its usefulness.

Within this framework there were further restrictions placed in terms of not interviewing every student and interviews only being able to be conducted at the end of the course. This was a requirement put in place by the MUHEC. I may have had different conversations in the interviews had they been conducted earlier, or if I had interviewed every student in the class.

The choice of methodology also introduces an element of limitation. Had I wished to really understand how my students were making the ethical decisions I might have used argumentation theory or informal reasoning (Dawson & Venville, 2009). However, this may not have addressed what for me was the ultimate goal, change in practice. Rather than understanding how the students made decisions I wanted to know what I could do to assist in the process.

There are a number of limitations evident in this research, by virtue of the fact that it is a self-study. However, the methodology itself is what makes this research of interest to others, and whilst my colleagues may find some of my findings interesting or even useful, I hope that more than that, they will embrace self-study as a methodology to bring change to their own practice.

6.5. Conclusions and implications

There are four significant findings from this research, each related to one of the critical incidents analysed.

6.5.1. The use of the Ethics Thinking Tool as a useful tool for making ethical decisions

Summary

When I initially considered which critical incidents to analyse, the use of the Ethics Thinking Tool was not included. When I reflected on why it was not chosen, I realised that there was significant value in further consideration. Initially I had separated both the selection and the use of the Ethics Thinking Tool from each other. I elected to consider them as a single critical incident, as I believe that they are part of the same idea - the selection and use of a new teaching tool.

The use of the Ethics Thinking Tool was a change to my practice. I had made this change to my practice, as prior to starting this research I had already identified ethical decision-making as an aspect of the assessment that was done less well by students in my class. The ability to form and justify an opinion on a contemporary issue was essential if the students were to gain an Excellence grade in their assessment.

For the Critical Incident Analysis I used a 'plus, minus, interesting' analysis (PMI) as described originally in de Bono's in 'CoRT Thinking' programme (De Bono, 1982). Tripp (1993) suggests using thinking strategies such as PMI because while the method is simple it can lead to deeper understanding. As a classroom practitioner, I have often used PMI analysis with students to provide a quick analysis of an issue or situation, but it is not a technique I have applied to decisions in my practice before.

Conclusion

The use of the Ethics Thinking Tool in my classroom was not simple by any means. It is an online tool, but I was unable to gain access to a computer room with my class to use the tool. However, I managed to print out the frameworks and use them in class as a paper based exercise. When I interviewed the students about the use of the tool no one suggested that this was a problem. There were a range of views in the class about how much time was dedicated to the use of the tool, some suggesting more would have been useful and others wanting less time.

When I consider my own reflections from my journal, I felt I would have liked longer, taking more time to go into depth with the frameworks. I saw it as a great opportunity to explore a socioscientific issue different from the one they had chosen for their assessment. This gave the students exposure and experience in considering a range of issues. Ideally, I would like time working as a class on a second issue, and then allowing the students time in class to use the Ethics Thinking Tool to consider their own research issue.

I considered a strength of the tool to be the fact that it was online. This would allow students to access the tool out of class time, and perhaps even use it to consider local, national or global issues. However, when I interviewed the students no one indicated that they had used the tool out of class, and more so it was only with prompting that they recognised it could be used beyond the immediate learning context.

Changes to my Practice

As a consequence of the analysis, I will continue using the Ethics Thinking Tool in class. However, I need to consider how I deal with the computer access and the time available. Changes I intend to make include:

- ensuring access to a computer room by booking very early in the year. In addition the use of students' own devices may help in this regard, although they may also need some coaching in order to fully utilise the flexibility of portable computing.
- creating more time in the course so that class time can be used to apply the Ethics Thinking Tool to two different socioscientific issues; one of my choosing and the one the students will be using for their own research.
- using a tool like PMI when I make changes in my practice as a more reflective basis upon which to make decisions.

6.5.2. Teaching for Citizenship

Summary

I believe that preparation for citizenship is a critical part of a teacher's role. When I consider the curriculum and the Achievement Standards that are available to assess work, the teaching of socioscientific issues and assessment of AS90714 (Biology 3.2) *Research a contemporary biological issue* is the most citizenship-focussed aspects of the Biology course at this level. Whilst many students go on to tertiary study, not all go on to study biology. Equally, a number do not embark on tertiary study at all. However, all are citizens, and as such all are part of a democratic process that provides opportunities for them to vote in local or national elections. Knowledgeable voting requires decision-making skills.

