

Learning about Social and Ethical Issues in a Biology Class

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This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other institution. To the best of my knowledge, this thesis contains no information previously published or written by another person, except where due reference is made in the text of the thesis.



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Abstract

This thesis discusses students' learning in the context of researching and writing about bioethical issues associated with cancer. A unit of work was developed for a senior high school biology class in New Zealand to foster students' awareness of the bioethical issues and to help them to be more introspective about their learning. The unit took into account previous work on the development of pedagogies and practical applications for teaching in this context. It included a range of activities designed to help students to clarify and analyse the bioethical issues. Modelling procedures and prompting students to evaluate their work, through enhancing critical thinking and metacognitive processes were included.

Data included the students' and the teacher's perceptions from interviews, classroom produced materials (brainstorm sheets, journals, essays) and my own observations. The class is used as a single case to show trends and changes in thinking regarding the bioethical issues, as well as the relationships between the knowledge and use of declarative, procedural and metacognitive strategies and the quality of essays. Five individual case studies provide examples of how students' awareness and control of their learning can be linked to their achievement.

The findings show that students broadened their awareness of the issues and that there was a strong relationship between the knowledge and use of declarative, procedural and metacognitive strategies and the quality of students' essays.

This study provides examples to show that the teaching of learning strategies, or making them more accessible through examples, cueing or prompting, does not necessarily mean that students will use them effectively. How students perceive the purpose of tasks, affects their "engagement with the tasks". They need to be aware that they are being given the responsibility to take charge of their own learning.

I use the term *evaluative constructivism* to describe how aspects of introspective learning processes can enhance students' intentions and decisions about learning. The discussion considers ways to support *evaluative constructivism*. These include: recognising the importance of content; identifying and analysing prior knowledge; promoting knowledge and use of declarative, procedural and metacognitive strategies; and fostering other aspects of the learning environment, such as support, mutual trust and respect, to enhance learning. Students in turn have to invest in an element of trust in the teacher; trust that teachers can provide the "tools" for learning more effectively. Motivational factors and other contextual factors such as timing, the perceived importance of assessment and students' self perceptions, all affect students' intentions and choices for learning. My thesis is that all of these factors affect students' intentions and choices which in turn influence the effectiveness of their learning.

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Chapter 1 Dilemmas Delineated

1.1 Personal Dilemmas

This study stemmed from a personal concern about the dilemmas associated with teaching about social and ethical issues in science classrooms. As a former teacher of senior high school biology in New Zealand for over a decade, I was aware that students in my year 13 (final year of high school) classes found it difficult to identify and articulate their views on social and ethical dimensions related to biology issues (bioethics). I had approached the contemporary issues topics in year 13 biology by providing students with resource materials and an outline of essay questions. They were expected to individually research the topic and write an essay. Students were asked to derive their own social and ethical implications of the issues with little or no debate. This was clearly inadequate. They did not consider to much extent the complexity and ambiguity of the issues.

Their lack of success was very apparent. Was it because I had not emphasised the issues fully enough? Maybe I had not allowed enough time for students to explore their thinking. I tended to assume, because they were year 13 students in their final year of high school, that they would be able to reflect, and would be able to research and write essays independently. These were probably false assumptions. Perhaps my expectations of what they knew were too high. They may not have had the skills that I expected of them in terms of being able to reflect. I had not provided them with the luxury of being able to clarify and analyse their personal ideas in a structured way. Perhaps they did not have enough prior knowledge/experience about bioethical issues to enable them to make an evaluation. Also their researching and essay writing skills may not have been adequate. Clearly, many students in the past had found it difficult to get started and certainly were a long way from being self-regulated learners. This was disturbing, particularly since it applied to the end of their schooling.

In the short time since I left high school biology teaching, my reflections on these problems led me to the questions that underpin this research:

- What is it about teaching social and ethical issues in science/biology that makes it contextually different from other ways of teaching in science?

- How can teachers help students to reflect on what they know and use this reflection to advance their understanding of bioethics?

- How can students be helped to be more self-monitoring and self-regulating in their learning?

I sought to understand these matters by designing a different approach to the teaching and learning of bioethical issues in a year13 biology class. The approach was used in the classroom of a current biology teacher. This study considers the implementation and ways in which students responded to it.

1.2 Research Questions

The research project was essentially designed to answer the following central question.

How can learning be enhanced in bioethical contexts?

More specifically the research was focussed by a number of subsidiary questions, many related to the classroom intervention that is the context for this research:

1. Can students' views about social and ethical issues be broadened?
2. Which classroom activities in the intervention influenced students' thinking about social and ethical issues ?
3. What kind of relationship is there between students' prior knowledge of bioethical issues and the content of their essays?
4. Which activities in the intervention helped in developing students' learning processes?
5. What kind of relationship, if any, is there between students' prior knowledge of learning strategies and their use of these in researching and essay writing?
6. What evidence is there that the intervention helped students to be more self-monitoring and self-regulating in their learning?
7. What other teaching and learning factors might influence the way in which students learn about social and ethical issues?

1.3 Dilemmas about Teaching and Learning in Social and Ethical Issues

Exploring social and ethical issues is intimately bound with individuals' values and beliefs. Keown (1998) has discussed the dilemmas associated with teaching values in education. Many of the dilemmas, outlined below, relate to the ways in which we view teaching in science. Keown's ideas have been modified here to apply to the teaching of bioethical issues.

Western science education has tended to be dualistic, where only right or wrong solutions exist, rather than there being "grey areas" (shades of meaning) or holistic interpretations. Teachers who adhere to the western tradition tend to place a very high value on reason, knowledge, and cognitive aspects of knowing. Holistic approaches that take into account feelings, aesthetics and affective dimensions, tend to be under valued.

In a pluralistic society, what could or should be done in terms of social responsibilities and ethical matters take on multi-dimensions. Whose values are examined? Which values should be promoted and which discouraged? There are tensions for teachers. To share their own views with a class may then be perceived by the students as the teaching of "correct values", allowing students to be acknowledged for their own views risks the acceptance of relativism. Even when teachers try to be "neutral" and ensure that lessons are "balanced", some people in the community may be upset that particular views were even discussed or left out. And such "neutral" approaches often result in unintended teaching of values (such as issues being seen by students to not have significant value dimensions).

"There is a "seeming" lack of knowledge about how values learning works and how to influence values through education" (Keown, 1998, p140). It may be that many science teachers have little confidence that ethics can actually be "taught". There is a perception that there is a lack of solid, credible and useful methodologies/procedures for teaching bioethical issues. While there is considerable discussion of various models and procedures for effective teaching of factual material and concepts, and for teaching discrete skills and recognised processes like the "scientific" inquiry process, much less is heard about how to teach effectively in the area of bioethics. Teachers consider teaching bioethics is worthwhile, but want support through additional teaching materials and professional development on implementation strategies (Van Rooy, 1993a).

It may be that some students are not confident enough in their own views (have enough background or experience) to feel comfortable about vocalising them, even in small groups. Some teachers have voiced concern that some students are generally apathetic or do not have an opinion and therefore avoid participation in some activities (Van Rooy, 1993a).

My concern then, as both a teacher and a researcher, was what classroom procedures could be used to address these problems?

Sharp (1987, p. 39) has stated that education should:

help us become clearer about what we know, more able to make better distinctions, more able to recognise underlying assumptions, better from worse reasons, more able to think consistently and comprehensively, more able to criticise one's own goals and others', more able to criticise one's own thinking as well as the thinking of others.

If I was serious about trying to achieve these educational goals mentioned by Sharp (1987), then I needed ways to encourage students to articulate their opinions and to reflect on their own and others' beliefs.

Essentially, evaluating bioethical issues is a critical enterprise. It requires reflection on personal ideas and beliefs and a willingness to be open to new ideas and information. The content is complex because it is made up of personal, social and emotive aspects as well as specific biological information. Reflection about what is known encourages people to view problems from different points of view (Dewey, 1933). This is precisely what is required for increasing an awareness of bioethical issues.

I wanted to design an intervention to promote a more in-depth awareness of the social and ethical issues. The intervention also needed to help students to communicate (both orally and in writing) and to develop their skills in self-monitoring/self-regulation or approach their learning *intentionally* (Scardamalia, Bereiter & Lamon, 1994) so that they could work independently and be more prepared for tertiary education and other life-long learning objectives. To achieve the latter (independent learning), I realised it would be necessary to insert procedures that would develop their information processing skills and allow them to reflect on their experiences.

This research project therefore investigates an intervention unit of work focussed on biological, social and ethical issues in a year 13 high school biology class, in New Zealand. In particular, it is concerned with the students' perspectives, the teacher's perspectives and my own interpretations of what transpired.

1.4 Demands of the Curriculum

In terms of outlining skills that students should acquire during schooling, the *New Zealand Curriculum Framework* states

The school curriculum will foster the development of the knowledge, understanding, skills, and attitudes that will empower students to take increasing responsibility for their own learning. It will provide students with satisfying and worthwhile experiences which will motivate them to continue learning throughout life (Ministry of Education, 1993, p. 7).

This statement explicates the underlying principles that are intended to drive teaching practices in New Zealand. I have interpreted the skills and attitudes as ones related to intentional learning, where students actively and strategically pursue learning. The *Curriculum Framework* also gives overall guidelines for including values across all subject learning areas:

The school curriculum will help students to develop and clarify their own values and beliefs, and to respect and be sensitive to the rights of individuals, families, and groups to hold values and attitudes which are different from their own (Ministry of Education, 1993, p. 21).

More specifically, *Biology in the New Zealand Curriculum* requires year 13 students to:

Investigate contemporary biological issues and make informed judgements on any social, ethical, or environmental implications (Achievement Objective 8.3(a), Ministry of Education, 1994).

Students are required to write an essay of about 500 words in the end of year University Bursary Examination which is worth 20% of the exam mark. It is therefore very important that students develop skills in researching and essay writing, as well as their thinking about biological, social and ethical issues that are linked with their topic.

The contemporary issues topics that are examined in any year are predetermined by an examination panel, with usually about 4 topics to choose from. The class selected for this investigation chose cancer issues as its' topic because this is an area of personal

relevance to many students (see Section 6.6) and is well supported by content resource materials.

This topic raises a number of ethical issues and thus provides a rich source of dilemmas for students to consider. In particular, there are many issues associated with the biological knowledge and medical technology relating to cancer. These issues include:

- detection methods;
- the choices of who to treat and how to treat cancer patients;
- the costs of prevention and treatments;
- advantages and disadvantages of a range of treatments;
- genetic screening;
- euthanasia; and
- the personal, family and social implications of all of the above.

The scientific knowledge about how certain lifestyles increase the incidence of cancer has implications for behavioural aspects of lifestyle. For example, the effect of diet, smoking and sunbathing are relevant to adolescents.

For the ethical issues associated with cancer to be handled in the classroom, the approach needed to be sensitive. The specific content for any issue is not prescribed by the curriculum document (Ministry of Education, 1994).

1.5 Notions of Learning in Relation to this Study

Learning as an introspective activity is an important aspect of the approach for exploring bioethical issues and is crucial for self-monitoring and controlling learning processes (Boud, Keogh & Walker, 1985). Reflection allows you to ask questions about your own views and how they have come about. Dewey (1933) has highlighted the vital role of reflection in learning through experience. Since learning is intrinsically bound with reflection and reflection is largely a response of the learner to experience, it follows that the type of experiences, and the quality of experiences, influence learning (Dewey, 1933).

Experience for Dewey was not just about doing things but involved the active processes of reflective thinking. He refers to conscious reflective activity as involving

reflection at various points throughout the learning process: at the start in anticipation of the experience, during experience, and following experience during a writing and consolidation phase. In the context of bioethical issues, previous experiences from outside of schooling, as well as those provided in the classroom, play a part in the learning process.

My own approach to teaching has been heavily influenced by constructivist paradigms, the main tenets of which have influenced and driven my choice of teaching methods and hence experiences I provide my students. Principally, I consider that active participation is powerful, and relevance and engagement with content are particularly important in learning. Social-constructivist principles also indicate that people can increase their learning potential through mediation and interaction with others (Vygotsky, 1978). It has also become apparent to me that it is crucial to provide experiences that promote self-questioning as a means to monitor and evaluate learning so that self-regulation is inherent in the learning process. Scardamalia, Bereiter and Lamon (1994) described intentional learning as occurring when learners purposefully put effort into tasks to achieve more than what was required by the immediate tasks. It is desirable to help students to be independent, self-motivated critical thinkers who are able to take responsibility for life-long learning. These fundamental principles drove this research project. The principles also drove the design of the intervention, in collaboration with the teacher in whose classroom the research was conducted.

1.6 Thesis Overview

This chapter has given an outline of the origins and purpose of the investigation. The focus is on exploring an intervention designed to:

- promote a more in-depth awareness of bioethical issues associated with cancer and;
- develop students' skills in researching and essay writing that might promote self-regulated learning.

Both of these aims are amenable to using reflection as a means for learning. The students' and the teacher's perspectives and my own observations and interpretations of the intervention are the central approaches used in the exploration.

Chapter 2 outlines research relevant to teaching and learning approaches in science, technology and society contexts in general, as well I discuss the teaching of social and ethical issues in particular. It expands on the tensions and difficulties facing teachers and students that have been mentioned in Section 1.1. This background helped to provide a framework for the types of activities and approaches used in the unit of work that comprised the intervention.

The theoretical principles underlying teaching and learning in science are discussed in Chapter 3. These have particular relevance to why activities were selected and approaches taken. In particular, constructivist principles are discussed. I also outline how metacognition is important in learning and how previous interventions have utilised procedures to enhance the use of metacognition. It is pertinent for this study to discuss the links between constructivist learning principles, learning strategies and self-directed/self-regulated learning. In Chapter 3 I also consider student, contextual and characteristics of teaching that can influence the implementation of the activities.

Chapter 4 describes the research process. It outlines how I investigated the research questions above. Chapter 4 discusses the appropriateness of the methods chosen and explains how design and sampling decisions were made. The descriptions include a rationale for the methodology, details of the methods used to collect the data, and how the various sources were analysed. In particular, I describe how I combined my data sources into metamatrices for each student, so that evidence from multiple sources could be compared more directly on a variety of learning themes.

The overall approach for this intervention is discussed in Chapter 5. The approach included actively exploring students' prior knowledge and developing inquiry processes, encouraging oral and written discourse and cueing or prompting students to evaluate their ideas about bioethical issues and about learning. The activities in this unit of work are described. The communication between participants and their views of their obligations are also highlighted as being important. Consequently, I discuss that how the classroom environment was established and maintained, was important in determining the social participation structure in this context.

Chapters 6 to 8 report the data obtained in this research. In Chapter 6, I present detailed evidence of students' thinking about the biological, social and ethical issues linked

with cancer. Since enhancing students' views on bioethical issues was one of the aims of the intervention, it was important to consider whether any changes had occurred. Examples of the personal and social relevance to the students are given. Students' perceptions of how the activities in the unit of work contributed to their thinking about the issues are also presented.

The other main aim was to promote students' skills in researching and essay writing. In Chapter 7 I have documented through triangulation the students' knowledge and use of learning strategies. These include declarative, procedural and metacognitive strategies. Some of these strategies were integral to and promoted as part of the unit, whereas other strategies had been developed by the students themselves. I explore the trends and patterns evident in this analysis and discuss the links between strategy knowledge, strategy use, some motivational aspects and the quality of essays produced. Additionally in Chapter 7, I consider the students' views on their own learning, and how the procedures and activities which targeted learning strategies, were received by the students.

Chapter 8 provides rich descriptions of 5 student case studies. These are discussed in order to exemplify ways in which students utilised or did not utilise their knowledge of the issues and knowledge of their learning processes. These cases are used to discuss students' learning characteristics that are considered important for enhancing self-directed learning as mentioned by Wang and Peverley (1986). These include learning awareness, use of learning strategies, monitoring progress, integrating and extending knowledge, and motivation. I use their essays to discuss how these students translated what they thought was required.

A discussion of the findings in relation to each research question and implications of these are given in Chapter 9. I also consider important factors relevant to the overall findings in terms of themes. The findings are discussed in relation to student learning and the implications for teaching about bioethical issues. Some of the subtleties that interact and impinge on my impressions of success are also discussed.

Chapter 10 summarises the conclusions that can be drawn from this research project.

Chapter 2 Perspectives on Teaching Bioethical Issues

2.1 Chapter Overview

This chapter considers both the problems involved in teaching about bioethical issues and the significance of such teaching. The literature provides a frame of reference for considering what classroom activities would be included and some important pedagogical considerations.

Section 2.2 discusses why teaching social and ethical issues in science contexts is important. A range of approaches for teaching about social and ethical issues is outlined in Section 2.3. The role of the teacher is centrally important because personally held ideas and beliefs are so much a part of this learning context. Affective aspects need to be explored, valued and accommodated as part of the overall approach when teaching social and ethical issues. I discuss how teachers may facilitate classroom procedures for an in-depth way of learning about bioethical issues in Section 2.4. Some of the concerns associated with assessment of social and ethical issues are associated with this multi-faceted nature of issues. I briefly discuss these in Section 2.5. The final section, 2.6, summarises the ideas in this chapter. In this section I propose that an inquiry approach combined with other activities to help with values clarification and values analysis might be useful for developing a more in-depth awareness of bioethical issues.

2.2 Reasons for Including Social and Ethical Issues in Science Contexts

Scientific and technological knowledge and capability has exploded over the last 20 years. Because of its impact, educators internationally have seen the need to incorporate social and ethical issues into science curricula (Layton, 1993) to try to keep discussion about the issues in pace with the scientific advances.

Recognition of the extraordinary transformation powers of biotechnological change over lifestyles and human values has highlighted a social concern for the control of new technologies. Discussions are widespread in the media, particularly concerning genetic developments and other social and ethical issues. These discussions are occurring at multiple levels, from individuals right through to national and international debates.

National guidelines and regulations relating to ethical procedures are being established in New Zealand. UNESCO considers that their universal and cultural role is to involve all countries in these debates. An international bioethics committee has been established to consider health and human safety issues related to the use of new technologies.

There has been a call for "accepting that exploring and resolving issues are the responsibility of everyone in a free and open society" (Galbraith, McClelland, McLeod, Johansson & Winter, 1997, p60).

There is no doubt that including social and ethical issues of biology contexts in biology teaching is essential. This was recognised in the current version of *Biology in the New Zealand Curriculum* (Ministry of Education, 1994), the prescribed curriculum for senior high school biology. The inclusion of objectives linked to social and ethical issues was instigated by the huge advances made in the life and health sciences in the last two decades. In particular, advances in molecular techniques have allowed huge progress in both genetics and medical interventions. These developments will affect our everyday lives and far reaching consequences on humankind (Van Rooy, 2000).