When I interviewed the students at the end of the course, all of them identified this unit and the skills I taught them as being good preparation for university. This contradicts what I saw the outcome as being, which was preparation for

citizenship. I have called this outcome dissonance. To analyse this critical incident I chose to do 'The Why? Challenge' as described by Tripp (1993). My use of 'The Why? Challenge' stems from the fact that at a conference presentation when I highlighted this difference, someone simply asked me why this dissonance mattered. That question, at a conference almost a year before I undertook the analysis, seemed to light the path for me for this critical incident.

Conclusions

The use of Tripp's (1993)'The Why? Challenge' took me to three differing destinations:

- As a member of society I have to live with the decisions made by the voting public. Therefore it is important that my students are able to make decisions in an informed way (so preparation for citizenship is important).
- University is like a subset of citizenship, so in fact it is not too much of an issue that the students and I saw the purpose of the unit of work differently.
- I want students to know what I think the intended outcome is, even if their perceived outcome is different.

In terms of my practice, the first destination is of minimal impact. However, the second and third destinations have clear links to practice. I recognised that sometimes in my haste to focus on preparation for citizenship I ignore the fact that the most pressing need for many students is university preparation. Although we may both perceive differing outcomes, having a pedagogical focus to some of the conversation in the classroom and outside the classroom may not overcome these differences, but at least makes all parties aware of what the other is thinking.

Changes to my Practice

As a consequence of this analysis I intend to increase the number of conversations I have that have a pedagogical focus. These conversations may

be between myself and other teachers or between myself and students. Being clearer with students about some of the teaching decisions I make may eliminate such obvious mismatches as was highlighted here in the expected outcomes. The difference may still be present but an awareness of each other's perspective may bring clarity. Such conversations are also important between teachers, as they potentially lend a critical element to what is occurring and introduce a different professional perspective to the decisions being made.

6.5.3. Teaching general research skills is critical, not just subject specific research skills

Summary

The teaching of research skills is something that I think I have improved upon over a number of years. I have changed the way this is taught in my classroom to specifically include the teaching of skills such as finding information, knowing how to tell if a source is reputable, reading of scientific journal articles, organising and summarising the information found and writing a plan for an essay. I have been concerned that I spend too long on this part of the teaching, and assumed that I am covering skills that they have already been taught in other subjects. When I interviewed the students the indication was that no one had taught them to carry out research before, and that this was a really useful set of skills that they would use again.

To analyse this critical incident I use dilemma analysis described by Berlak and Berlak (2012) and Tripp (1993). I considered three different dilemmas, each a curriculum dilemma.

Conclusions

Dilemma 1 – Each child is unique vs children have shared characteristics
Each student arrives in my class with a different level of knowledge and skills. However, due to the practicalities of teaching they are often considered to have

shared characteristics, and are taught a skill or content as such. The use of formative assessment is critical in identifying the aspect of the work that requires more input. Conversations with students can form part of that formative assessment. Whilst I cannot assume that every student struggles with the skills needed for researching effectively, my formative assessments and the interviews conducted with a sample of the class indicate that for this class research skills were an issue. Hipkins has identified a similar skills deficit (Hipkins, 2006). Therefore, I think it is possible to draw a similar conclusion generally. Obviously however, as a classroom practitioner professional judgement needs to be used for each class, and as such it is important to know the students in your class.

Dilemma 2 – Knowledge as content versus knowledge as process
There is significant tension in science education between delivering the content that is required in the course while still teaching students the skills that they need to know. Content has for many years been a driver of the Science curriculum (Cowie et al., 2009). My teaching also reflects this tension. Time spent teaching skills such as research skills is time away from teaching content and enabling students to prepare for external examinations.

Resolution of this tension is not necessarily possible. If I resolve this tension for me it may in fact increase the level of tension for students. However, having an awareness of the tension makes it more manageable. More time teaching skills and less time teaching content is managed by engaging professional judgement. Equally, teaching the skills using the content as a context may enable some double dipping.

Dilemma 3 – Personal knowledge versus public knowledge
Once you know something, you cannot 'un-know' it. I now know that my students appreciate the time I take to teach them research skills as they are not being taught them elsewhere. That knowledge is personal to me. If I make

that knowledge public, there are implications to consider, so this creates a tension.

Self-study research is considered to be founded on a five foci framework. The research is personally situated, a critically collaborative inquiry, about improved learning, is transparent and systematic and is about knowledge generation and presentation (Samaras, 2011). These final two foci - the need for transparency and for knowledge generation and presentation - exemplify this dilemma. On the one hand I could keep the knowledge to myself, and have my students alone benefit from being taught research skills. Alternatively, I could share the knowledge, as would be fitting in self-study, and risk offending others; the school developing a research skills protocol different from mine; or have all students get to a point where they are taught the skills using my type of protocol. All of these possibilities would ultimately mean more work for me.

Changes to my Practice

There are two significant findings arising from this critical incident. First, it is essential to know the learners in your class, both individually and collectively, to attempt to meet their learning needs. I intend to have more conversations with my students, as part of and as well as using formative assessment, so I know what they do and do not know. This way I will be in a better position to make the professional judgements needed to meet their learning needs.

Second, the transparency of self-study is really important to me. As such I feel compelled to share with other teachers the deficit students feel about the lack of teaching of research skills. This requires diplomacy, but I think it is important. Pedagogical conversations with colleagues benefit everyone in the profession. I do not think that teaching, and in particular innovative teaching practice, is the place for secrecy and personal knowledge. I intend to share my knowledge and allow others to benefit from what I have learned. In turn I will also benefit from their knowledge.

6.5.4. Interviewing Students

Summary

At the end of the academic year, interviews were conducted with nine of the students in the class. This was the first time I had seriously engaged with students in an attempt to improve my practice. Prior to this I had used end of course surveys, but these often questioned students around the course work rather than my teaching. The process was extremely rewarding, and I found that having the opportunity to clarify and get the students to elaborate upon answers meant I gained data far more useful and detailed than any I obtained from surveys. The process was also two-way, with students able to gain clarity around some of the issues that they had with the course.

For the analysis of this critical incident I chose to use an ideology critique (Brookfield, 1995; Tripp, 1993). Such a critique recognises uncritically accepted ideologies entrenched in practice (Brookfield, 1995). I had failed to recognise the power of this data set, as well as how empowering the process of interviewing was, for both me and, I believe, my students. I was interested to see what ideologies lay behind my thinking.

Conclusions

As a result of these interviews, and of exploring the ideologies underlying the process, I now recognise this as an incredibly powerful way to gather data about teaching practice. There were a number of issues with interviewing that needed to be addressed, not least the power imbalance. It was expressed to me that because I was conducting the interviews, students may not be honest as I was in a position of power over them. The timing of the interviews, at the completion of the academic year, was intended to mitigate against the power held by me as the teacher.

Ultimately, I think that the students were honest with me. They made insightful observations and asked meaningful questions. In some ways it was wrong to

assume that they might not be inclined to be honest; I believe that they took the process very seriously and felt some pride in being selected. Admittedly, not every student will be so honest. However, I selected students to interview who I felt would be articulate and insightful. Also of importance is the nature of the relationship between the students and teacher. I had a positive relationship with this class, and I am certain that will have made a difference.

I can imagine a future scenario where conversations such as these, with a focus on teaching and learning, are commonplace in my classroom. Cogenerative dialogue (Grimes, 2010; Tobin & Roth, 2005) would be one way to increase this type of conversation, but equally it does not need to be so formalised.

Changes to my Practice

I recognise now the valuable contribution that students can make to the conversations about teaching and learning. This process is two way, and these conversations can also resolve tension and uncertainty for students. Therefore, it is critical that I ensure that these types of conversations become a part of my teaching practice. There are many ways to make this happen, but what I intend to commit to is:

- holding small group discussions at morning tea after class. Bringing a packet of biscuits is a small way to show the students that you value their input.
- being open and willing to hear what students say may result in them being more willing to reciprocate.
- making time in class to catch students for quick conversation, perhaps when they are doing individual work.