William Kyle is adamant about why we should include a social aspect to science education.

We have lost our sense of ethical responsibility to future generations... We must assume the ethical responsibility for investing in our children's future, or be willing to accept that our principle legacy to them is a world that is deteriorating ecologically, economically and disintegrating socially... We must ensure that science education enables students to change, transform and reinvent the world they are inheriting (Kyle, 1999, p. 260).

There are many reasons for including social and ethical issues into science curricula. These include: the development of informed citizenry, the fostering of attitudes such as care and responsibility through an increase in students' sensitivity to human rights and differing beliefs, provision of illustrations of the scientific paradigm, promotion of interest in science (and hence motivation), as a setting for problem-solving, reasoning and critical thinking and to help to develop intentional learning. These reasons are discussed separately below.

My point here is not that we should include social and ethical issues as part of biology teaching. This is taken as already widely accepted. Rather my point is to indicate

the strength of this importance, due to the currency, relevance and effect that decisions will have on our futures. These developments concern everybody and offer opportunities in an educational context to bring biological research and everyday experience together (Van Rooy, 2000).

2.2.1 The Development of Informed Citizenry

Social and ethical issues are deemed to be relevant to individuals and society as a whole (Cheek, 1992). Students should know how important it is for society to exercise its obligation to question the direction and principles that underlie future scientific endeavour. As future citizens, students will need to make decisions not only about their own directions but also about those that society should take. Through an increase in knowledge about the issues, students may be enabled to make more informed social and political decisions in the future (Fien & Williamson-Fien, 1996; Kolstø, 2001).

Many issues are shrouded by uncertainty due to the lack of sufficient scientific knowledge or knowledge about the effects of the technology. By inserting issues into science teaching programmes, students can be given opportunities to find out scientific information associated with the issues, or at least be led through processes that might allow them to find out in the future. This is important for their future considerations of the impact of science and technological advancements on their own lives (Mertens & Hendrix, 1990). Without sufficient information, it is difficult to make an informed judgement (Kolstø, 2001). Students need to be able to evaluate the evidence available, even if this generates more questions than answers.

What background knowledge is required to analyse issues then becomes a key question. The depth and extent of background knowledge required is often difficult to identify and may change with new technological advances. This may be a reason why the content associated with bioethical issues is not prescribed by the New Zealand curriculum documentation. One way to consider this issue of necessary content is to get students to use self-questioning strategies to help them focus on content through an inquiry process. Through this mode, issues analysis may encourage students to explore the associated science content that will help to develop informed citizenry (Solomon, 1993).

2.2.2 Fostering Attitudes of Care and Responsibility

One of the important outcomes of analysing bioethical issues is that students may see how dogmatism could influence how people make decisions. Through critical discussion, students may reject dogmatism. They may become more aware of the multiple social aspects of an issue through an increased sensitivity to human rights and differing beliefs. This can foster empathy and tolerance for others. The ethics of care, individual and social responsibility can be discussed. What individuals or society ought to do, or should consider, is important. There are no easy answers when it comes to evaluating values, morals and ethics. These are socially and politically embedded. However, if we are to foster a democratic, pluralist society, we must provide opportunities for discussing the disparity of views (Snook, 2000).

2.2.3 Providing Illustrations of the Scientific Paradigm

Lemke (2001) describes how the Western scientific paradigm professed to supply a valid approach to knowledge based on positivist approaches using instrumentation and technologies. He also discusses how this view of science and science education is changing to incorporate socio-cultural perspectives. It is important to ask whether school science can promote unsustainable claims that science has the power to explain and control (Jenkins, 1999).

Aikenhead (2000, p. 66) has also commented on the need to challenge the stereotypic view that science is

authoritarian, objective, purely rational, non-humanistic, purely empirical, universal, impersonal, socially sterile, and unencumbered by the vulgarity of human imagination, dogma, judgement, or cultural values, by providing illustrations of the broader influences on science.

Fensham (1992) has cautioned curriculum developers that some stakeholders, who have these stereotypic views, have a powerful influence. Often such stakeholders simply want science to act as society's screening device to maintain an intellectual, social elite. Although this view is not held by all science teachers, some of them may be among the strongest proponents, as shown in surveys carried out in the United States (Gallagher, 1991; Gaskell, 1992). Blake (1994, p. 387) elaborates these arguments by noting that

a science curriculum that is narrowed by the rigid epistemological categories required by a "modern" conceptualisation of science is not only an inaccurate depiction of the discipline but a curriculum designed for the capacities of a few...Such an outcome does not correspond to the goal of active and informed citizenship.

She goes on to assert that views of science which emphasise abstract, rational thinking must accommodate personal and affective aspects.

Several studies have shown a relationship between learners' beliefs about a discipline and the classroom procedures they consider appropriate (Schöenfeld, 1983). Including dialogic reasoning and argumentation about issues may challenge students' core beliefs about science and emphasise that science does involve consideration of social and ethical dimensions.

Conversely, students may include aspects of the nature of science when engaged in discourse on social and ethical issues, as shown in a study by Walker, Zeidler, Simmons and Ackett (2000) where the dialogic reasoning included evaluation of evidence and integrating multiple perspectives with students' own ideas. This suggests that through the insertion of issues, students may come to appreciate that science is value-laden, provisional and problematic (Hodson & Hodson, 1998; Van Rooy, 1993a).

2.2.4 Promotion of Interest in Science

If contexts for teaching science are used that are personally relevant to students, they are more likely to be interested in them (Wood, 1997). To foster this intrinsic interest, proponents for including social and ethical issues argue that units must include situations that are real, current, and relevant to the associated science content (Heath, 1992; Ramsey Hungerford & Volk, 1990). Teachers consider that students are more interested and hence more involved in science when controversial issues are included (McComas, 1993; Van Rooy, 1993a).

Van Rooy (1993a) mentions the energy students seem to have for controversial issues and that science teachers need to harness this to enhance learning in science. In my own classes I have observed that if the content material is personally relevant for students, motivational aspects related to learning, including energy levels and enthusiasm, are increased. Students may actually develop intrinsic interest in learning if a context has personal relevance.

2.2.5 Promotion of Problem-solving/ Reasoning Skills/ Critical Thinking

The inclusion of social and ethical issues in science courses provides contexts suitable for solving problems, developing evaluative processes and critical thinking. Heath (1992) notes that these skills include:

- developing "independence of mind" by evaluating one's own opinions and beliefs
- weighing up researched evidence (synthesis/analysis)
- detecting bias in information
- questioning the validity of sources and
- reasoned decision-making.

The consideration of issues challenges our values, especially when the issues are controversial. It requires individuals to reflect on their personal ideas and beliefs. An expanded awareness of the issues, combined with the questioning attitude which is required for the development of the skills just listed, promotes a healthy scepticism and critical thinking. Issues education is thought

to stimulate children to think, to improve their cognitive skills so that they reason well, to challenge them to think about significant concepts and yet develop their ability to think for themselves so that they think reasonably and responsibly (Lipman, 1987, p. 146).

Skills in reasoning rely on linking ideas and being able to justify or validate particular standpoints. The insertion of issues into science classrooms allows different types of knowledge to be linked or integrated, so that ultimately it might be more useable. The relationships between science, technology and society can be explored in this way, especially how what drives what is investigated in science, or developed in a technological sense, (that is, what public money is spent on) is inherently bound with the values of society.

When students use problem-solving, reasoning and critical thinking, they are developing skills to become independent, self-motivated, critical thinkers who are more likely to take responsibility for life-long learning (Brown & Campione, 1990).

When students ideas are valued, they can shift from "dualistic reasoning" where they believe there is always a right and wrong answer, to where the partial validity of contrasting interpretations can be considered (Rudduck, 1986).

2.2.6 Developing Intentional Learning

When interest in the content and the concomitant motivation is high, students may be more intentional in their learning (Brown & Campione, 1994). One way to respond to this in classrooms is to use content and activities that will arouse students' curiosity or appeal to their existing interests so that they spontaneously engage in intellectual effort (Scardamalia, Bereiter & Lamon, 1994). The idea is to get students to apply themselves seriously to school tasks.

In the last couple of decades, there has been a growing emphasis on active, self-conscious, self-directed and self-regulated learning. We know that learners have the potential to be introspective and can choose how they attack learning tasks. If students are given some choice in what they do, it helps them to develop an internal locus of control (Ramsey, et al. 1990). This may allow them to gain a sense of empowerment about the issue(s) as well as a sense of control over their own learning. Because one of the aims of the intervention in this present study was to help students to be more self-monitoring and self-regulating in their learning, I elaborate on ways this can be mediated in Chapter 3.

Contexts most suitable for using reflective learning procedures are those perceived by students to have some personal relevance (Baird & Mitchell, 1986; Gunstone & Baird, 1988; White, 1988; White & Gunstone, 1989). There is some evidence to suggest that in Japan, Australia and New Zealand, 17-18 year olds are concerned about bioethical issues (Macer, 1997). I give examples of how the students in the present study considered cancer issues to be personally relevant in Section 6.6.

2.3 Approaches for Teaching Programmes

There have been some guidelines developed for delivery and support for teaching effectively in the areas of social values and ethical issues across multiple curricula (Fraenkel, 1977; Lemin, Potts & Welsford, 1994). However there have been very few guidelines for specific approaches suitable for use with science contexts. What has been

advanced has been in the broader context of Science-Technology-Society (STS) curriculum and teaching. I will now discuss teaching approaches advanced in STS contexts, followed by a consideration of values-focussed approaches.

2.3.1 STS Approaches

The approaches used in STS curricula can be used as a guide for teaching about social and ethical issues. Some extensive reviews and guidelines on how to teach STS have been given by Aikenhead (2000), Cheek (1992) and Fensham (1988). They outline how issues associated with relating science and technology to society have been included in various teaching programmes around the world.

Aikenhead (2000) has outlined a scheme to illustrate the spectrum of ways in which STS has been infused into science courses. The distinctions in his 8 categories depend on the weighting given to societal aspects, both in the extent of inclusion and in assessment. At one extreme (category 1), connections between the science content and societal issues are mentioned merely to promote interest and motivation. The students are not assessed on the social content. It is not surprising then, that at this level, the societal aspects are not treated very seriously by either the students or the teacher. At the other extreme (category 8), a major technology or social issue is studied. The science content is only included to show the links with science. In this category, very little or no science content is assessed. The social issues are of prime importance. Aikenhead (2000) believes that the majority of courses taught around the world fall somewhere in the middle, in what he categorises as levels 3-5. I outline how the unit of work under investigation here can be categorised as level 4 in Section 3.2.

A variety of instructional procedures have been used to teach (STS) issues since their initial use in teaching programmes in the late 1970's. These include motivational descriptive accounts of technology in action, factual references and exercises based on selected examples of related technology (Hunt, 1988), thematic or context approaches (eg. Dawson, 1996) and systematic learning about one or more societal aspects of a major technology (eg. Lucassen, 1995). Other examples are incorporating vignettes (eg. Brinckershoff, 1990; Van Rooy, 2000), case studies, debates, surveys, oral presentations and written reports (eg. Jarvis, Hickford & Conner, 1998) and scenarios (eg. Van Rooy,

1994). These approaches were used to promote student questioning and decision-making about societal issues.

Many of these teaching and learning procedures, by themselves, do not delve into the social and ethical components in very much depth. They merely provide examples, rather than looking at the issues from multiple perspectives, and do not employ long-term investigations. There is some evidence, noted below, to suggest that these types of procedures that use examples here and there, have no effect on either students' learning of the associated scientific concepts or their regard for social and ethical issues.

Two studies carried out by Rubba, McGuyer and Wahlund (1991) showed that inserting STS vignettes into an otherwise conventional science curriculum had no effect on students' awareness of issues, the perceived importance students assigned to current STS issues or their achievement levels in a unit on genetics, as measured by teacher-made tests. This may be a function of the assessment items, but Rubba et al. (1991) do not mention this. When some of these types of methods are used in isolation, they merely include a social or ethical component "on the run", as a series of sidelong glances during the main pursuit of the real objective, to understand scientific conceptual knowledge. The argument that including issues somehow enhances motivation and achievement in science is not necessarily true (Cheek, 1992). The degree to which societal aspects are given real importance, not only in the teaching programme, but also in assessment is a significant factor in the enhancement of motivation and achievement (Aikenhead, 2000).

Fleming (1986) found that students approach socio-scientific issues primarily from their own social constructions of the world. These include the psychological domain (self, identity and cause of one's own and others' behaviour), moral domain (justice and fairness), and societal domain (social regulation and organisation). Fleming suggests that teaching materials should be structured to access and stimulate this social construction. He also emphasises that students already have ideas about the social side of particular issues.

It is pointless to suggest to students that they "hold back" their social judgements until they "know more" for they are already dealing with the issue albeit from a cognitive domain not traditionally dealt with by many science teachers (Fleming, 1986, p. 686).

As suggested by the above quote, approaches used to address bioethical components of science curricula have developed in a similar way to the approaches used in the social sciences. These include recognition of social constructions to varying extents. The decision-making framework derived from academic approaches to bioethics, such as consideration of autonomy (the right to choose), beneficence (promote good), non-maleficence (avoid harm) and justice (fairness) (Beauchamp & Childress, 1994), is not a focus of the approaches considered below, although these ideas may arise through analysis. Rather, the approaches below draw on constructivist tenets that explore students' prior knowledge and endeavour to build on this. The approaches are considered under the following headings: values clarification, values analysis, moral reasoning and inquiry-based approaches.

2.3.2 Values Clarification

Values clarification is a way to access students' social constructions. It aims to help students reflect on their own individual values, and to make values choices based on implications, in a non-judgemental environment. Mertens and Hendrix (1982) provide an example of this approach. Students usually choose a position on a continuum which best fits their value judgement on alternatives. Other procedures include agree/disagree, questions or ranking exercises. It is important for students to identify where they stand in regard to a particular issue. These techniques require teachers to acknowledge individual standpoints. However, the basic relativism underlying value clarification as a model is open to serious criticism (Fraenkel, 1977). How should teachers deal with conflicting values? If all values are accepted, the message given to students is that we do not need to base decisions on commonly accepted and/or justified reasons/morals/laws. Even so, values do need to be clarified. Values clarification by itself does not acknowledge how multiple views can be accommodated within universal norms. The acceptance of all values would be similar to giving credibility to uninformed personal choice. Therefore there is a need to extend this approach and combine it with others discussed below.

2.3.2 Values Analysis

Values analysis involves students gathering data from a wide range of sources and using a structured reasoning process followed by discussion to analyse evidence on values issues in a logical way. Although it is accepted that there is no "right" answer, the objective of this model is to help students exercise reason and to make the most defensible value judgement. There are several procedures that belong to this model. Specific dilemmas can be given to students (vignettes or case studies) to provide a stimulus and a specific context for analysis. Other procedures such as "risk /benefit" and "advantage/ disadvantage" tables, have been described by Butterfield (1987). Weighing up background factors by using mnemonics, for example "Plus/Minus/Interesting" (PMI) and "Consider All Factors" (CAF) have been described by De Bono (1992). This model is useful in that multiple perspectives related to the background information for specific situations can be analysed. However, "weighing up the balance" can often be difficult in some issues.

Critical thinking or evaluating knowledge claims and ideas is a strong component of values analysis. One of the best ways to enculture students into this way of thinking is for teachers to model it (Lipman, 1987). They can use talk aloud procedures to let students "in" on their thinking, give examples of critical questioning processes or back up knowledge claims with reasons (Geddis, 1991).

Where discussions are used as part of values analysis, students are able to air their views and therefore are more likely to be aware of others' opinions as Oser (1986) has advocated for moral and values education. When verbal interaction is used to help students develop an understanding, the idea is to promote reciprocal recognition of claims. If students claim truth and rightness, discussion may allow these ideas to be challenged. Discourse has been identified as the interactional instrument to develop critical thinking competencies (Oser, 1986) through the use of complex explanation and argument.

2.3.4 Moral Reasoning

This approach draws on Kohlberg's stage theory (1973) of moral development. It encourages the discussion of reasons for values positions and choices so as to facilitate growth in moral reasoning ability. Butterfield (1987) described a procedure that helps students decide "what should I do?" This involves listing alternative courses of action, projecting consequences from those alternatives and deciding which of the consequences

are not desirable. This approach is persuasive and it appeals to classroom teachers, particularly because it emphasises that the movement through the stages of moral development is a natural process that teachers can assist by promoting the discussion of moral dilemmas (Duska & Whelan, 1975). Nevertheless, the approach has not been widely adopted, because it makes assumptions about a universal, normative-ethical and cross-cultural basis of stages in the hierarchy of moral development. Carol Gilligan (1982) also points out that Kohlberg's stages do not include the female perspectives of relationship and responsibility. Furthermore, the small number of cultures that Kohlberg used cannot endorse his sweeping conclusions about the concept of justice being fundamental to reasoning in the higher stages of development for *all* people in *all* cultures (Fraenkel, 1977). The hierarchial nature of the stages Kohlberg suggests is also questionable. That *higher is better*, seems impossible to prove. And if *higher* is not *better*, then there does not seem to be any justification for trying to "improve" the reasoning of children by helping them move through the stages. Other concerns about using a moral reasoning approach are linked to the teacher acting as an authoritarian, where they have preconceived ideas about the reasoning and the possibility of imposing his/her own moral values.

Further, moral reasoning is only one of the domains of social cognition used for reasoning in socio-science (Fleming, 1986). There are some suggestions that a moral consensus should be reached through discussion. However we have to be cautious if consensus is our goal, simply because it may be linked to indoctrination. To indoctrinate is to try to by pass rational acceptance which would violate human dignity (Snook, 2000). Perhaps it would be better to discuss the values that divide us; it is conflict, not consensus which marks values dimensions. Students in schools should be given opportunities to confront these conflicts and learn to handle them in rational and tolerant ways (Snook, 2000).

2.3.5 *Inquiry Approaches*

More recently, inquiry approaches, which also develop information processing skills related to researching and writing, have been advocated (Armstrong & Weber, 1991; Conner, 2000; Dawson, 1996; Jarvis et al., 1998). These approaches include a range of activities, but rely more on a research process to facilitate students' inquiry. The rationale behind using an independent-inquiry approach is that if values were taught didactically

they may not be internalised (Fisher, 1998). Inquiry can be conducted both individually or collaboratively.

Collaborative group investigation or inquiry in the broadest sense (inquiry into affective dimensions as well as facts) seems to support student learning in socio-science areas (Solomon, 1991). Working collaboratively allows students to explore their existing views, which is considered essential in issues education (Cheek, 1992). It also allows for explicitly connecting new information to existing ideas through dialogic means with peers and the teacher (Tsai, 2002). Vygotsky (1978) reminds us that our intellectual range can always be extended through the mediation and interaction with others. Fisher (1998) uses Habermas' argument that moral judgement is best developed through conversation, where socially accepted norms are discussed. The idea is not to find universal laws but rather a general law that can be agreed upon by members of the community. This allows variance from given rules and frees thinking from mindless relativism that suggests there are no norms at all.

Research and investigation using a range of artefacts (text, videos, electronic resources) can be part of the processes that assist with critical thinking such as evaluating sources of information and weighing up advantages and disadvantages of specific decisions or actions. Constructivism assumes that meaningful learning takes place when students construct their own meaning (Gunstone, 2000). There is scope within inquiry for construction to be socially mediated before it is internalised by the individual. Indeed writings about constructivism have increasingly argued over the last decade that such social mediation is a central component of individual construction. This can occur through socially interactive learning experiences, reflection, and using the scientific content in everyday contexts (Aikenhead, 1992).

From this perspective, teaching takes the form of facilitation where content is acquired on a need-to-know basis. The students generate their own questions to drive their inquiries. Student expertise is fostered and valued by the community. This type of learning community has been shown to improve the students' thinking skills and their domain-specific content knowledge (Brown & Campione, 1990, 1994).

In setting up learning communities, we make assumptions that children are able to work within them. To do this they need to be able to engender care for one another as

persons with rights and be tolerant of the views and feelings of others. We also make assumptions about the ability of children to commit themselves to objectivity, impartiality, consistency and reasonableness. The latter has social, moral and political implications (Sharp, 1987) and may be difficult for some students.

To a certain extent, the unit of work that was the intervention in the present research was set up in a learning community environment. The activities were mostly student-centred and required students to be active participants (see Chapter 5). Students were encouraged to discuss the issues and work collaboratively. Reflective aspects were incorporated into activities, to take account of developments in the cognitive sciences that allow students to be more in control of their own learning (Hurd, 1991).

2.4 Facilitation of the Classroom Procedures

Not only does the consideration of socio-scientific issues challenge the traditional view of science, but it also challenges teachers to re-examine their roles as science teachers. The challenge is to present the values that expose science as having conditional elements, that is recognise that often there are value-laden and contestable aspects to science.

Teachers in New Zealand have professional freedom to choose what and how they teach within the confines of the curriculum documentation. Science teachers have their own ideas about what constitutes appropriate content, instruction and assessment. Teacher understanding and interpretation of curriculum guidelines is arguably the most influential force in what occurs in the classroom (Welch, 1969). It is imperative then that teachers have ownership over what they teach. This is why it was important for the class teacher to be instrumental in what was delivered in the unit of work in the present study.

The predominant professional paradigm of science teaching has been an authoritarian one. The teacher had "authority" through the power of delivering and explaining the knowledge. So in the past it was appropriate to use teacher-directed approaches. However, in issues education, the content or answers are not clearly definable. It is not appropriate to use an authoritarian approach. Rather, students' ideas need to be valued. Therefore a student-centred approach is desirable (Aikenhead, 2000; Cheek, 1992).

The classroom climate needs to be "open" to allow students the freedom to reflect on and express their ideas, and allow them to hear various viewpoints. One of the aims is to develop autonomy of thinking. This requires the teacher to act as a facilitator rather than an authoritarian so that ideas are constructed rather than imposed. Such an approach is also consistent with the pre-requisites for reflective and self-directed/ self-regulated learning to occur (Winne, 1996). Teachers need to be constructive, positive, tolerant and non-judgemental in their approach, so they do not have hidden or covert agendas (Van Rooy, 1993b).

Teachers also need to be aware that, often, classroom discussions on bioethical issues result in unfocussed emotional expressions of opinion with no or little regard for clarification or critical reasoning (Mertens & Hendrix, 1990). Although teachers should be both honest and suspend judgements about student views, students need to know that when their decisions do not conform to societal norms there are consequences. This also requires an ability among both students and teachers to separate intellectual responses from emotional ones. Other problems related to how students behave during discussions have been indicated by Rudduck (1986). These include:

- students' tendencies to depend on the teacher rather than taking their own initiatives or being prepared to learn from each other
- dominant students who command attention
- individual students who are used by the group as scapegoats or who become the subject of ridicule
- silent students or isolates
- polarisation of male/female views
- acceptance of an over-easy consensus
- escape- i.e. attempts to avoid facing difficult issues
- use of the group by a pupil, for personal ends
- attention-seeking, usually through the adoption of bizarre roles
- conflict rather than co-operation.

The teacher needs to be aware of these potential problems. Mutual respect between the teacher and students and amongst students may be crucial for these kinds of problems to be dealt with (Sharp, 1987).

During discussions, teachers can make their own contribution to content, but because of their pedagogic authority, they should be aware of the influence their "voice" can have (Veugelers, 2000). Teachers cannot actually remain neutral with regard to expressing certain values. Students want to know what opinions the teachers hold. This means that teachers need to reflect on their own values and help students to be aware of other points of view. Veugelers (2000) has shown that students prefer a strategy (approach) in which teachers express differences, but are clear about their own values. Finding the balance in the way they show different perspectives is a real challenge (Aikenhead 1988; Mertens and Hendrix, 1990).

Another challenge is to foster critical awareness in students. Paul (1987) states that for teachers to encourage critical thinking, they must themselves value critical thinking. That is, they must be comfortable and experienced with critical discussion, critical reflection and critical inquiry. This involves teachers being willing to acknowledge their own gaps in knowledge, their biases and their interpretations. They need to model how to be critical and reflective. However it is often difficult for teachers to be objective about their own opinions and provide balanced views (Van Rooy, 1994).

2.5 Assessment Issues

What is assessed tends to drive approaches to learning (Biggs & Moore, 1993). Therefore the relative importance of biological content versus social and ethical issues in an assessment may influence students' and teachers' perceptions of what is important (Aikenhead, 2000).

There are problems with developing assessments of thinking that involve nuance, judgement, and weighing of alternatives rather than fixed answers. They require assessment techniques that themselves depend on judgement and that are open to alternative interpretations. This is the case for assessing social and ethical issues.

Some of the difficulties and dilemmas surrounding the teaching and learning in these contexts stem from a lack of clarity about what we expect students to demonstrate if they have met goals such as those outlined in Section 2.2. O'Loughlin (1992) asks us to question "Whose knowledge is privileged in the assessment? Whose goals define the criteria for evaluation? How are those goals derived?" Teachers have found it difficult to articulate what they expect for the assessment of critical thinking or reasoned arguments.

If assessment practices are to be used as part of the learning, then it is important that students get feedback on their progress. This can be through the community of learners or directly with the teacher. Students need to get feedback in order to monitor and plan future activities.

There is a need to have some evidence of student thinking, and how they perceive the issues. Aikenhead (1988) conducted a study which compared different ways of assessing students' understanding about biological ideas in STS contexts. He found that standardized instruments such as Lickert-type responses and multiple choice tests showed a high level of ambiguity when compared with students' views expressed in interviews. When students were asked to write paragraphs to explain their reasons for their answers, he discovered that students interpreted the questions differently to the teachers' intentions (Aikenhead, 1988). Another problem with using paragraph writing to assess and evaluate student learning was that students did not have sufficient writing skills or they found it difficult to clearly record and give thorough written accounts of their views. This suggests that ambiguity between what students write and what they say, may either be a result of their lack of understanding or that limitations in their writing (composing) skills prevented them writing accurate representations of their thinking. Aikenhead (1988) cites a similar study by Yaroch in which students tended to understate, and sometimes not state, what they knew.

In New Zealand, summative assessment has traditionally been linked to the way in which exams have been assessed externally. Teachers usually use marking schedules from previous exam papers to help quantify and allocate marks to essays. Categories for critical thinking aspects have not been well defined in examination schedules. Consequently teachers have not known exactly what was required.

2.6 Summary of Perspectives on Teaching Social and Ethical Issues

This chapter has covered how approaches to teaching values and issues in Science, Technology and Society can contribute to the unit of work under investigation. These approaches have associated with them a range of classroom procedures that, by themselves, only skim the surface of the exploration of social and ethical issues. Barman and Hendrix (1983), Grant, Johnson and Sanders (1991) and Devlin (1992) have outlined procedures that include aspects of all three of the above models to varying degrees, but even these have not been widely adopted because of the dilemmas associated with teaching values (see Section 1.3.1), particularly because of the high level of ambiguity, emotions and values/morals.

Teachers tend to make assumptions that students have similar community and possibly altruistic motivations to their own. Unfortunately, many people in our society (including students in classrooms) are motivated by self-interest. This is a reflection of a change in value systems to a business model rather than a humanistic model in schools, business and society as a whole (Snook, 2000). We have been encouraged to look out for ourselves and idealism has been cast aside. What makes the dilemmas so powerful is that students' ideas have been taken up from the fundamental values of the society in which they live. Students see that what wins out in our society is power and money, not rational argument. Huge changes in societal value systems would need to take place before the dilemmas associated with teaching social and ethical issues could be adequately addressed.

Given the limitations of the approaches discussed in this chapter, there is a need to consider what might be useful for a teaching programme. As mentioned previously, an evaluative approach where students share their thinking in a community of inquiry seems promising. Such an approach allows for a range of procedures to be included to provide sufficient depth of content, yet incorporate the social cognitive dimension that is necessary for considering issues (Rudduck, 1986). It can allow student choice, and dialogic interaction to develop reasoning and critical thinking.

The main concern about using an independent inquiry approach stems from the difficulty in moving students from a mode of teaching and learning that they have been accustomed to in previous biology class settings. In order to be more aware of the complexity of bioethical issues, students need to move from the "dualistic reasoning" of

more traditional science teaching and learning to a pluralistic mode (Aikenhead, 2000). An inquiry approach can incorporate some of the teaching procedures to help develop informed citizenry, attitudes of care and responsibility, promote interest in science and to help to develop intentional learning as discussed in Section 2.2. Aspects of value clarification and values analysis can be incorporated to foster the ways students learn and the awareness of a range of viewpoints on values. It could model what a pluralist society might be like, that is one that recognises and respects traditions and tries to move beyond them by revising them in the light of changing circumstances and more inclusive understandings (Snook, 2000).

Even so, once students move into accepting multiple options, these need to be based on specific situations (Snook, 2000). Decisions about issues will rely on the contextual examples and there may be partial validity in accepting a range of options (Rudduck, 1986). Part of the problem when choosing approaches and activities to deal with bioethical issues, is to strike the balance between general affective components that guide social decision-making and specific examples which make the issues concrete. It is the specificity of examples that allows students to examine the conditional aspects related to issues. Therefore it is important to include specific cases, scenarios and questions where students are required to get involved in order to make personal choices. This would render the issues more personally relevant and students may be more likely to challenge the accepted options.

Van Rooy (1993b) recommends:

- start with student interest;
- find out what the students' current level of understanding is because this can be used to further construct ideas and beliefs;
- use knowledge about how students learn and how they generate their own meanings and
- teach students to think, doubt and question rather than to accept knowledge indisputably.

Aspects of teaching and learning about bioethical issues in this intervention are central to the research discussed in this thesis. The ideas given in this chapter and in Chapter 3 (Perspectives on Learning) were incorporated as much as possible into the

approach and activities used. A description of the approach and details of the classroom activities are given in Chapter 5.

Chapter 3 Perspectives on Learning

3.1 Overview of the Chapter

Our understanding of human learning has advanced greatly over the last three decades due to the extent of research on the processes of thinking and learning, the development of intellectual competencies and, in particular, the characteristics of organised knowledge. In this chapter, I consider some of the literature concerned with some of these perspectives on learning. I use this literature to describe how evaluative learning processes are fundamental for the active construction of meaning.

The theoretical ideas given in this chapter provide a framework for the pedagogical practices that may help to develop more effective ways of learning. They also give a background for analysing and interpreting the findings of this study.

The chapter begins with a discussion of aspects of constructivism. An underlying assumption of constructivism is that learners actively construct and manage their own learning. I outline the principles of constructivism in Section 3.2. The fundamental role of reflection in constructing meaning is discussed in Section 3.3. How metacognition contributes to learning is considered in Section 3.4. In particular, I discuss aspects of metacognition that can promote more effective learning, three specific interventions in secondary schools, the importance of content and the learning context to the development of metacognition, and how inquiry and writing as contexts can be used to promote metacognitive processes.

One issue central to the consideration of metacognition is evaluation. Evaluation can be a useful descriptor to encompass a range of learning processes. These include searching, identifying, reflecting, appraising, planning, monitoring and checking because all of these processes lead to decision-making regarding what and how to proceed in learning situations. Purposeful self-questioning is also very important in all of these processes. Making decisions (that is actively evaluating what is needed in terms of content and processes) for more effective learning requires a goal or an intention. Therefore, intentional and self-regulated learning are discussed in Section 3.5. In Section 3.6, I

consider some other factors that can influence learning - students' motivation, the influence of learning environments, and the role of the teacher.

The chapter is summarised in Section 3.7 where I propose the notion of *evaluative constructivism* as being useful for describing the use of purposeful cognitive and metacognitive processes to construct meaning.

3.2 Principles of Constructivism

3.2.1 General Principles of Constructivism

Science education over the last thirty years or so has been strongly influenced by constructivist paradigms of learning (Gunstone, 2000). Constructivism is a theory that provides a framework for how people learn and "about how those who help people to learn ought to teach" (Phillips, 2000, p.7). When people use experience, common sense, evidence, logic and theories to make sense of the world, they are constructing meaning (Solomon, 2000). A constructivist approach emphasizes that learners actively participate in experiences to make meaning out of them, so that they adapt and alter the educative event to fit it with schemas or past versions of their world view (Driver, 1997). McCarty and Schwandt (2000, p. 197) have expressed this as:

Constructivism means that human beings do not find or discover knowledge so much as we construct or make it. We invent concepts, models, schemes to make sense of experience, and we continually test and modify these constructions in the light of new experience. Furthermore, there is an inevitable historical and socio-cultural dimension to this construction. We do not construct our interpretations in isolation but against a backdrop of shared understandings, practices, language, and so forth.

Constructivism is a way of describing how people derive meanings or interpretations from experiences. Cognitive theories of learning have helped to differentiate some specific components of knowledge that can be constructed. In his theory of cognitive learning, Gagné (1985) distinguished between declarative knowledge ("knowing that") and procedural knowledge ("knowing how"). A third category, conditional knowledge, includes "knowing when or why" (Paris, Lipson & Wixson, 1983). These three categories provide a useful framework for identifying knowledge components that can all be constructed. It is

often not acknowledged in research on constructivism that all of these knowledge types are constructed (particularly conditional knowledge).

Ausubel (1968) noted that for learners to substantively incorporate new ideas meaningfully, three criteria must be met: the material itself must have potential meaning; the learner must already possess relevant concepts to anchor the new ideas; and she or he must voluntarily choose to incorporate the new knowledge in a non-arbitrary, non-verbatim fashion. This implies that content, identifying and analysing prior knowledge and choice are very important in learning meaningfully.

Helping students to recognize and build on previous knowledge is a crucial goal of constructivist teaching, whether this is related to facts (declarative knowledge), process skills (procedural knowledge) or conditional knowledge (metacognition or self-monitoring/self-regulation). I discuss this further in Section 3.2.2.

The total number of influences on individual cognitions is huge. There are also many interactive effects between content, prior knowledge, and a contextual variables to do with how new knowledge is mediated and the consequent decisions learners make. What students already know will influence their interpretations of new experiences. The content context and learning environment variables make a difference as to how students engage with activities and internalise knowledge. I expand on these ideas in later sections in this chapter. What this means is that the potential interactions could pose enormous constraints on a research approach. How could a researcher possibly take all factors into consideration? The best we can do is to analyse some constituents that have valid reasons for being most influential in a particular context, and acknowledge that there are assumptions made about the influences of other factors. As Nickerson (1993, pp. 233-234) has stated,

if we were able – and we are not – to represent the knowledge of a single individual in such a way as to do justice to its richness and breadth, its various degrees of specificity and certainty, its mix of explicitly included facts and beliefs, its inconsistencies and contradiction, and its understanding, more or less, of countless concepts, principles, relationships, and processes, it would be a complex representation indeed.

Affective elements do influence how people make judgements and they particularly need to be considered in contexts involving issues (Cheek, 1992). Teachers and individual students may develop different meanings for the same material, and certainly interpret the

goals of what is required or the purpose of the task differently (Osborne and Gilbert, 1979). Therefore, when considering the learning of social/ethical issues in science, it would be prudent to allow students' own ideas to be explored in terms of the scientific content and their values and beliefs from a social perspective. I have already outlined how this is an integral feature for learning about social and ethical issues in chapter 2.

Teachers or teaching methods *per se* do not change students' ideas. It is the interpretation of information generated as a result of experiences that leads to the construction of meaning. Students' beliefs about knowledge are important here. If they consider that there is only a single right answer, then they may wait to find out "the answer" from the teacher or the text or other source, which can then be memorised and repeated in the subsequent assessment. In a constructivist approach, students need to understand that their role is to make their own constructions.

From the research on how to address conceptual change (Gunstone, Gray, & Searle, 1992; Posner, Strike, Hewson, & Gertzog, 1982) we know that students are more likely to address their "misconceptions" if they are provided with cognitive conflict strategies. Unfortunately, when there is a contradiction of ideas with their own (which is likely when dealing with affective components of bioethical issues), they may perceive this as "something beyond their understanding". They need to be reassured that there might be multiple answers, and that their opinions count (Rudduck, 1986). In order for the teacher to infer how they are thinking, students need to communicate their interpretations.

This research project is underpinned by the idea of trying to develop teaching and learning procedures to help students become aware of ways to make their learning more effective. In developing the classroom activities for this research intervention, I was aware that active construction of knowledge requires energy and effort and hence time. Students will not construct declarative, procedural or conditional knowledge unless they actively use cognitive processes. The classroom procedures needed to incorporate ways to help students be more active in their knowledge construction so that students developed and used ways to help them learn more effectively. If students believe they have the "tools" (knowledge of procedures) or skills to add to or modify their knowledge, they are more likely to invest effort and time to use them (Kluwe, 1982).