I think that it also goes further than this. There is little point in having conversations if there is no action or change as a consequence. Therefore, I think it is critical to be flexible about the teaching programme and your teaching methods, so that you can be responsive to the suggestions of students

if it is appropriate. I think that the students will see the value you are placing on what they say, leading to even more valuable discussion.

Finally, as a profession I think we need to be willing to participate in challenging reflective conversations with colleagues. There is no place for secrecy in teaching, and the more people share their experiences and enjoy critical reflection from colleagues, the more each of us will benefit. With this in mind I intend to set up a small self-study group within my school. I hope that the group will be cross-curricula group, opt in and involve a commitment outside of school. This group will mean that everyone there will want to be there and wanting to focus on practice improvement. With a group, there will be built in critical friends or friendly critics depending upon perspective, allowing all those involved to have those sorts of challenging, critically reflective conversations.

6.6. Implications

In this final section of the chapter I want to make a commitment to make the following changes to my practice. These changes are evidence based, and given what the evidence suggests, these changes may improve my teaching practice.

When I introduce a new tool or resource to my teaching, I will critically reflect on its use and impact. This will be done using a thinking strategy such as the PMI analysis. As a consequence I will no longer make decisions on the use of new resources without reflecting deeply on their use.

I am committed to having conversations within my classroom that have a pedagogical focus. These conversations may be about how the students are learning, why I am teaching what I am teaching, or talking through some of the teaching decisions I make. I am committing to being more transparent and

open with my students about the teaching and learning process. These conversations may be more structured, like interviews or co-generative dialogue, or they may be informal. The critical point for me is that they must happen. This is the way in which I have learned the most about my teaching practice.

I will continue to teach research skills to my class, and start to engage other colleagues in a conversation about how we can improve the teaching of such skills across the school. I cannot predict how this will be received, but I feel an obligation to share the experiences of my students.

Finally, I think it is essential to share my understanding of self-study, and help others to realise its potential. Supporting colleagues through a self-study process would be a great way to understand it even better myself, and to allow me to continue driving the change to my practice.

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List of Appendices

Appendix A: Achievement Standard 901714

Subject Reference		Biology 3.2			
Title		Research a contemporary biological issue			
Level	3	**Credits**	3	**Assessment**	Internal
Subfield	Science				
Domain	Biology				
Status		Expiring	**Status date**		4 December 2012

This achievement standard is expiring. Assessment against the standard must take place before the expiry date set out below.

Expiry date	31 December 2013	**Date version published**	4 December 2012

This achievement standard involves researching a contemporary biological issue.

Achievement Criteria

Achievement	Achievement with Merit	Achievement with Excellence
• Research information to describe a contemporary biological issue.	• Integrate researched information to explain a contemporary biological issue.	• Integrate and evaluate researched information to discuss a contemporary biological issue.

Explanatory Notes

1   This achievement standard is derived from *Biology in the New Zealand Curriculum*, Learning Media, Ministry of Education, 1994, p. 28, achievement objective 8.3 (a).

2   In *research*, the student collects and interprets information from mainly secondary sources. Use of primary sources is acceptable. The research will be conducted with teacher guidance. This means the teacher is supporting the student throughout the research but the whole process will be student driven. The student is to select an issue, either from a list provided by the teacher or from the student's own research. The teacher

guidance gives general information in the form of broad questions, resource suggestions, or possible new directions.

3   An *issue* is one for which people hold different opinions or viewpoints.

4   For achievement, students are expected to describe:
   • biological concepts and processes relating to the issue
   • implications of the issue, which can be biological, social, ethical, economic or environmental
   • differing opinions or viewpoints.

5   Students are required to support their description, explanation or discussion with referenced information. This means that references to information sources are included within the text of the report, with full details given in a reference list.

6   Terms
   • *Describe* requires the student to define, use annotated diagrams, give characteristics of, or an account of.
   • *Integrate* means to bring together and organise relevant information and opinions from a range of sources.
   • *Explain* requires the student to provide a reason as to how or why something occurs.
   • *Evaluate* requires the student to:
      – comment on sources and information, considering ideas such as validity (date, peer reviewed, scientific acceptance), bias (attitudes, values, beliefs), weighing up how science ideas are used by different groups, own opinions, attitudes and beliefs
      – provide a justified position that supports or opposes aspects of the issue or an implication of the issue. *Justified* means to demonstrate, with supporting evidence, why the position has been chosen.
   • *Discuss* requires the student to show understanding by linking biological ideas. It may involve students in justifying, relating, evaluating, comparing and contrasting, and analysing.