3.2.2 *The Role of Prior Knowledge in Constructivism*

Constructivism acknowledges that learning is a cumulative process that involves adding new knowledge to existing knowledge. Students do not enter a learning situation without any background whatsoever. Ausubel (1968) considered that an important factor that influences learning is what the learner already knows. This idea was extended in Rosalind Driver's work on students' conceptions of science (Driver, 1981). She found that students' learning depended on their existing ideas and beliefs. Students have social constructions, derived from informal learning and their everyday experiences (Driver, Asoko, Leach, Mortimer & Scott, 1994). This is especially important in a domain such as bioethical issues (Fleming, 1986) where students may have formed opinions about the issue being discussed. Anchoring learning in specific situations that have personal relevance is more likely to access a critical source of meaning for learners. This is because it allows learners to make connections with personal experiences (Wertsch, 1991). There is evidence that learning is enhanced when the content context used allows students to make connections with previous academic or personal experiences (Wood, 1997). Therefore in the intervention that was the focus of the present research, it was essential to explore students' personal ideas about the issues so that they could make connections with their personal experiences.

Prior knowledge is likely to influence not only learning of content (declarative knowledge) but also encompass the domains of procedural and conditional knowledge, especially since these knowledge domains are likely to interact with each other. Learners need to acquire facts or concepts and be able to manipulate them through processes, or visa versa. There is certain background knowledge needed of both content and processes, to make this happen. Therefore, to some extent, what students can learn depends on what they already know and how that knowledge enables or impedes future learning (Bruer, 1994).

In order to generate knowledge, people need to actively engage with their existing knowledge and use their experience to integrate and extend this information (Wittrock, 1994). As part of the teaching then, it is important to include ways of establishing what students already know in terms of content and procedures so there can be a focus on the critical features needed to make learning tasks effective (Shuell, 1988).

The work of Driver (1981) and Osborne & Gilbert (1979) has shown that if the prior content knowledge is inconsistent with the scientific concept, then the student may focus on an alternative non-scientific concept. I suggest that prior knowledge of learning procedures will also influence learners' interpretations of what is required for learning. This influence may be a little more complicated though. Whereas scientific concepts tend to be definable in terms of scientific interpretation, procedural and conditional knowledge could have multiple appropriate methods. Often there is not one right way of proceeding with a task, but rather, alternative or more efficient ways of processing information and several ways may be just as effective. Similarly, it is feasible that students may develop their own more suitable strategies for learning.

Individuals have implicit knowledge about the nature of learning, learning strategies and personal learning characteristics. Over the last couple of decades, the drive has been to make this knowledge more explicit and therefore more accessible to learners (National Research Council, 1999). One of the most powerful ideas in education at the end of the 20th century was that students can learn (and hence be taught) to be more effective in the way they process information. As a result, a range of teaching methods have been developed that teach cognitive processes through increasing students' knowledge of learning strategies (Mayer, 2001). I expand on this in Section 3.5.

Resnick (1987) emphasises that part of the role of formal education should be to provide opportunities for learners to apply thinking processes widely and frequently. I would add that thinking processes should be directed at enabling accrual of declarative knowledge but also procedural and conditional knowledge. This includes the explicit teaching of learning strategies to help students address challenges that tasks incite, anticipate difficulties, evaluate feedback and gauge their own progress.

Previous research on learning strategy knowledge indicates that it is not enough simply to know the strategies (McKeachie, Pintrich & Lin, 1985). Students must also be motivated to use the strategies in flexible ways. Motivation to expend energy, effort and time to use learning strategies and consequent achievement seems to be strongly linked to learners' beliefs about learning (Dweck & Elliot, 1983; Edmonson & Novak, 1993). Through an evaluation of their existing beliefs, and by being guided to consider what they know and can do, students can move forward to re-construct meanings for content and the

processes of learning. If students lack knowledge of their own learning strengths and weaknesses or lack an understanding of how they come to know, they can hardly be expected to be reflective on utilising this knowledge to their own advantage by choosing or developing learning strategies (National Research Council, 1999). This is why evaluation as a notion linked to constructivism is so important because it refocuses attention on accessing and assessing prior knowledge to establish the consequent learning needs.

The students in this research study already had knowledge about cancer and an awareness of their learning processes. The aim was to build on students' prior knowledge through sensitive choice of activities to enable students to develop their repertoires of learning capabilities.

3.2.3 Mediation of Construction by Artefacts or Other People

Learning can be mediated by artefacts or other people. The collaborative nature of learning and hence its social mediation has a huge influence on what and how people learn (Egan, 1997; Marton & Booth, 1997; Wertsch, 1991). Substantial weight has been given to the role of social interaction in teaching and learning science (Lemke, 2001). This is because science is seen as a very human activity that distributes cognition between people and artefacts and amongst people. Also our lives are entwined with the associated languages, belief systems, value systems and specialised discourses needed for sense-making of scientific endeavours (O'Loughlin, 1992). The notion of distributed cognition comprises the sharing of ideas, experiences, successes, failures and ideas for next steps, for making meaning socially. There is some evidence to suggest that this can be an effective mechanism for classroom learning in constructivist approaches (National Research Council, 1999; Brown & Campione, 1994).

This view stems from socio-cultural theory which asserts that all human activity has multiple inputs, as described by Lemke (2001, p. 297). These inputs include:

the psychological to the interactional to the organisational to the ecological How we learn, how we talk and graph and walk and dance, what we believe and what we value are all both unique to us and to each occasion, but also usually somehow typical of people who have led lives like ours: people of our time and place, of our gender, class, and race.

Vygotsky saw the use of language, where individuals interact dialogically, share and discuss their views and beliefs to construct meaning, as being central and necessary to learning (Vygotsky, 1978). One aspect of his concept of the *Zone of Proximal Development* (ZPD) is the gap between what a learner can achieve alone and what they can achieve under the guidance or in collaboration with a more able peer or adult. "Scaffolding", a term coined by Wood, Bruner and Ross (1976), refers to a more able person guiding or enabling a learner to build new knowledge on prior knowledge. Wood et al. (1976) outlined how a teacher may provide such guidance through:

- Recruitment of the child's interest;
- Establishing and maintaining an orientation to task related goals;
- Highlighting critical features, that a child might overlook;
- Demonstrating how to achieve goals;
- Helping to control frustration, to avoid, at one extreme, being left alone to struggle with too much complexity and, at the other, having too little scope for involvement.

The ideas about how learning can be guided and supported ("scaffolded") through intellectual tools like language (Brown, Ash, Rutherford, Nakagawa, Gordon & Campione, 1993; Wertsch, 1991), other more experienced minds, the surrounding culture, tools and artefacts have been extended through reinterpretation of Vygotsky's writings (Brown, et al., 1993). Social interaction is also likely to help students to practice and internalise habits of reflection (Vygotsky, 1978).

When children are given the opportunity to explain their ideas, and agree or disagree in pairs and small groups, they achieve higher levels of thinking compared with students who do not have this opportunity (Wheatley, 1991). The process of explaining something to someone else may allow students to re-conceptualise their views. They seem to be able to remember knowledge as a result of the discussion. Hendry (1996, p. 30) has stated this as follows.

A child is more likely to construct new ideas by evaluating his or her peers' shared and idiosyncratic views, and explaining his or her meanings to peers, than by being quiescent and listening solely to a teacher tell what he or she knows.

Working with others then is likely to allow individuals to take advantage of constructing meaning through the mediation of others. It may also allow students to see how multiple perspectives can be applied in evaluating one's own and others' work (White & Frederiksen, 1998).

Studies in science classrooms (Gunstone, McKittrick & Mulhall, 1999; Hogan, 1999a; Hogan, 1999b; Jones & Carter, 1998) have reiterated that discussions play a major role in students' construction of ideas, concepts and beliefs. Science teachers therefore need to validate students' personal ways of knowing by incorporating socio-cultural pedagogies to allow the mediation of construction (O'Loughlin, 1992).

Determining the balance between teacher inputs (modelling processes, verbal prompts and questions), questioning interactions between students and other mediational materials/methods, will depend on the objective of the course and the content.

If evaluation is central in learning activities then the forms of instructional materials need to support the evaluative nature of the approach. Existing materials may well be suitable, but need to be scrutinised for their suitability or otherwise modified. New materials may need to be developed to incorporate evaluative aspects such as prompting questions or cues for self-questioning (Beyer, 1997), as was the case in this intervention.

Instructional methods in line with constructivist learning might include cognitive modelling (through description, questioning and comparison), guided discovery and/or setting up collaborative environments for inquiry, where students are encouraged to discuss their ideas. In all of these methods, there is a student-centred focus that is derived from students' ideas, negotiated tasks, and where more responsibility is placed on the learner for their own learning.

The authoritative power of the teacher is deferred in this mode of practice (O'Loughlin, 1992). The teacher acting as a facilitator is a basic tenet of the generative model of learning (Cosgrove & Osborne, 1985), and is also fundamental in metacognitive

approaches or those directed for enhanced self-regulation. I discuss this further in Section 3.6.3.

3.3 Reflection as a Tool for Learning

The idea that reflection is essential for learning was proposed in the first edition of John Dewey's *How we think* in 1909, and reinforced in subsequent editions of the book (Dewey, 1933) (subtitled *A restatement of the relation of reflective thinking to the educative process*) and by others (for example, Boud, Keogh and Walker, 1985). There is a perceived obvious link between reflection and learning. Boud, Keogh and Walker (1985, p.19) describe this link.

Reflection is an important human activity in which people recapture their experience, think about it, mull it over and evaluate it. It is working with experience that is important in learning. The capacity to reflect is developed to different stages in different people and it may be this ability which characterises those who learn effectively from experience.

However, the precise processes involved are difficult to verify since reflection is "so integral to every aspect of learning that in some way it touches most of the processes of the mind" (Boud et al., 1985, p. 21).

There is agreement however that reflection is an active process (Baird, 1992). It involves both cognitive and affective components and provides information for purposeful action. The active role the learner takes in the construction of knowledge, through reflection, helps the learner to move toward meaningful learning (Edmonson & Novak, 1993).

For Dewey (1933), reflection was a process that can help people to consider puzzling situations because it can help to view problems from different perspectives. His idea of reflective thinking included what we would now call critical thinking and an element of judgement. The puzzlement or uncertainty of a situation is important, for without a "right" answer or any sense of doubt about a situation, there would be no need for reflection. There is uncertainty and ambiguity inherent in clarifying and analysing bioethical issues. This is precisely why reflection in an evaluative way is crucial for learning in bioethical contexts.

Reflection occurs naturally, but previous work has shown that learning in schools can be enhanced by actively teaching reflective practices (Baird & Mitchell, 1986; Baird,

1998). Research indicates that there are many reflective practices that we can use while engaged in thinking through tasks (Perkins, 1993; Pressley, Borkowski & Schneider, 1987).

These include:

- Talking to ourselves;
- Asking what we know and need to find out;
- Posing questions about content and process;
- Visualizing relationships with existing knowledge and
- Drawing our own conclusions.

Reflection can involve both cognitive and metacognitive processes. For example, reflection on declarative knowledge may be a cognitive process if it requires recall of facts or ideas, yet it can also be metacognitive if evaluation of those facts or ideas is required.

3.4 The Contribution of Metacognition to Learning

Metacognition is now widely recognised as an essential element in the development of general intellectual abilities (Brown, 1987; Perkins & Salomon, 1989) and as a means to improve academic achievement (Mayer & Wittrock, 1996). In this section, I first discuss general aspects related to the scope and breadth of metacognitive learning processes (Section 3.4.1). Then I use examples of interventions to illustrate practical aspects that need to be considered for more effective implementation in secondary school classrooms (Section 3.4.2). The influence of content and context on learning through metacognitive processes is considered in Section 3.4.3.

3.4.1 Aspects of Metacognition

One of the first descriptions of metacognition comes from Flavell (1976, p.232), who describes it as "one's knowledge concerning one's own cognitive processes and products or anything related to them". He also stated that metacognition includes "the active monitoring and consequent regulation and orchestration" of information processing activities (Flavell, 1976, p. 232). Baird (1990) extended these ideas and used the following description: "Metacognition refers to the knowledge, awareness and control of one's own learning" (p. 184).

Flavell (1976) identified three facets of metacognition: knowledge of processes of thinking; awareness of one's own processes; and ability to control them. A fourth facet, willingness to exercise that control, has also been identified as the means for employing effective strategies (Borkowski, Carr, Rellinger & Pressley, 1990; Gunstone & Baird, 1988; Paris, Lipson & Wixson, 1983; White, 1998). Posner et al. (1982) have also highlighted that learners need to see the "fruitfulness" or worth of the effort required to engage in a more metacognitive approach. The assigned level of "fruitfulness" (worth) will influence students' "willingness" to participate. "Willingness" has been linked to students' perceptions of the task demands (Bruer, 1994), and students' self-awareness, both of which will be discussed in more detail in Section 3.6.

Gunstone (1994, p.134) has described awareness as students' "perceptions of the purpose of the current teaching/learning activity, and of personal progress through that activity". It is likely that learners need to be aware of their learning tendencies before they can exert control over them. The description of metacognitive control has recently been broadened so that it not only refers to the decisions made and actions taken by learners, but also to the ability of students to modify metacognitive knowledge (Case, Gunstone & Lewis, 2001). Gunstone (1994) points out that all learners are metacognitive to some extent and therefore teaching and learning should be directed to *enhance* metacognition. After all, it is how students make use of their prior knowledge, by linking it with new knowledge through integration and extension, which drives their development (Gunstone, 1994).

Metacognition and metacognitive development involves multiple aspects as outlined by Gunstone (1994, p.133). He has described his conception of metacognition in ways that include:

Learners are appropriately metacognitive if they consciously undertake an informed and self-directed approach to recognizing, evaluating and deciding whether to reconstruct their ideas and beliefs.

An informed approach means that students know about how they learn, because this is important in directing, monitoring and evaluating their future learning processes. Unless they have a foundation of background knowledge, (whether it is declarative, procedural or conditional knowledge) they cannot reflect on it, add to it or modify it. In other words they

cannot evaluate their own learning processes and modify these, unless they know what they do, in terms of learning, in the first place.

Metacognitive development can therefore be described as a development of metacognitive processes to *enhance* existing knowledge, awareness and control of one's own learning. Many previous studies have shown that good learners have developed their metacognitive abilities and poor ones show low levels of metacognitive processing in relation to how they tackle learning tasks (for example, Baird, 1992; Shuell, 1988; Wang & Peeverley, 1986).

Further, some studies have shown that learning can be enhanced if students become more aware of and use metacognitive processes as a result of experiencing planned activities and through prompting by the teacher or other artefacts (Baird, 1998; Hacker, 1998; White & Gunstone, 1989, White & Frederiksen, 1998). It is through experiences that students may come to see the benefits of modifying their approaches. Experiences that lead to success are likely to be valued. However experiences alone may not be sufficient for strategies to be incorporated into the learning behaviours of students. Teachers may also need to make the reasons for investing effort clear (Baird & Northfield, 1992).

The development of cognitive and metacognitive processes in formal education includes the recognised need to extend how students evaluate their learning. The key processes involved include planning, strategising, monitoring, checking, questioning, reflecting and reviewing. These processes have also been associated with the promotion of critical thinking in classrooms, as advocated by Resnick (1987).

Critical thinking in schooling has tended to be linked and applied to the consideration of content material and reasoning skills. However, its application through questioning and evaluation to the processes of learning, through incorporating metacognitive processes, has been the guiding force for developing more self-regulated learners (Kuhn, 1999). Through a critical approach that uses metacognitive processes, students may become aware of their prior knowledge, evaluate their prior knowledge and have access to ways for evaluating new procedures.

As mentioned previously, there could be multiple ways (procedures) for tackling tasks. I suggest that guiding students to evaluate learning processes and encouraging them

to choose ways to carry out learning tasks can enhance their awareness of multiple possibilities. This could be a powerful means to allow students to take charge and become intentional, self-regulating learners. For metacognitive processes to have an influence on learning, students need to be empowered to be responsible for their own learning and to take charge, realise that their learning is potentially controllable and that they have some control over it.

3.4.2 Interventions for Metacognitive Development

I will now discuss the major findings from three interventions; The Project for Enhancing Effective Learning (PEEL) (Baird & Mitchell, 1986; Baird & Northfield, 1992), the Cognitive Acceleration through Science Education (CASE), (Ady & Shayer, 1990) and the Thinker Tools Inquiry Curriculum (White & Frederiksen, 1998). All three projects contributed greatly to the development of activities and approaches for use in the unit of work investigated in this thesis. In particular, the philosophy of active participation and use of information-processing procedures of the PEEL project, questioning from the CASE project, and the prompting of cognitive and metacognitive strategies through artefacts and use of criteria for student self-assessment of the ThinkerTools project inspired the development of teaching materials and activities for the unit of work.

The Project for Enhancing Effective Learning (PEEL)

The PEEL project began in secondary schools in Melbourne, Australia. In this project, teachers developed multiple teaching and learning procedures for multiple curricula areas. The fact that this programme has continued and expanded to many schools is testament to its success. It is based on students becoming more aware of their learning processes and thereby using appropriate learning strategies for cognitive processing.

One of the findings of the PEEL project was that more active teaching/learning strategies *per se* did not lead to permanent shifts in learning approaches. Students' perceptions of learning, and perceptions of their role and the teachers' role, had a huge influence on whether they understood, valued or used metacognitive strategies (Baird & Northfield, 1992). Those students who expected to be "taught" by the teacher, to be told the facts and what to do believed in a transmissive approach to teaching and learning. This is inconsistent with metacognitive approaches to learning where students need to consciously

undertake an "informed" or "intentional" approach in line with the purposes of particular cognitive strategies (Gunstone, 1994).

A recommendation of the PEEL project is that learning procedures need to be introduced and reviewed with an accompanying explanation of their value. This recommendation is consistent with other studies (Stipek & Weisz, 1981; Thomas & McRobbie, 2001) which have found that students' perceptions of the task, as well as perceptions of their own abilities and expectations of their achievement, seem to prevail over their willingness to put effort into their work. This influences the consequent academic achievement. Therefore when researching about how students use metacognitive strategies, it is important to investigate students' perceptions in order to understand their willingness to participate as intended by the teacher.

The common themes that arose from the PEEL project are to do with the role of the teacher. They have been summarised by Mitchell & Mitchell (1997, Table 4.4, p.114) and are given below.

- Share intellectual control with students.
- Look for occasions when students can work out part ("*chunking*" the process¹) (or all) of the content or instructions.
- Provide opportunities for choice and independent decision-making.
- Provide a diverse range of ways of experiencing success.
- Promote talk which is exploratory, tentative and hypothetical.
- Encourage students to learn from other students' questions and comments.
- Build a classroom environment that supports risk taking.
- Use a variety of intellectually challenging teaching procedures.
- Use teaching procedures that are designed to promote specific aspects of quality learning.
- Develop students' awareness of the big picture: how the various activities fit together and link to the big idea (*make connections*).
- Regularly raise students' awareness of the nature of different aspects of quality learning.