Replacement Information
This achievement standard and unit standard 6319 have been replaced by AS91602.

Quality Assurance

1   Providers and Industry Training Organisations must have been granted consent to assess by NZQA before they can register credits from assessment against achievement standards.

2   Organisations with consent to assess and Industry Training Organisations assessing against achievement standards must engage with the moderation system that applies to those achievement standards.

Consent and Moderation Requirements (CMR) reference   0226

Appendix B: Board of Trustees Information Sheet

Massey University
COLLEGE OF EDUCATION
Te Kupenga o Te Mātauranga

SCHOOL OF CURRICULUM & PEDAGOGY

Private Bag 11 222,

Palmerston North,

New Zealand

T   64 6 356 9099

F   64 6 351 3472

24 March 2011

Dear Board of Trustees and Principal of XXXXXXX College

I am Kirsty Farrant, and as part of my study towards an EdD I am conducting a research project entitled "Teaching socioscientific issues and ethical thinking: a self-study". This project is a self-study, which means that the focus of the study is myself and my teaching practice. The aim is to investigate my teaching of socioscientific issues and ethical thinking, and as part of this I want to explore the perspectives of the students in my class. My research will be based around the teaching and assessment of the Achievement Standard Biology 3.2 Research a contemporary biological issue.

There are several phases to this research. These can be summarised as:
1.   exploration of my practice
2.   making changes to my practice – this will be done as part of my teaching in Level 3 Biology (in the AS 3.2 unit)
3.   evaluating the changes made

I am writing to invite XXXXXXX College to be involved in this project. With your approval I will be inviting members of my Year 13 Biology class to participate in the third component of the research. This will involve analysis of their written work and possibly an individual interview that will take at most one hour. The written work that will be analysed is work that will be completed as part of this unit, including the final assessment task. This analysis will be completed after the course is finished. A total of 8 students will be selected for the interviews. Selection will be made to give a balance of gender and overall ability in the interview group. I plan to carry out the interview between October and December 2011 at a time and date suitable to the students. This is most likely to be in their study period, but may be out of school hours or at lunchtime if this is more convenient to them. Agreement to participate means that I may also use parts of their class work completed as part of the regular teaching programme as evidence. This will not impact in any way upon the marking of the work.

The involvement of XXXXXXX College would be greatly appreciated. Each student in my Year 13 Biology class will be asked if they are willing to

participate. If they agree to participate in this component of the project, any information recorded as part of the project will remain confidential to me. No information directly relevant to them will be passed on to any other person apart from my university supervisors. Data relevant to them will be made available on completion of the study or, if desired, will be disposed of after five years.

Participation is entirely voluntary. If the student does participate he/she will have the right to:

- Withdraw from the study at any time by contacting either myself or Ms Deb King.
- Ask any questions about the study at any time during the research process.
- Provide information on the understanding that his/her name will not be used and that he/she will not be identifiable in any material produced from this study.
- Access a summary of the finished report when the study is concluded.
- Ask for the recorder to be turned off at any time during the interview.
- Once the interview is transcribed, the script will be sent to him/her for checking and release.

My proposal is currently going through the Massey University Human Ethics Committee. My involvement in this research, and that of consenting students, is dependent upon receiving ethics approval.

If you wish to contact anyone with regards to this project, please feel free to contact either myself or my supervisor.

Kirsty Farrant   Professor Margaret Walshaw
Researcher   Supervisor
XXXXXXX College   Massey University
kfarrant@XXXXXXX.nz   m.a.walshaw@massey.ac.nz
XXXXXXX x XXX   06-356 9099 x 8782

Appendix C: Participant Information Sheet

SCHOOL OF CURRICULUM & PEDAGOGY

Private Bag 11 222,

Palmerston North,

New Zealand

T   64 6 356 9099

Teaching socioscientific issues and ethical thinking: a self-study

INFORMATION SHEET

Dear Year 13 Biology Student

I am Kirsty Farrant, and as part of my study towards an EdD I am conducting a research project entitled "Teaching socioscientific issues and ethical thinking: a self-study". This project is a self-study, which means that the focus of the study is myself and my teaching practice. The aim is to investigate my teaching of socioscientific issues and ethical thinking, and as part of this I want to explore the perspectives of the students in my class. My research will be based around the teaching and assessment of the Achievement Standard Biology 3.2 Research a contemporary biological issue.