¹Chunking has also been described as a useful strategy by White (1988).

- Assess for different aspects of quality learning, not for rote learning.

The PEEL project also gives many recommendations about how teacher change needs to be developed before pupils will change and how there are requirements of the learning environment for success. These recommendations were taken into consideration for implementing the unit of work in this investigation.

Cognitive Acceleration through Science Education (CASE)

Many interventions attempt to show that there has been a measurable change of some sort as a result of the intervention. The CASE programme claims considerable enhancement of achievement, based on testing of formal operations of students. Because of this, it has expanded in recent years and is now used in many schools in England. This programme is quite different to the PEEL project in its development, even though they both use direct training to improve cognitive processing. Whereas the PEEL project involves teachers developing procedures for classroom use, the CASE programme revolves around prescribed materials that cover ten formal operational schemata (Adey & Shayer, 1990). The resulting 30 interventional lessons were trialed in a laboratory school and were then used in a range of secondary schools.

There are two basic premises of the CASE programme. One is to provide students with carefully graded cognitive conflict. This is thought to lead students to construct a type of reasoning or "meta-constructivism" where they are required to construct relationships between variables (Adey & Shayer, 1994). The other is to use the Vygotskian emphasis on the importance of language and social exchange in the development of thinking as well as the development of knowledge. Teachers are encouraged to frame their questions to get students to consider the underlying reasoning of knowledge claims. For example, in one lesson in this project, pupils are asked to look at statements from a variety of viewpoints relating to population policy in China and decide which parts are fact and which are opinion. In interviews, the students clearly acknowledged how difficult (but not impossible) it was to distinguish fact from opinion and give reasons.

The value of the programme materials as effectors of enhanced achievement has been questioned (Bliss, 1995). An alternative explanation as to why the CASE lessons are apparently so effective could be due to changes in teacher delivery as a consequence of the

accompanying in-service education for teachers (INSET). During professional development training, teachers are prompted to reconsider their teaching methods and questioning techniques. Perhaps it is the enhanced teacher questioning that has a positive effect on student achievement.

To a certain extent, when teachers are supported through a new innovation, when they meet to discuss what they have tried, achievement is raised. It may not be the innovative materials *per se* that are producing the effect. Teacher development has also been acknowledged as a positive benefit in the PEEL project (Baird & Northfield, 1992) and other interventions over multiple classes (Leat & McGrane, 2001). Even so, Adey and Shayer (1994) warn that assuming a process-product model as a result of teacher development could lead to erroneous conclusions because students' interpretations of teacher behaviours vary according to personality, teachers' behaviours may not be a result of the training and desired behaviours may be diluted and the measurability of outcomes associated with "assumed" good practice is problematical mainly because the assumptions are unsubstantiated.

Thinker Tools Inquiry Curriculum

The aim of the Thinker Tools programme was to provide students with instructional methods that scaffolded inquiry and used reflection and generalisation to develop metacognitive knowledge and skills (White & Frederiksen, 1998).

This programme used computer-enhanced materials to address complex models of force and motion phenomena. The Thinker Tools curriculum centres around a metacognitive model of research, called the *Inquiry Cycle*, and a metacognitive process called *Reflective Assessment*.

The findings from the programme show that students' learning was greatly facilitated by *Reflective Assessment*. Using this metacognitive process was particularly beneficial for low-achieving students. The students were given a set of "prompts" to encourage them to examine important aspects of their inquiry. Students were asked to self-assess their work against multiple criteria. The guidelines helped students to learn about the process of researching and how to judge their work. Self-assessment was a way of introducing self-monitoring and evaluation of learning processes. This gave students greater confidence that they knew what was required. Also, because students were working

in mixed-ability groups, higher-achieving students (who were assumed to have greater initial metacognitive abilities) generally mediated metacognitive processes for their lower-achieving partners. These findings fit with the ideas that learning is more effective when metacognitive processes are encouraged and that this can be done through prompting and providing guidelines for self and peer assessment.

There were difficulties with this intervention however, such as students being initially reluctant to criticize each other's research, and students feeling that there was too much self-assessment. Anonymous peer criticism was introduced to overcome this. Since collaborative ways of working were important, one of the challenges was identified as ensuring that students viewed themselves as a "community of researchers".

3.4.3 The Importance of Content and the Learning Context

Both content and the learning context need to be considered when trying to promote metacognitive strategies in classrooms. Content and context have huge influences over what is learned and how that learning takes place (Egan, 1997; Hyde & Bizar, 1989; Marton & Booth, 1997). As Miller and Driver (1987, p.56) have stated:

The challenge for science education is to find contexts which are charged with relevance to students' interests and concerns, and which offer strategies and frameworks for deepening their understanding of scientific concepts and the cultural contribution of science which really engage the intellect and fire the imagination.

Gunstone and Baird (1988) argue that enhanced and appropriate metacognitive abilities will only develop if there is recognition that metacognitive training should be integrated with content and context. This is because metacognitive processing will only be apt when learners' beliefs are applied appropriately to the content and linked to the demands of the task at hand.

Different content places different metacognitive demands on students. Gunstone (1994) suggests some requirements of content appropriate for metacognitive development: firstly, the content needs to require real cognitive learning; secondly, the content should be neither already understood nor totally unfamiliar. When these requirements are met, it is more likely that learners will see the benefit of investing more intellectual effort that a metacognitive approach demands, in that prior approaches to learning have not resulted in

learning for understanding. This is similar to Baird and White's (1996) emphasis on having students "purposefully inquire" as a key element of metacognitive development.

The personal relevance of the content to students may also determine the extent to which they engage in reflection on their ideas (White, 1988). Content matters because it can influence the judgements about the rewards of learning. If students see that the content can be applied to everyday living, they are more likely to invest effort into applying reflective ways of learning. Content may influence the extent to which students see the need to use and select appropriate metacognitive strategies.

Further, students' perceptions of the intrinsic value of content have been positively related to intrinsic motivation, which can enhance self-regulation and cognitive strategy use, regardless of prior achievement (Pintrich & De Groot, 1990). Therefore, for metacognitive processes to be used by students, learning should be embedded in content that is intrinsically relevant for students.

The content associated with bioethical issues can be related to properties of science content mentioned by White (1994). These are complexity (and ambiguity) of content due to the multiplicity of ethical dimensions such as mixes of types of knowledge (personal and social), links with common experience and a strong emotive element.

The intensity of emotional elements will vary depending on personalities, previous experiences, the skill of the teacher and the learning materials used (White, 1994). Van Rooy (2000) has suggested that teachers can capitalize on the increased energy created by emotional engagement in bioethical issues, as this increases motivation. There can be a down side to highly emotive content though. White (1994) asks whether it is harder to shift students' conceptions if topics are highly emotive, because there may be a greater personal investment in maintaining existing ideas.

White is also resolute about the influence of the learning context on learning.

Context is a powerful determinant of learning, as long as it remains shabby and limited, so learning will be mean and limited. We need to attend to the context in which science is learned, and to how it is perceived, if we are to improve the quality of learning (White, 1988, p. 115).

In discussing the importance of context, White (1988) refers to the dimensions of place: where, class, age, where in room, formal, atmosphere, structure, behaviour, who

decides what happens next and other variables. He also states that in terms of learning contexts, their influence really depends on what the learner makes of the context. Students' perceptions and interpretations are important. This is a very strong reason for using students' perceptions as a research focus.

There is no doubt that content and context are important in determining student engagement with learning. This is due to the importance of intrinsic interest for student engagement and the need for purposeful inquiry (Baird & White, 1996) or real cognitive effort (Gunstone, 1994) for learning in a more metacognitive manner.

3.4.4 Inquiry and Writing as Contexts for Metacognition

Inquiry-Based Learning Contexts

The process pedagogies associated with inquiry and writing are amenable to the development of metacognitive strategies. Students can be guided in how to deconstruct and construct text into planned conventions. "Writing in your own words" or writing questions or ideas into thinking journals is a strategy for identifying students' ideas (Rowell, 1997).

In level 8 biology courses in New Zealand, students are required to investigate contemporary biological issues (Ministry of Education, 1994). "Investigate" is interpreted to mean inquiry-based research using resource materials. Inquiry can also include questioning one's own ideas and beliefs. The investigative skills and attitudes required of students are clearly outlined in the curriculum document (Ministry of Education, 1994, pp. 37-47). Students are expected to ask a series of related questions of themselves, their group, and resource people, and refine these questions to plan their investigations. Students are also expected to locate and process relevant information using a variety of sources and to evaluate the quality of information gathered and its degree of relevance.

The reason why inquiry-based learning provides a suitable learning context for metacognitive processes is that, during inquiry, learners need to ask self-directing questions. These questions can provide an active way of reflecting and monitoring/evaluating learning. The cognitive demands of deciding what content is important and what processes are necessary, are valuable for developing metacognitive processes. Encouraging students to ask questions and to seek information in order to answer their own questions is fundamental in an inquiry approach. Students are required to

question what they already know and understand, and identify what they need to know or understand. Questions linked to planning, finding and synthesising information, and monitoring progress all help to promote independence in learning. When the students themselves derive questions, they are more likely to be authentic, relate to students' interests (that is have relevance) and be motivating.

More recently there has been an emphasis on the importance of using collaborative inquiry approaches to expand students' knowledge and awareness. Moje, Collazo, Carrillo and Marx (2001) recognise the importance of constructing "spaces" (learning opportunities) in science classrooms where students' own knowledge and everyday discourses are used in conjunction with science knowledge and discourses for the construction of new knowledge. There is much evidence that collaborative inquiry within a community (groups or classes in schools) can help the construction of meaning (Brown & Campione, 1994; Scardamalia, Bereiter & Lamon, 1994).

Writing Contexts

Children's conceptions of writing usually consist of writing down what they know or "knowledge telling" (Scardamalia & Bereiter, 1986). They tend to write any information that seems somewhat appropriate, with each new phrase or sentence stimulating the generation of the next idea. Children are often not aware of the discourse conventions used by good writers. They may not think of writing as a structured process where plans can be made for communicating an organised point of view to an audience, and they may not understand that revision is integral to effective writing (Resnick, 1987). This retrieve-from-memory-and-write process is typically automated and does not make use of metacognitive control (Graham, Harris & Troia, 1998).

The work of Ann Brown and colleagues has contributed greatly to developing methods that can be used to help children interpret reading and writing as intentional processes. Palinscar and Brown (1984) developed "reciprocal teaching" as a means to get students to ask each other questions about text. This has been extended to help readers use social-interactive processes combined with metacognitive processes for more effective learning in a "communities of learners" approach (Brown & Campione, 1994). In this approach, students pose their own questions to drive the inquiry process and set their own

learning goals through planning. They are encouraged to be active, strategic learners and to be aware and in control of their own learning through the use of metacognitive processes.

Using writing as a mode of learning assumes the cognitive skills necessary for composing written text and is embedded in process-centred and/or learner-centred pedagogies. The process pedagogies are based on instructional sequences designed to help students organize their ideas before writing, and to rethink and revise initial drafts. The purpose and audience are also stressed. Rowell (1997) suggests using activities such as brainstorming, journal writing, small group activities, teacher-student conferences and multiple drafting of texts as an evaluative process in response to feedback from peers or the teacher. These types of activities were therefore included in the unit of work in the present research (Section 5.3).

The composition process is not only putting words on paper but involves many evaluation processes that combine goal-setting, making decisions, and planning in light of prior knowledge and intention. It is important for students to realize that there is no one correct method for writing. There are always multiple possibilities, which present choices.

Flower (1989) suggests that the writer is often transforming knowledge into a new structure, by possibly drawing inferences and creating connections. Flower (1989, p. 206) stresses that

the writing process needs to be taught not just as a procedure or a set of "natural" activities but as purposeful cognition. Students need to be aware of the rhetorical goals behind a writing strategy and learn not only how to use a thinking procedure but when and why it might be worth trying.

"When and why" are conditional aspects of knowledge as mentioned in Section 3.2. These aspects are bound with goals or intentions that can direct the decisions learners make about how they should participate in their own learning. I will now discuss the connection between intention and self-regulation more fully.

3.5 Intentional and Self-regulated Learning

More able learners seem to consciously use evaluative processes to keep themselves on task and to obtain feedback about their learning. This active monitoring, planning and deliberate, self-directed use of metacognitive strategies to achieve a goal has been called

intentional learning (Brown & Campione, 1994; McKeown & Beck, 2000). In theory, metacognitive approaches to learning should encourage students to develop their abilities to evaluate, self-direct and self-regulate learning (Boekaerts, 1997; Paris & Winograd, 1990; Winne, 1996). In terms of the use of metacognition for strategic development, the question is whether students employ conditional knowledge of when and how to use appropriate learning strategies. The extent of use of metacognitive processing is likely to drive how individuals preferentially deploy strategies.

An emphasis on student self-regulation means teaching and engaging students in specific strategies that offer them opportunities to make decisions and solve problems on their own, without being told what to do at all times. The element of choice is essential so that students have options and opportunities to self-control and be self-regulatory (Zimmerman, 1994).

One of the factors that may limit students' ability to make choices is that they simply do not know the possible options. Ideally, students know a range of learning processes before they make choices about processing information. Teachers may need to model processes or provide cues or prompts to help students to know how to use a range of strategies (Beyer, 1997). This is so that students increase their self-confidence through believing they have the "tools" to succeed (Kluwe, 1982). Through the use of learning strategies, especially metacognitive ones, individuals are likely to develop more responsible roles and enhance their sense of agency (self-regulation and control over learning) (Alexander & Schwanenflugel, 1994).

Teachers can mediate student self-regulation and personal efficacy by ceding to students executive processes before, during and after a task. This then allows students to exercise some control over their own learning (Perkins, 1993), especially over those processes necessary for making choices about planning, monitoring and evaluating work. Students use learning strategies to accomplish these processes (Derry, 1990).

Learning strategies include a wide range of methods for attacking tasks and are explicitly invoked. They help to achieve cognitive intentions (for example, the strategy of using key words or key questions helps to identify relevant information) and are potentially conscious and controllable. The use of strategies lessens the demand on working memory and therefore mediates information processing (Hacker, 1998).

Intention assumes that a goal is set or that there are expectations about a learning situation (Blumenfeld, 1992). The goals that students set are often linked to their expectations or perceptions of what the task demands. Shuell (1988, pp. 286-287) described these expectations as:

- the type of learning outcome that the student is trying to achieve (for example, understanding relationships versus memorizing facts);
- the purpose of the learning activity (for example to learn content versus to complete the assignment as easily as possible); and
- self-perceptions of the learner's ability (that is self-efficacy) to achieve the desired goal (for example "I know the teacher wants me to *understand* this material, but all I am capable of doing, or have time to do, is to memorize the facts that are likely to be on the examination.")

Without prompting, students intuitively interpret tasks according to what they think the task demands, and, for most students, apply their knowledge of strategies as best they can. However, if students are left to their own devices, their strategy choice may or may not be task appropriate. The appropriateness will depend on the degree to which students match the use of strategies with their anticipated benefits. A desire to obtain learning benefits such as increased understanding or improved skills assumes an intention. Such a desire that invokes evaluation through monitoring and re-planning/ reconsideration is more likely to lead to wise strategy use. In contrast, merely going through the motions, doing the minimum or a desire to complete a task without regard for quality, does not correspond to intentional learning.

If teachers want to help students to move forward in their learning, to become more intentional, more evaluative and more self-regulating in their learning, then it is imperative that they actively encourage students and remind them of possible strategies for particular learning situations and the possible benefits of using these strategies. When we help students to develop awareness about their own thinking and learning processes, we are helping them think in a metacognitive sense about the effectiveness of the strategies they use in reaching the goals they have set (Barell, 1991). This can be done through teaching strategies directly or by incorporating them more subtly into tasks that students are required

to do. The latter approach can be aided by modelling and giving examples or by developing cueing "tools" to prompt students, such as those mentioned in the interventions in Section 3.4.2. Providing examples of procedures as well as cognitive and metacognitive prompts as part of tasks, was the approach taken in the intervention involved in the present research (see Section 5.2.4).

Self-regulating learners are expected to actively control their behaviour, motivation and affect, and cognition according to the demands of the learning situation. This is often difficult in the face of distractions or competing intentions (Zimmerman, 1994). However, a self-regulated learner would become aware of a loss of attention and comprehension and modify their behaviour accordingly. For example they may re-read text or self-question to monitor their own progress.

The idea that metacognition is largely responsible for the initial decision to be strategic is linked to an understanding that learning usually improves when sufficient effort is put into choosing and using strategies (Borkowski, Carr & Pressley, 1987) and when there has been some success in their use (Borkowski & Krause, 1985). With practice and repeated use, strategy implementation may become seemingly spontaneous or automatic. This is a desired behaviour since learners would then be demonstrating that they had internalised the processes enough for the strategies to become skills (Derry, 1990). Thus, prolonged strategy use as a consequence of metacognitive processes can lead to automaticity. As Borkowski, et al. (1987, p. 69) have observed, "Once strategy use occurs automatically and efficiently, metacognition is no longer necessary." This last idea has implications for researchers who use the conscious self-reports of students as their measure of success of an intervention that promotes metacognitive processes, as will be discussed in Chapter 9.

Automaticity is probably the result of a combination of the students' knowledge of strategies, monitoring and control of the use of these strategies (that is, when to use them) and their motivational beliefs. It is likely that the apparent spontaneity is "the result of a continuous, long-term developmental process that reflects the maturation of the metacognitive system" (Borkowsky, et al. 1987, p. 63). Spontaneity does not rely on an intention.

We also know that intentional learning requires considerable effort. Sometimes students perceive that the effort required is too great. They may negotiate tasks downwards, so that they can complete them with minimal effort. White (1992) discussed how students tend to conserve their efforts in what he called "the principle of minimum expenditure of energy".

The implications for classrooms are that we can probably improve students' intentional learning by teaching cognitive strategies, but students will not put effort into them unless they value the strategy or see the "fruitfulness" in expending effort (Gunstone, 1994). To enable this, the purposes of the strategies need to be made explicit and the goals for learning in that particular way need to be established (Brophy, 1983; Bruer, 1994). This is because a learner needs to see the relevance and usefulness of the cognitive processes she or he controls so that the strategy can be linked to the intention. This idea is consistent with the work on students' approaches to learning, where it has been shown that students tend to use an approach based on their expectations of what is required of them (Marton & Säljö, 1976) and work on how students use mastery or performance goal orientations depending on their perceptions of tasks (Ames, 1992).