There are several phases to this research. These can be summarised as:
1.   exploration of my practice
2.   making changes to my practice – this will be done as part of my teaching in Level 3 Biology (in the AS 3.2 unit)
3.   evaluating the changes made

As a member of my Year 13 Biology class, I invite you to participate in the third component of the research, which involves analysis of your written work and possibly an individual interview that will take at most one hour. The written work that will be analysed is work that will be completed as part of this unit, including the final assessment task. This analysis will be completed after the course is finished. A total of 8 students will be selected for the interviews. Selection will be made to give a balance of gender and overall ability in the interview group. I plan to carry out the interview after you have completed your NCEA examinations, at a time and date that is suitable to you. Agreement to participate means that I may also use parts of your class work completed as part of the regular teaching programme as evidence. This will not impact in any way upon the marking of the work.

Your involvement would be greatly appreciated. If you agree to participate in this component of the project, any information recorded as part of the project

will remain confidential to me. No information directly relevant to you will be passed on to any other person apart from my university supervisors. Data relevant to you will be made available to you on completion of the study or, if you wish, will be disposed of after five years.

Participation is entirely voluntary. If you do participate you will have the right to:

- Withdraw from the study at any time by contacting either myself or Ms Deb King.
- Ask any questions about the study at any time during the research process.
- Provide information on the understanding that your name will not be used and that you will not be identifiable in any material produced from this study.
- Access a summary of the finished report when the study is concluded.
- Ask for the recorder to be turned off at any time during the interview.
- Once the interview is transcribed, the script will be sent to you for checking and release.

If you wish to contact anyone with regards to this project, please feel free to contact either myself or my supervisor.

Kirsty Farrant	Professor Margaret Walshaw
Researcher	Supervisor
XXXXXXX College	Massey University
kfarrant@XXXXXXX.nz	m.a.walshaw@massey.ac.nz
XXXXXXX x XXX	06-356 9099 x 8782

Appendix D: Parent Information Sheet

Massey University
COLLEGE OF EDUCATION
Te Kupenga o Te Mātauranga

SCHOOL OF CURRICULUM & PEDAGOGY

Private Bag 11 222,

Palmerston North,

New Zealand

T   64 6 356 9099

Teaching socioscientific issues and ethical thinking: a self-study

INFORMATION SHEET

Dear Parent of Year 13 Biology Student

I am Kirsty Farrant, and as part of my study towards an EdD I am conducting a research project entitled "Teaching socioscientific issues and ethical thinking: a self-study". This project is a self-study, which means that the focus of the study is myself and my teaching practice. The aim is to investigate my teaching of socioscientific issues and ethical thinking, and as part of this I want to explore the perspectives of the students in my class. My research will be based around the teaching and assessment of the Achievement Standard Biology 3.2 Research a contemporary biological issue.

There are several phases to this research. These can be summarised as:
1.   exploration of my practice
2.   making changes to my practice – this will be done as part of my teaching in Level 3 Biology (in the AS 3.2 unit)
3.   evaluating the changes made

Your student is a member of my Year 13 Biology class, and as such I have invited them to participate in the third component of the research. This will involve analysis of their written work and possibly an individual interview that will take at most one hour. The written work that will be analysed is work that will be completed as part of this unit, including the final assessment task. This analysis will be completed after the course is finished. A total of 8 students will be selected for the interviews. Selection will be made to give a balance of gender and overall ability in the interview group. I plan to carry out the interview after the students have completed their NCEA examinations, at a time and date that is suitable to them. Agreement to participate means that I may also use parts of their class work completed as part of the regular teaching programme as evidence. This will not impact in any way upon the marking of the work.