There is a dilemma for teachers though in terms of the amount of explicit instruction or guidance they give. I will discuss this further in Section 3.6.3.

3.6 Other Factors that Influence Learning

It is indisputable that there are numerous influences on learning. Cognitive complexities arise from varying personalities, preferences, genders, development, ideologies (intentions) and backgrounds. The effects of home, peer and school environments upon students' dispositions (motivations) to learn and their achievement levels have been widely documented. These are important influences not only in academic achievement but also in attendance at school, personal values, self-perceptions as a learner and how learning can be achieved. Although it is acknowledged that there is a large body of evidence indicating that adolescent students' performances are due to their social backgrounds and prior attainments, (for example, Jencks, Smith, Acland, Bane, Cohen, Guifis, Heyns, & Michelson, 1972) school factors that influence learning are of prime concern here.

We know that knowledge is the product of both an individual's cognitive activities and the social learning context (Bruner, 1996; Egan, 1997). Not only does the choice of classroom activities make a difference as to how students engage with cognitive activities but the characteristics of the learning environment (particularly relationships) also influence student motivation and their willingness to participate in activities (Tasker, 2002).

I will now discuss how the use of metacognitive processes relates to increasing motivation and the teacher's role in mediating appropriate support to maximise the conditions for effective learning.

3.6.1 The Relationship Between Use of Metacognition and Motivation

It is generally agreed that motivation influences the choices people make, how persistent they are and how much effort they put into tasks (Dörnyei, 2000). There is a strong link between motivational aspects and trying to move students towards using strategies to expand their awareness and evaluation of their learning. When teachers guide students to have some control over executive processes, motivation increases because students tend to gain a sense of control (and hopefully a sense of achievement) over what they are doing (Pintrich & De Groot, 1990; Scardamailia et al., 1994). Students need more than knowledge of cognitive and metacognitive strategies for more effective learning (McKeachie et al., 1985; Pintrich & de Groot, 1990). They have to engage with that knowledge and use it for it to be effective. Their decisions about which tasks to participate in, and how persistent they will be (conditional aspects) determine their engagement with and use of learning strategies (White, 1988).

Teaching can only alter what students do in a classroom if students are willing to participate at a cognitive level and put effort into tasks. Biggs (1986, p. 133) describes the link as "congruent motive-strategy packages" which include both an intention to use and the actual use of a related strategy. This is the "willingness" component of metacognition mentioned in Section 3.4.

The facets of metacognition mentioned previously (knowledge, awareness, control and willingness) interact with each other. I consider that the aims of promoting metacognitive processes are to promote knowledge, strengthen self-efficacy for learning, and enhance motivation. There is a strong, interrelated connection between how students

perceive their relative independence, their beliefs about knowing how to carry out strategies, their perceptions of the purpose of tasks and their willingness to expend effort in actioning strategies (Pintrich & De Groot, 1990).

Strategy knowledge and use are probably bi-directionally linked with motivation. There is some evidence that general knowledge about the usefulness and applications of strategies promotes greater motivation (Borkowski & Krause, 1985). The positive aspects of motivation linked to metacognitive processes include positive self-efficacy, an internal locus of control, and constructive attribution beliefs about the causes of success and failure. As self-efficacy increases, an internal locus of control and the tendency to attribute success to effort result from repeated successful experiences with strategy use. Good performance, as a result of strategy use, in turn promotes positive self-efficacy and attributions of success to effort rather than to uncontrollable factors such as ability or luck.

Motivational factors are probably important in subsequent strategy use through providing incentives necessary for deploying strategies, especially in relation to challenging, difficult tasks. There is no doubt that self-confidence and a feeling of being in control play important roles in learning (Stipek & Weisz, 1981). Pressley, Borkowski and Schneider (1987) suggest that students perform at higher levels if they have confidence in themselves. Dweck (1991) has highlighted a salient point, that children's academic performance is closely linked to their perceptions of their ability. More importantly, what seems to be critical is their view of the malleability of their talents. A student who does not feel very able and attributes this to lack of effort, is more likely to improve as a result of increasing effort than a student who feels her/his abilities are due to luck or chance. When students realise that they can control or act as self-agents (McCombs & Marzano, 1990), they can positively affect their own beliefs, motivations, and academic performance. An assumption that students view tasks as being potentially controllable is very important. This is often overlooked in discussions about the worth of interventions that promote new ways of learning, or thinking about learning.

Students who value success will strive to achieve it by settling to tasks readily and willingly, staying on-task for a longer time, and persisting when confronted with a challenge or distraction. When students attribute their performance to the amount of effort, they are more likely to have a sense of personal control over their learning.

The classroom application of attribution theory is to convince all students that they have sufficient ability and that through effort they will achieve success. The teacher's expectations of the individual and her/his belief that the student can achieve can make a difference (Barry & King, 1998).

As mentioned previously (Section 3.4.3), the levels of motivation, use of metacognitive strategies and the consequent levels of self-regulation are intricately bound with content. The idea is that students might have adaptive motivations (Ames, 1987) stemming from the need to know more, an intrinsic or personal interest in the content, curiosity, and so forth. While it is clear that, to a certain extent, students will determine the relative importance of tasks depending on how relevant the content is to them, it is also true that the level of motivation is often linked to particular subjects or teachers (Adey, 1997) and is bound with students' perceptions of control over their learning (Stipek & Weisz, 1981). The teacher can set up activities and the learning environment to help students to gain a sense of control. I will discuss the teacher's role in setting up the learning environment in the next section.

Even though I have outlined links between motivation and the use of metacognitive strategies in this section, I also acknowledge that motivational constructs also vary with time, depending on other personal and social influences (Dörnyei, 2000). The effort a student may be prepared to put into their work on one day may vary considerably from that of the next. This has implications for research using case studies in that the researcher probably needs to observe the participants over an extended period of time to assess the typicality of their behaviours, or otherwise acknowledge that what they observed only represents the particular time and situation as described.

3.6.2 The Role of the Teacher in Mediating the Learning Environment

Gagné (1976) realised that the teachers' role in setting up the learning environment was crucial for effective learning. He said that

the essential task of the teacher is to arrange the conditions of the learners' environment so that the process of learning will be activated, supported, enhanced and maintained (Gagné, 1976, p. 21).

The prevailing norms and expectations within a classroom can influence the willingness of students to participate in active learning (White, 1988). The learning

environment, consisting of physical, emotional and interactional components, is likely to have an effect on the cognitive, metacognitive and affective aspects related to learning. There are labyrinthal interactions amongst the factors effecting learning as mentioned in the previous section. We know that the learning environment also includes factors such as time of day, what happened in the previous lesson and personal thoughts.

The teacher's challenge is to organise learning experiences to take account of some of these influences by linking students' thoughts to the tasks at hand. For example, the teacher might highlight important features of the task, make the task meaningful in terms of what the students already know, establish a familiar content context, split the task into manageable stages, or reduce complexity. Scaffolding could also involve an affective component such as making the task emotionally and socially appealing, reducing stress and anxiety and creating a supportive, learning-focussed atmosphere (Alsop & Hicks, 2001).

As discussed previously in Section 2.4, the development of a classroom environment conducive to the acceptance of more evaluative approaches may require teachers and students to re-negotiate their roles. This is especially so for learning in bioethical contexts (Dawson & Taylor, 1998), but also where teachers want students to use student-centred inquiry approaches. Some of the authoritative power of the teacher needs to be deferred so that students can be empowered to take on more self-responsibility for their own learning. The teacher needs to act as a facilitator who organises the teaching materials and sets up suitable conditions (physical and emotional) within the classroom. There needs to be a non-threatening, non-judgmental atmosphere in which children can freely express their ideas (Van Rooy, 1994).

The teachers' role in establishing an environment of self-regulated and intentional learning is not "hands off" or "let them do whatever they want to". It is the teacher's responsibility to encourage students in the development of their ideas, guiding them in useful procedures so that knowledge is constructed through dealing with specific issues and through discussion (Dawson & Taylor, 1998). Further, teachers who use this mode of operation are not concerned with the fallibility of their knowledge. They respect students' autonomous, generative processes of learning. Answers are not necessarily provided but how to go about finding the answers, is explicitly taught. This encourages self-responsibility by the learner.

In order to get students to be evaluative of their knowledge and build on that knowledge, there has to be an inquiring environment where it is customary for both the teacher and students to use questioning protocols. Self-questioning is a key element for evaluative processes and this may need to be modelled by the teacher. Further if students are allowed to negotiate tasks, and have some choice in how they go about their learning they are more likely to be motivated (Brophy, 1983) and self-regulating (Stipek & Weisz, 1981). Students have no need to decide what to do if they are told what to do. Teachers also need to provide opportunities for students to question what they know and what they should do (Hyde & Bizar, 1989). This latter point may seem rather obvious, but it may simply be setting up activities for tapping into prior knowledge and allowing time within a lesson for reflection to occur.

There is an element of risk-taking for students to participate in this approach. For students to feel at ease with risk-taking, the learning environment needs to be supportive and non-judgemental. Students need to be able to rely on the teacher, and other students, to be supportive of their ideas, rather than to react disparagingly to perceived incorrect views. They want to trust that a teacher will deal eventually with their concerns and that their confusion or unease is temporary only. Gunstone and Mitchell (1998) stress the importance of an atmosphere of trust between teacher and students for the promotion of metacognitive development. If students are encouraged to continue to take risks in their learning, to question what they know and what they should be doing, they are more likely to actively construct meaning (Baird & Northfield, 1992). These views are fundamental in a constructivist approach to teaching and learning (Yager, 2000).

When trying to promote self-regulation, there is a dilemma about how much instruction and guidance to give to learners. If teachers give a lot of explicit instruction, they may override the choices that students need to make to develop autonomy and self-regulation (Perkins, 1993). Therefore teachers should provide opportunities for students to make their own choices about how they tackle tasks. If choices are not provided, there is no need for students to evaluate what they should do.

Metacognitive strategies can invoke critical thinking (Kuhn, 1999) which is necessary for both considering bioethical issues and inquiry-based learning procedures. The classroom has not generally been a place where critical evaluation of one's own and others'

ideas have been developed and encouraged due to the content restraints of examination systems. Evaluation aspects of critical thinking requires challenging the prevailing norms (Siegel, 1988) in relation to both the content and the processes of learning. It is often difficult for teachers to challenge the assumptions students bring to their work and to foster self-questioning. Some students may think they know already. Others may expect to be "spoon-fed", to be told the facts and where and how because being told is an easy option, since it requires less intellectual effort on their part.

Social interaction is essential for working through situations that challenge, refine and affirm our values (Gilbert & Hoeppe, 1996) and for constructing meaning (Section 3.2.3). The influence of social relationships (student-student and student-teacher) within the classroom can influence students' willingness to take risks in new procedures. It is very important that students feel at ease with contributing to pair encounters, small group discussions or whole class interactions. During these activities, teachers need to ensure that views are shared, all views are considered and that discussions are open. They need to encourage students to consider a range of viewpoints and evaluate them from their own developing critical points of view. This is so that some of the dilemmas mentioned in Section 1.1 can potentially be addressed. An element of trust, support and mutual respect will help this to occur. Therefore how the teacher creates conditions within the classroom, by modelling mutual respect, is likely to influence how students participate (Tasker, 2002).

3.7 Summary of Perspectives on Learning

The central ideas developed in this chapter are summarised in this section. These ideas informed the design of activities for the intervention that was the context for the present research, and provide a framework on which to analyse the data obtained from the research.

In this summary I consider how the perspectives on learning mentioned in this chapter relate to each other. I propose that the term *evaluative constructivism* could be used to describe and to give greater emphasis to the nature of learning processes needed for more effective learning to take place. The interrelationships between the main ideas mentioned in this chapter are shown in Fig 3.1.

Evaluative constructivism is centred on active learning. This means learners should purposefully monitor and regulate their learning needs. It is goal or intention oriented in relation to thinking processes and learning strategies.

The effectiveness of learning depends on both appropriate cognitive activity and motivation. The decisions students make will depend on their knowledge and awareness of the choices they have and their intentions. Conversely more effective learning as a result of using appropriate metacognitive strategies is likely to enhance affective elements that influence participation and willingness to make decisions (Section 3.6.1). Using metacognitive processes is positively linked to increased motivation (Weinert, 1987).

I have chosen the word "evaluative" to link with "constructivism" because in its broadest sense it encompasses processes such as choosing information or ways to tackle tasks, identifying what is needed, establishing, weighing up choices, reflecting, appraising, planning, monitoring and checking. These processes lead to decision-making regarding learning. The decisions learners make influence what type of knowledge (declarative, procedural, or conditional) is constructed and how it is constructed. Evaluative is therefore a highly significant descriptor to encompass a range of cognitive and metacognitive processes that are inherent in constructivist models of learning.

I suggest in Figure 3.1 that it may be possible to drive *evaluative constructivism* using two main agendas:

cueing or prompting students to develop **intentions**; that is, get them to ask "What do I need to know or do?" and

allowing students to make **choices** in the ways they tackle tasks.

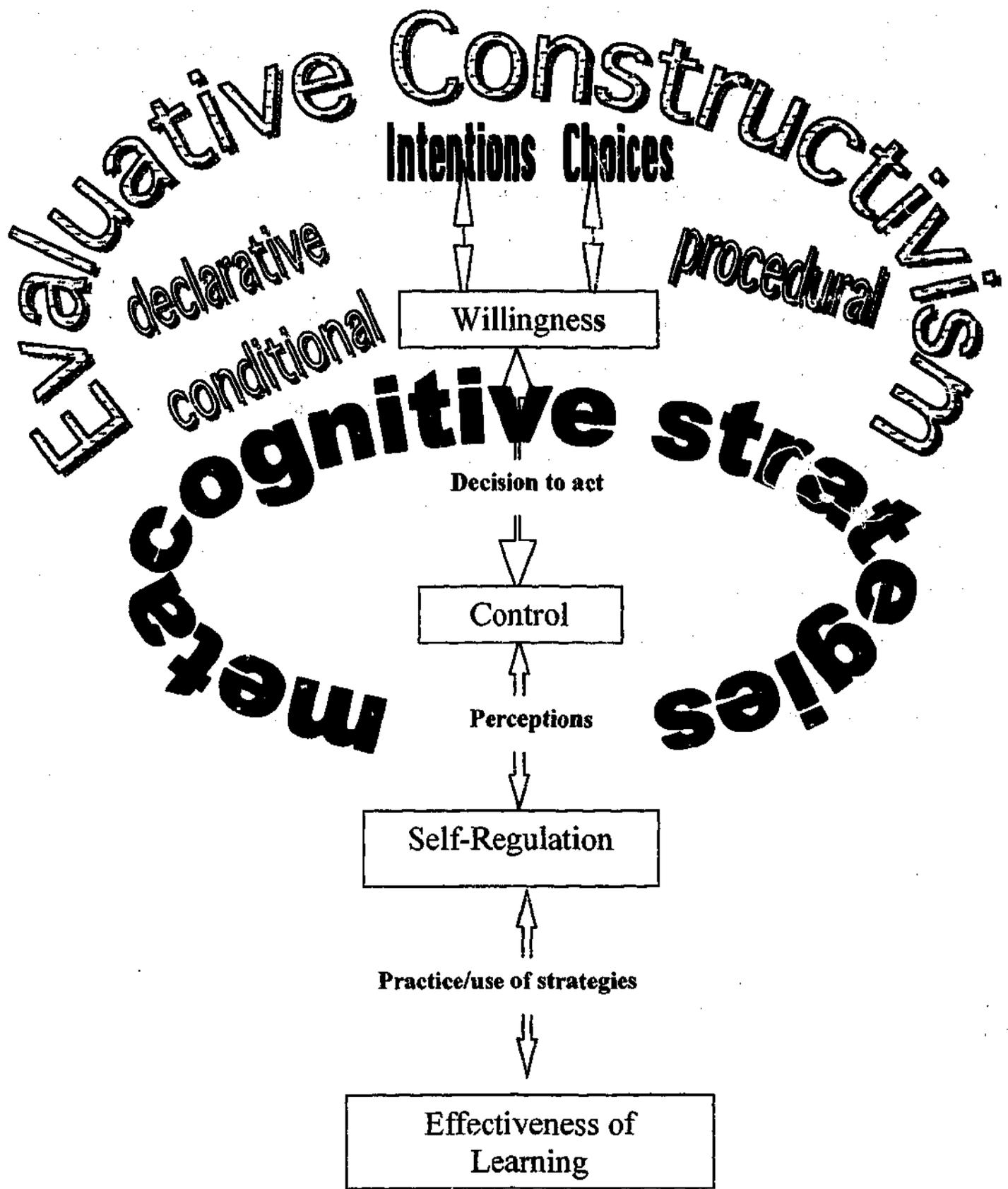


Fig. 3.1 Interrelationships between elements of evaluative constructivism

Deriving intentions and making choices are linked to both cognitive and affective aspects (such as intrinsic interest and wanting to achieve well). When learners develop intentions and choose what to do, their willingness to participate and use metacognitive strategies is more likely to lead to evaluation of their knowledge constructions.

As discussed in Section 3.2.2, it is important to get students to question what they know in terms of declarative, procedural and conditional knowledge. This can be done through metacognitive strategies. Accessing prior knowledge may help learners to see that they have the "tools" for learning (know what options they have for processing information or are aware of ways to evaluate and make decisions about their learning). Students may already know of strategies but may not use them unless prompted.

If students do not know how to access learning strategies, teachers need to mediate ways to help them. When students know strategies, they may need to be prompted before they will actively use them. They may initially need guidance as to how to make decisions and act on them so they are more engaged with their learning. This engagement engenders a sense that there is a way forward, they know what to do and have some control over their learning. Controlling learning is not likely to occur without knowledge about what to control or how to control it. It is important that students have a sense that they can control their learning. Providing choices, prompting students to plan and monitor progress, offering criteria to help students judge their work and expecting them to use these criteria are key elements for gaining this sense of control. Evaluation of what they are doing, how well it worked and what could be done to improve, helps to develop students' perceptions of the usefulness of strategies. In other words a critical-evaluative approach is expected through the use of metacognitive planning, monitoring and evaluation.

As learners gain positive experiences in using strategies through self-evaluation and feedback, they may become even more willing to use these strategies. Perceptions of what is required need to be clarified, especially regarding any assessment requirements. What learners focus on in terms of aspects of the task will reflect their views about the purpose of tasks and whether the effort required is worthy. As their perceptions of the usefulness of strategies increase, students are more likely to self-regulate their use. Learning then becomes more efficient and effective through practice, and the strategies become skills that may be used intentionally or automatically. Through experience and evaluation of the

strategies, learners may appropriate them according to their intentions. The ultimate goal is to enable students to use ways to access and assess prior knowledge and experiences so that they can purposefully choose appropriate strategies to enhance their learning.

I will now elaborate on how intentions and choices influence the extent of engagement with evaluative constructivism.

Fig 5.2 shows that when there is intention and active choice (that is, choice to participate or use a learning strategy), engagement will be high and learners are more likely to use evaluative constructivism. When there is an intention but no or little choice (through lack of knowledge), learners will be frustrated. When learners know strategies and know the purpose of them but do not intend to use them, they tend to negotiate the task downwards to minimise effort. In the latter case learners may have evaluated that the gains from using the strategies were not worth the effort or time required. In the worst cases, they could be deemed lazy or non-compliant. If there is no intention and no choice, there is no drive or need to evaluate what should be done. The result will be a low level of engagement with evaluative constructivism or non-participation.

Evaluative Constructivism

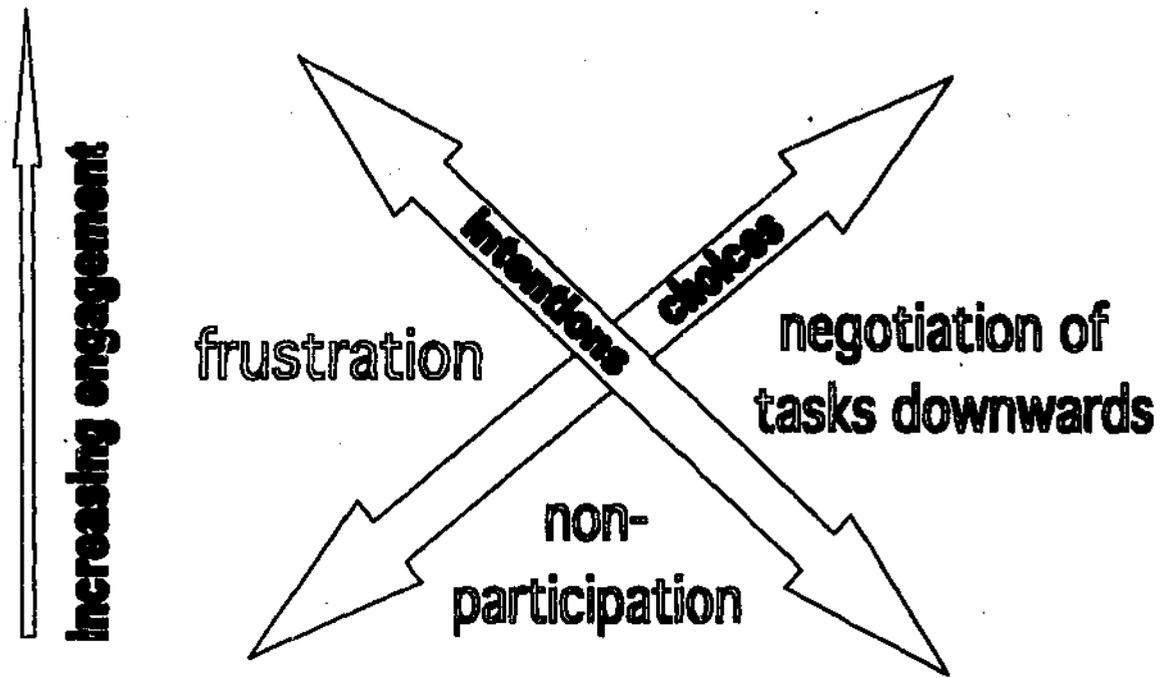


Fig. 3.2 The influence of intentions and choices on engagement with evaluative constructivism

Evaluative constructivism as a description of learning processes also embraces the elements of mediated ways of constructing meaning, through either artefacts or other people. It encompasses multiple perspectives on learning, where knowledge and intention combine with control aspects over learning processes to result in more effective learning.

The teacher's role is to help students to derive intentions or consider what they are trying to achieve and alert them to various pathways for achieving these ends. This can be done by modelling cognitive and metacognitive processes, cueing student thinking, through questioning or by providing written prompts, checklists or questions to help students access their prior knowledge and to allow them to evaluate the content and the processes of learning. Instruction must involve helping learners to really dig into their minds to discern what, how and when to appropriate the various types of knowledge to meet new learning demands. Self and peer assessment may also mediate metacognitive strategies that lead to increased engagement with evaluative constructivism.

Although teachers may need to guide students in the use of learning strategies, they need to recognise and be sensitive to the need for gradually removing support as learners become more able to self-regulate their own learning.

One of the aims of the research reported in this thesis is to consider classroom practices that may help to develop more effective ways of learning. The objective is to move students to be more self-regulating by enhancing their awareness of ways to be more effective learners. The information in this chapter provides a background for investigating how classroom practices might enhance the knowledge and use of learning strategies within a bioethical context.

Chapter 4 The Research Process

4.1 Introduction

This research explores how learning can be enhanced in a bioethical context with a year 13 biology class in New Zealand. I have used a naturalistic research paradigm, including a range of interconnected interpretive methods, to try to understand the experiences of the students in this class.

In designing the research, I assumed that the participants' accounts alone would not necessarily provide a clear picture of what individuals experienced during the unit of work.

Denzin and Lincoln state that

subjects, or individuals, are seldom able to give full explanations of their actions or intentions; all they can offer are accounts, or stories about what they did and why. No single method can grasp all the subtle variations in ongoing human experience (Denzin & Lincoln, 2000, p. 19).

Part of the research was to design and evaluate the activities *per se*, as described in detail in Chapter 5. It was also important to consider the teaching process; how it was experienced by the students and how that experience (or reflection on it) linked to their perceptions and understandings of both the content and processes for learning. Also, because research into teaching and learning has shown that what students do in the classroom is closely linked to their perceptions of the requirements of the learning task (Biggs & Moore, 1993), it was important to use the students' perspectives as a research tool. Where possible, I have also used the teacher's perspectives and my own observations to expand on the interpretations.

Crotty (1998) has outlined four elements that need to be considered in developing a research outline. These are given in Fig 4.1 below.

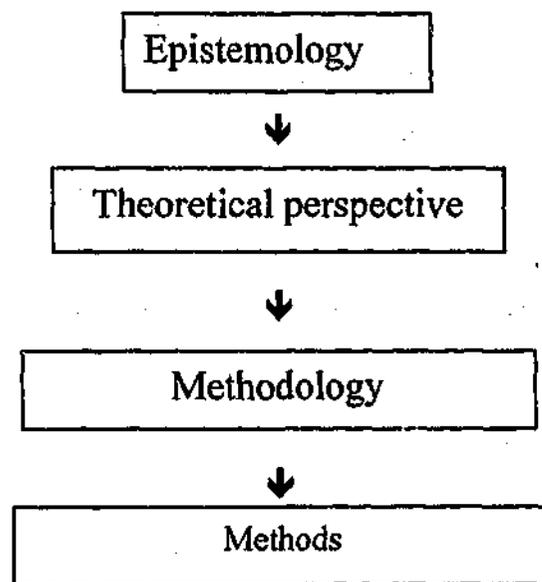


Fig. 4.1 Elements for developing a research outline.

Each of these elements inform one another. The epistemology justifies the assumptions we bring to the research. In particular, what kind of knowledge do we believe will be attained by our research? What should observers make of the outcomes? The epistemology is the theory of knowledge embedded in the theoretical perspective, which influences the methodology as well as the theoretical perspective. The theoretical perspective is the philosophical position that informs the methodology. It provides a context for the research process and grounds it in logic and criteria. The methodology is the plan, action or strategy used to design and formulate the choice and use of particular methods. The methods are the techniques or procedures used to get and analyse data related to the research question(s).

In this study, I use a constructionist epistemology. My theoretical perspective is interpretive phenomenology. Consequently I use a range of interpretive methods which utilise a variety of research tools or instruments (questionnaires, interviews, content analysis of student brainstorm, journals and essays). These have been triangulated with my participant observations of the biology class and teacher involved in the research. I use a case study reporting mode to frame my interpretations of whole class changes and individual characteristics.

I have organised the sections in this Chapter according to the phases in the research process outlined by Denzin and Lincoln (2000, p. 20). In Section 4.2, I outline the interpretive epistemology of constructionism. This section gives a summary of the premises that framed and guided my research. Then, in Section 4.3, I discuss my research strategies, including the study design, the theoretical perspective of phenomenological studies, how my study was situated in naturalistic enquiry, use of case studies, background information about the class and the teacher, and the ethical dimensions considered in the conduct of the research. Section 4.4 outlines my research methods, which includes six data collecting instruments supplemented by participant observation. In Section 4.5, I give details of the research questions and explain how these relate to the data sources and how these data were analysed. It is important to note how the data sources were combined for each student in metamathics (Miles & Hubberman, 1984) to allow me to visually compare students for trends in learning characteristics across the group(s) and to see individual subtleties and peculiarities. In the final section (Section 4.6), I discuss the limitations of using students' and the teacher's perceptions as a research tool.

4.2 The Constructionist Research Paradigm

In this study, a constructionist epistemology allowed the building of understanding of how features of the tasks, accedence with authority (teacher or text material), evaluation and students' perceptions dynamically interact within the classroom. What the participants revealed about their experiences allowed me to interpret what happened and why it happened. In reporting on them, the reader is assisted in the construction of knowledge (Stake, 2000). Although I have my own conceptual frameworks, I have tried to assemble the meaning from the salient trends and relationships, to illustrate the meaning I have derived. The ideas presented here are very much embedded in the context. I have only written about those that I considered important after consulting with my peers (including international conference presentations) and my supervisors and acknowledge that these ideas are bound by my own values. Often I have been conscious that my meanings have been derived through the mutual interactions of the possible interpretations. I intend that through making sense of this research project, the reader will reconstruct the knowledge in a holistic way, as I have tried to do, to make it purposive.

4.3 Research Strategies

4.3.1 Study Design

This study investigates how learning occurred in this context, how a range of classroom activities influenced students' thinking about bioethical issues linked with cancer and how students' knowledge and use of learning strategies related to their essay writing. It describes how the students, the teacher and myself perceived these activities, what the important aspects of the learning environment were and how they were experienced. I assumed at the outset that within the single class under investigation, there would be a wide range of individual differences, both in terms of student interpretations and final outcomes. The aim of this study then, was to describe how the intervention was perceived in a common sense across the class and how it was interpreted differently by individuals; that is, as far as possible, how members of the class differed from each other in unique ways. The class was used as a case study for describing the overall approach (Chapter 5), students' thinking about bioethical issues (Chapter 6) and students' thinking about learning (Chapter 7). Five individual cases are given in Chapter 8 to provide detailed descriptions of individual interpretations and outcomes. The data sources used are augmented by my role as a participant observer. I have therefore elaborated on this role in section 4.4.1.

4.3.2 Phenomenography

The unit of work, in a research sense, can be considered the phenomenon, and the set of activities and experiences gained by the students are considered as multiple phenomena. Phenomenography is a research method that is used to map the qualitatively different ways in which people perceive phenomena. It involves investigating reflections on people's experiences and their conceptualisations and understanding of the phenomena.

A phenomenological study describes the meaning of the lived experiences for several individuals about a concept or phenomenon (Creswell, 1998, p.51).

Phenomenography, as a research approach, grew out of research in the early 1970's that was driven by the need for more in-depth approaches to describing the meaning behind the variation in students' learning. The basic idea of the phenomenographic approach is to describe individual's perceptions as faithfully as possible, with the underlying intent of the research being to disclose different ways of seeing, experiencing or understanding. It is the

ideas about the phenomena that are important, rather than trying to precisely determine a truism or reality.

Phenomenography then is very useful in investigating teaching and learning, because the intent is to develop an understanding of the relationship between the students' experiences of the teaching and learning and the quality of the learning outcomes. It uses naturalistic enquiry methodologies that focus on discovering meaning for a particular context (Merriam, 1988).

4.3.3 *Naturalistic Enquiry*

I used a naturalistic enquiry approach so as to provide rich descriptions of the interactions in factors that influence learning, and to provide holistic accounts and explanations of the study. Lincoln and Guba (1985) state that naturalistic inquiry has thirteen characteristics. I explain how each relates to this project below.

1. A natural classroom setting was used since the phenomena was the teaching and learning of the bioethical issues associated with cancer.
2. The students and the teacher were the participants for data gathering.
3. Tacit knowledge was used as well as propositional knowledge. In this case, I had a working relationship with many of the students in the class. I was aware of some of their behaviours, strengths and limitations from having observed them for three years previously as a teacher of their classes. This alone gave me valuable background knowledge and allowed me to interact with the students and interpret their responses in ways that an outside researcher would not have been able to do.
4. Qualitative methods were chosen because they were adaptable to dealing with the multiplicity of factors and the unknown elements that would emerge from the nature of the project.
5. I purposefully used a specific class because of my previous relationship with them.
6. The data has been analysed inductively to derive categories from the sources so that the multiple interpretations could be documented.

7. The guiding substantive theory emerged from the data. No à priori theory could include all the interpretations that would be likely in this particular context.
8. What became important, in terms of the design, was determined, to some extent, by what happened, and therefore what needed to be followed up. During the research process I needed to respond to emerging trends or check individual characteristics. This involved changing emphasis on questions during the post-unit interview, to focus on learning strategies.
9. In some respects, the open nature of the interviews allowed me to negotiate meanings and clarify them with the informants (see Section 4.4.5).
10. I used a case study reporting mode as described in Section 4.3.4.
11. The data has been interpreted ideographically because it is peculiar to this context.
12. I did not intend to make broad generalisations, but rather derive tentative applications of the findings.
13. The credibility of this piece of research is underpinned by the subtleties it exposes, and the degree to which it is plausible and links with previous findings. I discuss this further in Chapter 9.

4.3.4 Case Studies

Case studies are examinations of specific situations or phenomena (Merriam, 1988).

Yin has stated

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 1994, p. 13).

Interpretations of case studies are always couched in the contexts in which they are observed. Of prime importance is what can be learned from the case(s). I have used the case study method because I deliberately wanted to uncover contextual factors.

Cases provide examples of what happened and why it happened. This case involves an investigation of learning in a particular context: what went well and what could have been improved.

There are several layers in this approach. On the first level, I used the class as one case (Chapters 6 and 7). The material was condensed in order to observe trends. On the second level, I clustered students into 3 groups according to their essay marks and sought commonalities within these groups. Individual students were selected from the groups as "nested" cases to preserve the integrity of the source material and to illustrate how these students were similar and contrasted with the other students (Chapter 8).

In order to get a more holistic understanding of the case(s) I triangulated multiple sources of data as recommended by Smith and Deemer (2000). Triangulation sanctions the "criss-crossing" of all the information in multiple directions to allow for convergence of the data sources (Yin, 1994). This allowed me to identify the different ways the phenomena were seen or interpreted by the students. Triangulation also helped to verify internal reliability of the findings (Merriam, 1988). What people think they are doing, what they say they are doing, what they appear to others to be doing, and what they are doing may be quite different. Therefore, it was important to consider multiple data sources to gain an overview and authenticate the claims I make about the cases.

4.3.5 Background Information about the Study Group

A former teaching colleague, whom I had worked with for three years, agreed to make his year 13 class available to me. It was a logical choice. As I had recently been a teacher in this school, the students knew me well and were very unlikely to treat me as an intruder. This was particularly important in this classroom study, since many of the cancer issues to be raised could have been emotionally close to individual students. I also felt that these students would be prepared to try new activities and be more willing to participate in the research than students with whom I had had no prior connection.

The school was a co-educational, inner city school. There were 21 students in this class. Sixteen of them (4 males and 12 females) volunteered to be involved in the study.

The group of students could be described as having a wide range of abilities and backgrounds. The school is classed by the Ministry of Education as a decile 3, which means many (certainly not all) of its' students come from low income families. Many of these 17-18 year old students had part time jobs outside of school hours.

Thirteen of the 16 students were of European decent. Daniel and Tulane (pseudonyms) were of Samoan decent. Although they both had all of their schooling in New Zealand, Samoan was the spoken language at home. Awar had emigrated from Somalia two years prior to this. He was still learning English as a second language.

The students had a variety of reasons and related goals for taking biology in year 13 (see Table 7.1). Two students in the study group (Mary and Mitchel) had not taken biology as a subject in year 12.

4.3.6 Background of the Teacher

In New Zealand secondary schools, teachers have a high degree of individual professional freedom to choose what they deliver within the confines of the curriculum. Pre-set programmes of work are generally not used, although unit outlines and possible activities and resources are provided. In biology classrooms, teachers may choose to use a range of textbooks or other resources. There has also been some teacher development related to using student-centred activities to promote more active participation by students. Because teachers are free to make choices, the culture of evaluating and changing approaches is not new. This is important in that the teacher of the class involved with the research was willing to be flexible. He wanted to address the issues of how to expand students' awareness of the bioethical issues (central to the component of the curriculum on which this research focussed), and how to advance skills in researching, writing essays and self-regulated learning.

The teacher had taught biology and science in high school settings for 26 years. From my observations of his teaching for the previous three years as a colleague, I determined that he was very experienced in setting up learning environments that were conducive to student-centred approaches. He was also committed to improving the effectiveness of his teaching and was very willing to try procedures that I suggested. He took ownership of the teaching and considered how he would adapt the ideas into instruction. His experience also allowed him to draw on a large body of content knowledge and socially contextual idiosyncratic contexts (see Sections 5.3.10 & 5.3.14) that he used to illustrate ideas or principles. The students appreciated his non-confrontational manner and told me that his stories and anecdotes helped them to remember. More specific characteristics of his teaching are discussed in Section 5.2.5.

4.3.7 Ethical Dimensions Considered

Permission to observe this year 13 class was obtained from the Principal and the Schools' Board of Trustees. I outlined the nature of the project to the students during class time and explained that they could volunteer to be a part of it, if they wished. They were also told that they could withdraw from the study or withdraw information at any time. Letters were given to the students that described the project, outlined what was expected of them, the choices they had regarding voluntary participation and continued participation, and how access to data and reporting would be maintained (Appendix 1). They were asked to sign a consent form (Appendix 2). Parents /guardians were also asked to sign the consent form, even though most of the students had already turned 18 years of age. Sixteen of the 21 students in the class volunteered to take part.