Their involvement would be greatly appreciated. If they agree to participate in this component of the project, any information recorded as part of the project

will remain confidential to me. No information directly relevant to them will be passed on to any other person apart from my university supervisors. Data relevant to them will be made available on completion of the study or, if desired, will be disposed of after five years.

Participation is entirely voluntary. If your student does participate he/she will have the right to:

- Withdraw from the study at any time by contacting either myself or Ms Deb King.
- Ask any questions about the study at any time during the research process.
- Provide information on the understanding that his/her name will not be used and that he/she will not be identifiable in any material produced from this study.
- Access a summary of the finished report when the study is concluded.
- Ask for the recorder to be turned off at any time during the interview.
- Once the interview is transcribed, the script will be sent to him/her for checking and release.

If you wish to contact anyone with regards to this project, please feel free to contact either myself or my supervisor.

Kirsty Farrant	Professor Margaret Walshaw
Researcher	Supervisor
XXXXXXX College	Massey University
kfarrant@XXXXXXX.nz	m.a.walshaw@massey.ac.nz
XXXXXXX x XXX	06-356 9099 x 8782

Appendix E: Participant Consent Form

Massey University
COLLEGE OF EDUCATION
Te Kupenga o Te Mātauranga

SCHOOL OF CURRICULUM & PEDAGOGY

Private Bag 11 222,

Palmerston North,

New Zealand

T   64 6 356 9099

F   64 6 351 3472

Teaching socioscientific issues and ethical thinking: a self-study

PARTICIPANT CONSENT FORM - INDIVIDUAL

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

By agreeing to participate in this study, I am consenting to the following:

- the analysis of a formative assessment task, completed as part of the normal teaching process
- the analysis of my essay completed for AS3.2 Research a contemporary biological issue
- participating in an individual interview of up to one hour. This interview will be completed after my NCEA exams.

I agree/do not agree to participate in this study, under the conditions set out in the information sheet.

I agree/do not agree to the interview being sound recorded.

I wish/do not wish to have my recordings returned to me.

Signature: ....   **Date:** ....

Full Name - printed ....

Appendix F: Authority for the Release of Transcripts

Massey University
COLLEGE OF EDUCATION
Te Kupenga o Te Mātauranga

SCHOOL OF CURRICULUM & PEDAGOGY

Private Bag 11 222,

Palmerston North,

New Zealand

T   64 6 356 9099

F   64 6 351 3472

Teaching socioscientific issues and ethical thinking: a self-study

AUTHORITY FOR THE RELEASE OF TRANSCRIPTS

I confirm that I have had the opportunity to read and amend the transcript of the interview(s) conducted with me.

I agree that the edited transcript and extracts from this may be used in reports and publications arising from the research.

Signature: ....   **Date:** ....

Full Name - printed ....

Appendix G: Key competencies (Ministry of Education, 2007)

The New Zealand Curriculum identifies five key competencies:

- thinking
- using language, symbols, and texts
- managing self
- relating to others
- participating and contributing

People use these competencies to live, learn, work, and contribute as active members of their communities. More complex than skills, the competencies draw also on knowledge, attitudes, and values in ways that lead to action. They are not separate or stand-alone. They are the key to learning in every learning area.

The development of the competencies is both an end in itself (a goal) and the means by which other ends are achieved. Successful learners make use of the competencies in combination with all the other resources available to them. These include personal goals, other people, community knowledge and values, cultural tools (language, symbols, and texts), and the knowledge and skills found in different learning areas. As they develop the competencies, successful learners are also motivated to use them, recognising when and how to do so and why.

Opportunities to develop the competencies occur in social contexts. People adopt and adapt practices that they see used and valued by those closest to them, and they make these practices part of their own identity and expertise. The competencies continue to develop over time, shaped by interactions with people, places, ideas, and things. Students need to be challenged and

supported to develop them in contexts that are increasingly wide-ranging and complex.

Thinking

Thinking is about using creative, critical, and metacognitive processes to make sense of information, experiences, and ideas. These processes can be applied to purposes such as developing understanding, making decisions, shaping actions, or constructing knowledge. Intellectual curiosity is at the heart of this competency.

Students who are competent thinkers and problem-solvers actively seek, use, and create knowledge. They reflect on their own learning, draw on personal knowledge and intuitions, ask questions, and challenge the basis of assumptions and perceptions.

Using language, symbols, and texts

Using language, symbols, and texts is about working with and making meaning of the codes in which knowledge is expressed. Languages and symbols are systems for representing and communicating information, experiences, and ideas. People use languages and symbols to produce texts of all kinds: written, oral/aural, and visual; informative and imaginative; informal and formal; mathematical, scientific, and technological.

Students who are competent users of language, symbols, and texts can interpret and use words, number, images, movement, metaphor, and technologies in a range of contexts. They recognise how choices of language, symbol, or text affect people's understanding and the ways in which they respond to communications. They confidently use ICT (including, where appropriate, assistive technologies) to access and provide information and to communicate with others.

Managing self

This competency is associated with self-motivation, a "can-do" attitude, and with students seeing themselves as capable learners. It is integral to self-assessment.

Students who manage themselves are enterprising, resourceful, reliable, and resilient. They establish personal goals, make plans, manage projects, and set high standards. They have strategies for meeting challenges. They know when to lead, when to follow, and when and how to act independently.

Relating to others

Relating to others is about interacting effectively with a diverse range of people in a variety of contexts. This competency includes the ability to listen actively, recognise different points of view, negotiate, and share ideas.

Students who relate well to others are open to new learning and able to take different roles in different situations. They are aware of how their words and actions affect others. They know when it is appropriate to compete and when it is appropriate to co-operate. By working effectively together, they can come up with new approaches, ideas, and ways of thinking.

Participating and contributing

This competency is about being actively involved in communities. Communities include family, whānau, and school and those based, for example, on a common interest or culture. They may be drawn together for purposes such as learning, work, celebration, or recreation. They may be local, national, or global. This competency includes a capacity to contribute appropriately as a group member, to make connections with others, and to create opportunities for others in the group.

Students who participate and contribute in communities have a sense of belonging and the confidence to participate within new contexts. They

understand the importance of balancing rights, roles, and responsibilities and of contributing to the quality and sustainability of social, cultural, physical, and economic environments.

Appendix H: Ethical Thinking Frameworks (University of Waikato, 2009)

Consequentialism

Consequentialism is to do with the consequences of actions. Using this ethical approach, we weigh the benefits and harms resulting from our actions.

1. Who/what is affected by this issue?
2. What are possible benefits for those affected?
3. What are the possible harms for those affected?
4. Which option(s) will produce the most good and least harm?
5. If one is harmed and another benefits, how do you decide who or what matters most?

Rights and Responsibilities

Rights and responsibilities are closely related: the rights of one imply the responsibilities (or duties) of another to ensure those rights.

1. Who/what is affected by this issue?
2. What groups have rights associated with this issue? What are their rights?
3. Do these same groups also have responsibilities? What are their responsibilities?
4. Do we value some rights more than others? Whose rights do we want to protect?
5. Do any codes, declarations or conventions relate to this issue?

Autonomy

Autonomy requires the right to choose for yourself.

1. Who/what is affected by this issue?
2. What effects might my choice have on others?
3. What effects might others' choices have on me?
4. Does everyone have to do the same thing? Will this cause problems?

5. What is informed consent? Is it important here?

Virtue Ethics

A virtue is something that the community accepts as being 'good', such as honesty, kindness and patience. Virtue ethics emphasise decisions that are in line with these characteristics.

1. Who/what is affected by this issue?
2. What qualities make someone a 'good' or virtuous person?
3. What decisions/actions in relation o this issue would make you a 'good person?
4. What people would agree that these decisions/actions are 'good'?
5. What people would disagree that these decisions/actions are 'good'?

Multiple Perspectives

Ethical decisions are viewed differently by different people. When considering an issue, it is important to explore a range of world views and respect diversity, for example cultural, socioeconomic, and spiritual or religious diversity.

1. Which groups have opinions about this issue? What are their opinions?
2. Why do groups of people think this way? Have they always thought this way?
3. Which groups voice opinions about this issue? (Not all groups that have an opinion voice them in a public forum.)
4. Do the opinions of all groups have equal weighting? How do you decide?
5. Can all of the groups agree, and do they need to?