At all times, I tried to be aware of ethical considerations regarding my interactions with the students and the teacher, as outlined by Stake (2000). In this kind of research we are, as Stake (2000, p. 447) suggests, "guests in the private spaces of the world" where on the part of the participants "their expressions are exposed, creating a risk of embarrassment and possibly loss of standing and self-esteem". I therefore tried to act within the boundaries of research codes when relating to students.

The students have been given pseudonyms to protect their anonymity.

4.4 Methods of Collecting the Research Material

In this section, I describe the variety of methods used for collecting data. These included classroom observations, questionnaires, pre and post unit interviews, and a range of artefacts generated as part of the learning process such as brainstorm sheets, journals, and essays. The activities which generated the data from learning experiences are described more fully in Chapter 5.

4.4.1 Participant Observation

Case studies are characterised by researchers spending time, on site, personally in contact with and observing activities, and reflecting and revising meanings (Stake, 2000). Although the usual class teacher directed the classroom activities, I took on the role of participant observer (after Gold, 1958). It was not possible for me to be "neutral" because

of my previous relationship with both the students and the teacher. I had previously taught 11 of the 16 students who volunteered to take part in the study. Because of this former relationship, I was not viewed as being an outsider and the students welcomed my presence and were open to the research paradigm.

I observed approximately three-quarters of the lessons in this unit of work. Mostly, I sat at the back of the classroom and took notes. If asked, I would answer questions from both the teacher and the students. Occasionally I also asked questions and prompted the students during class work sessions as I wandered around the room, while making observations. I recorded my field observations in a notebook, that was divided into whole class observations and sections for each of the 16 students. The notes included behaviours of the students and the teacher, as well as some comments made during class sessions. I also recorded some classroom instruction sessions and classroom conversations using a small dictaphone that was placed either on the desk in front of me or in my pocket, if I walked around the room. Therefore it was unobtrusive, as far as the students or the teacher was concerned. Mostly the participants were unaware of when I had it turned on or not. I consider that the presence of the dictaphone had very little effect on the behaviour of the students or the teacher. During one session, I outlined the Human Rights conventions and a list of ethical considerations that had been generated from a class I had taught previously.

As soon as possible after each observation, I transcribed the classroom activities and annotated my notes. I also wrote questions and memos to myself to remind me of aspects I wanted to explore in more depth with individual students in the post-unit interviews. I also wrote comments and questions in students' journals (Section 4.4.6) to give them feedback on their journal writing. This was partly because the teacher did not have time to do this after most sessions, and partly because I wanted to monitor the use of journals so as to offer guidance and support for student enquiries.

The effects of my presence on the outcome of the unit of work are unknown. No doubt there were advantages in having an extra teacher to answer questions. The students were expected to work independently but they also expected me to respond, if they asked me a question.

4.4.2 *Brainstorm Sheets*

The brainstorm sheets generated by students at the beginning of the unit were photocopied to provide a record of each group's prior knowledge. I have included several in Appendix 3 to give an indication of the depth and breadth of prior knowledge.

4.4.3 *Pre-and Post Questionnaires*

In order to determine whether student thinking about the bioethical issues had changed, the same questionnaires were given to students at the beginning and end of the unit of work. The questionnaire is given in Appendix 4. They were designed to explore students' ideas linked to the way essay questions had been worded in previous University Bursary exams. These questionnaires were answered individually, without peer consultation, in class time, as part of the teaching programme.

4.4.4 *Pre- Unit Interviews*

The interview has been described as the best way and perhaps the only way to find out "what is in and on someone else's mind" (Patton, 1980, p. 196). The main purpose of the pre-unit interview was to establish what the students knew about their own learning and their motivational constructs. Questions were formulated around finding out how students processed information when researching and writing essays. I also wanted to find out about their metacognitive processing, but questions were never phrased in such abstract terms. I wanted to use the responses to determine, as much as possible, what learning strategies the students used prior to the unit of work. An outline of the interview questions is given in Appendix 5.

The pre-unit interviews were carried out all on the same day. I had been invited by the class teacher to accompany the class to Wainui, a field station where the students were designing and carrying out experimental work as part of an internally assessed component of their practical animal study. The interviews were carried out individually, in the same room as other students were working on their experimental designs. Each interview took approximately 20 minutes. The interviews were transcribed verbatim.

4.4.5 Post Unit Interviews

An outline of the questions used to direct the post-unit interviews is given in Appendix 6. Although this was used as a guideline, I also used the memos in my observational notebook as well, to direct what I thought I needed to clarify with individual students. A list of activities carried out in the unit was used as a prompt, since I wanted to elicit their opinions about the activities and what they did in response to these perceptions. Students chose which activities they commented on.

Each of the post unit interviews was carried out individually in normal class work sessions, during the last week of the unit. In order to be out of earshot of the other students, these interviews were conducted in the preparation room adjacent to the laboratory. Each interview took approximately 30-40 minutes. The interviews were transcribed verbatim.

4.4.6 Journals

The students were given notebooks as part of the inquiry and evaluative processes of learning (Appendix 7). In the front of the notebooks there was a statement of purpose and a space for students to write their goals. Some questions about decision-making regarding treatments for cancer and prompt statements for evaluating the activities in the unit of work, were included at the back of the notebooks. The students were also given laminated bookmarks to keep inside their journals. These had prompts to help initiate considerations of the bioethical issues, as well as to cue planning, monitoring and evaluating their inquiry processes and writing (See Section 5.3.2).

At the beginning of the unit, I explained to the students that the journal was for them, to record their thinking, their key words, anything they wanted to find out or anything they were wondering about during the unit. I also explained that I would collect and use the journals, as part of my research.

4.4.7 Essays

Section 5.3.13 discusses how feedback was given on the pre-write paragraphs and how essays were used in a peer assessment activity. As a research source, the essays were collected and photocopied as students completed them. Samples of essays for the individual case studies are given in appendix 8. The teacher marked the essays according to a marking

schedule that had been negotiated between the students and the teacher. The essay marking schedule is given in Appendix 9. I also marked the essays and wrote comments to indicate to students where they had done well and what they could improve on. The essays and marking schedules/comments were stored as photocopies.

4.4.8 Summary of Data Sources

Student absences and two tape recording malfunctions prevented a complete data set being collected for all 16 students in the study group. A summary of the data sources for each student is collated in Table 4.1. Because Samantha was absent for the pre-unit interview, and Liz's first interview did not record, for these two students, the questions for the pre-unit interview were asked at the time of their post-unit interviews. Niome did take part in a post-unit interview, but it did not record. Daniel and Tulane did not write in their journals at all. Daniel, Kay, Mary, Sally and Tulane did not complete a final essay. Ann, Liz, Marianne and Terri wrote two essays, to get more practice and additional feedback on their efforts.

Table 4.1 Summary of data sources for each student

Student	Q 1	Q 2	I 1	I2	Journal	Essay
Ann	✓	✓	✓	✓	✓	✓✓
Awar	✓	✓	✓	✓	✓	✓
Charlie	✓	✓	✓	✓	✓	✓
Daniel	✓		✓	✓		
Kay	✓	✓	✓	✓	✓	
Liz	✓	✓	✓	✓	✓	✓✓
Lois	✓	✓	✓	✓	✓	✓
Marianne	✓		✓	✓	✓	✓✓
Mitchel	✓	✓	✓	✓	✓	✓
Mary	✓	✓	✓	✓	✓	
Niome	✓	✓	✓		✓	✓
Sally	✓	✓	✓	✓	✓	
Samantha		✓	✓	✓	✓	✓
Terri	✓	✓	✓	✓	✓	✓✓
Tulane	✓		✓	✓		
Vincy		✓	✓	✓	✓	✓

Q = Questionnaire

I = Interview

For reporting on all data sources in subsequent chapters, I use the following codes:

Pre-unit interview (iv1)

Post-unit interview (iv2)

Journal entry (j)

Essay extract (e)

Classroom observation (co)

4.5 Data Analysis

4.5.1 Research Questions Linked to Data Sources and Analysis

No one method of data analysis would be able to describe this intervention adequately. For this reason, I have employed a multi-method approach that combines microanalysis of tasks and cognitive behaviour, and detailed investigation of students' knowledge and evaluations, as well as the teacher's understandings and my own experience.

The overall research question for this study was:

How can learning be enhanced in this bioethical context?

The specific sub-questions are given in Table 4.2. This table also shows how the multiple data sources link to the research questions and summarises how these were analysed.

Table 4.2 Links between the research questions and the data sources

Research Questions	Research objectives	Data Sources	Analysis
1. Can students' views about social and ethical issues be broadened?	To investigate how year 13 students perceive the "biological concepts," "social, ethical and biological implications" of cancer.	<ul style="list-style-type: none"> • Questionnaires pre and post-unit • Brainstorm responses based on classroom activity • Journal entries • Essays • Post-unit interviews 	<ul style="list-style-type: none"> • Categorise answers to both pre and post questionnaires and compare • Categorise brainstorm answers • Record and categorise comments/conversations during class work sessions • Initiate and monitor records in learning journals • Collect and mark essays • Categorise post unit interviews according to types of issues
2. Which classroom activities in the intervention influenced student thinking about the social and ethical issues associated with cancer?	<p>To analyse students and teachers comments about different types of activities</p> <p>To use classroom observations for reliability</p>	<ul style="list-style-type: none"> • Journal entries • Post-unit interviews • Teacher interview • Observation notes 	<ul style="list-style-type: none"> • Categorise all data sources according to activity • Re-categorise comments and other sources according to emergent themes

Research Questions	Research objectives	Data Sources	Analysis
3. What kind of relationship is there between students' prior knowledge of bioethical issues and the content of their essays?	To evaluate students prior knowledge about social and ethical issues. To evaluate the social and ethical issues mentioned in essays and compare it with the prior knowledge.	<ul style="list-style-type: none"> • Pre-unit Questionnaire • Essays 	<ul style="list-style-type: none"> • Document specific issues written in pre-unit questionnaire in comparison with specific issues mentioned in the essay.
4. Which activities in the intervention helped in developing learning processes?	To analyse students' and teacher's comments about different types of activities To use classroom observations for reliability	<ul style="list-style-type: none"> • Journal entries • Post-unit interviews • Teacher interview • Observation notes 	<ul style="list-style-type: none"> • Categorise all data sources according to activity • Re-categorise comments and other sources according to emergent themes
5. What kind of relationship, if any, is there between students' prior knowledge of learning strategies and their use of these in researching and essay writing?	To investigate whether students can identify strategies/approaches that make their learning more effective. <ul style="list-style-type: none"> • identify their own learning needs • plan, monitor and evaluate their work 	<ul style="list-style-type: none"> • Pre-unit interviews • Post-unit interviews • Journal entries • Observation notes 	<ul style="list-style-type: none"> • For each student, categorise learning strategies according to whether students knew or used them • Analyse journals for statements and questions that might indicate learning strategies • Analyse essays for planning, text structure, allocate marks.

Research Questions	Research objectives	Data Sources	Analysis
6. What evidence is there that the intervention helped the students to be self-monitoring and self-regulating in their learning?	To analyse student performance in planning, researching, note making, self questioning, summarising, editing and writing.	<ul style="list-style-type: none"> • Post-unit interviews • Journal entries • Observation notes • Essays 	<ul style="list-style-type: none"> • Analyse journals for questions or planning, monitoring or evaluation evidence • Categorise planning, monitoring or evaluation and other evidence of self-reflection in post-unit interviews • Analyse essays for evidence of planning, researching, self questioning, summarizing, critical analysis
7. What other teaching and learning factors might influence the way in which students learn about social and ethical issues?		<ul style="list-style-type: none"> • Post-unit interviews • Teacher interview • Observation notes 	<ul style="list-style-type: none"> • Categorise factors and collate comments mentioned by both students and the teacher • Add in contextual factors noted in the classroom observations.

4.5.2 Questionnaires

Categories for answers to questions were inductively generated from the students' responses. Each student's answers were allocated to a particular category. These categories were modified and extended as the answers were tabulated. The categories were checked independently to verify their clarity and coverage of the responses. The number of categories given by each student for questions was tabulated. These were compared for changes in thinking about the biological, social and ethical issues and implications. Terri did not take the post-unit questionnaire very seriously. She left blank spaces for some questions. This instrument may therefore not give a very accurate indication of Terri's knowledge at the end of the unit of work.

4.5.3 Brainstorms

Items written on the brainstorm sheets were coded according to the following categories: types of cancer, causes, biological effects, treatments, social and ethical issues. The number of items in each category were "group" totals. All of the students who contributed to a particular group were given the totals derived from their group.

4.5.4 Pre Unit Interviews

I selected quotes from the interviews and categorised them electronically according to students' perceptions as to what they did regarding various aspects of their learning. The categories were:

1. "good" at (perception of ability)
2. reason for being "good" at (perception of control).
3. "needed help with" (awareness of weaknesses)
4. reason for needing help (perception of control)
5. achievement expectations
6. planning
7. ease of essay writing
8. discrimination of information
9. evaluation of essays

10. learning mode preference (individualistic or group)
11. help-seeking characteristics
12. self-control over learning
13. distracters

These were then compared with other data sources, as described in Section 4.5.8. Learning strategies were not pre-determined. Instead, students' knowledge and use of learning strategies was gauged indirectly by interpreting their interview responses.

4.5.5 Post Unit Interviews

The post-unit interview answers contributed to many aspects of the overall data analysis (see Table 4.2). The first phase was a selection procedure carried out within each interview transcript. For research question 1, I searched for quotations to illustrate students' ideas about the biological, social and ethical issues. These were categorised into multiple themes as given in Tables 6.1-6.5. Answers to the interview question "Have your ideas about what ethical ideas are, changed?" were used to determine if they perceived there was a change in their thinking.

For research questions 2 and 4 (Table 4.2), I selected quotations and categorised them by activity. Not all students commented on all activities since they were asked to identify activities from the prompt list, that they thought were helpful. The second phase of analysis involved sorting the quotes within the categories for similarities and differences to derive a "pool of meanings" for each classroom activity. These were then sorted, so that those with similar themes were grouped together.

The post-unit interviews were also used to provide quotations for motivational aspects and features that contributed to the overall approach to the unit.

Quotations were also categorised in the metamatrices for learning characteristics as explained in Section 4.5.8.

4.5.6 Journal Entries

Journals were scanned for evidence of thinking about the biological, social and ethical issues. Entries that indicated planning, monitoring or evaluation were also selected. The number of questions written in journals was tabulated (Table 7.5).

4.5.7 *Essays*

Essays were marked according to a marking schedule that had been negotiated with the students. An outline of this schedule is given in Appendix 9. Since producing an essay was the intended product outcome of the unit of work, students were grouped into the following categories according to the quality of their essays: "Invisible Product", "Satisfactory Product" and "Quality Product". Students in the "Invisible Product" category did not hand in a final essay. Students in the "Satisfactory Product" category produced essays that ranged in marks from 13/40- 24/ 40. Students in the "Quality Product" category wrote essays which gained a mark between 26/40 – 32/40. Those students who wrote more than one essay in either the "Satisfactory Product" or the "Quality Product" categories were put into separate sub categories of "Multiple Satisfactory" and "Multiple Quality".

4.5.8 *Metamatrices*

Metamatrices or master charts were constructed for each of the 16 students, so that I could visually collate the multiple data sources above simultaneously, as recommended by Miles and Huberman (1984). This enabled me to categorise quotations, extracts, observational notes and outcomes into themes related to learning. It also allowed me to more visually link individual's learning tendencies to their learning outcomes.

The grid categories went through several iterative changes because I needed to be able to sort within categories and be able to cluster some of the original ones. The final main categories were: Ability Perception, Perception of essay writing, Planning, Researching, Essay Writing, Seeks Help, Monitoring of Progress, Self Questioning and Other evidence of reflection. The metamatrices for the five students used as individual cases in Chapter 8 have been given in Appendix 10 (A-E) as examples.

The data represented in the metamatrices allowed me to cross reference my sources to determine if students knew of learning strategies and whether they used them. These results are reported in Chapter 7.

I also established whether students had prior knowledge of the strategies for research question 5, by analysing the pre and post-interview comments.

In order to identify specific learning strategies, the metamaterials were scanned and new tables were created for each of the targeted strategies. The learning strategies were divided into three major categories: declarative, procedural and metacognitive awareness and control. Each of these was further subdivided according to the categories outlined by Derry (1990).

Declarative strategies were divided into locating and focussing, schemas, and elaboration.

Locating and focussing information includes using text structure to identify important points, underlining or highlighting important words or phrases, or using key words or key phrases to search information.

Schemas include the use of concept mapping or any graphic organisation to structure, order or rank text, the use of mnemonics such as G.E.E. (Generalisation, Explanation Example) and visualisation techniques for memorising.

Elaboration includes explaining ideas (e), answering questions and using generative note making strategies (q), and summarising or paraphrasing (s).

Procedural strategies were subdivided into generalisation, discrimination and practice/effort.

Generalisation strategies are those where summaries or overviews of a particular idea are constructed.

Discrimination strategies are those where information is sorted according to relevance or importance. Students who used the "trash and treasure" exercise or their own modifications of it, were classified as having used discrimination.

Practice/effort related to whether the students perceived that practice or effort was important in writing a good essay.

Metacognitive awareness and control strategies included planning, monitoring and asking evaluative questions.

Planning included setting goals or making an intention for the inquiry process clear. For some this involved writing lists of content that needed to be

investigated or included in essays, making headings or writing a flow chart for the structure of their essays.

Monitoring included self-checking on progress, re-reading material if it was not completely understood, using information from peer-checking or setting priorities.

Asking evaluative questions were indicated by journal entries or self-reports during interviews.

Metacognitive awareness is linked to knowing the strategies, whereas control is linked to making decisions about using the strategies.

4.5.9 Individual Student Case Studies

The selection of individual cases for extended description (Chapter 8), was linked to the categorisation of groups according to the essay marks. I chose at least one example from each of the categories "Invisible Product", Satisfactory Product", "Quality Product" and the subcategories of "Satisfactory Multiple" and "Quality Multiple". The choice of each case was difficult, because several students in each category showed interesting characteristics. Each of the five cases were not necessarily selected for their typicality, but were selected to provide examples for extending the meaning of aspects related to this study, as discussed in Chapter 8.

Each of the 5 students has been compared with the other students in their essay category group to elaborate on aspects of learning given in Chapter 7. I searched all data sources to collate information on the categories considered important for enhancing self-directed learning as described by Wang and Peverley (1986) The categories are; learning awareness, use of strategies, monitoring progress, integrating and extending knowledge and motivation.

4.6 Limitations of using students' and the teacher's perspectives as a research tool

Students' perspectives were derived from multiple sources: the pre and post-unit interviews, pre and post-unit questionnaires, journal entries, classroom comments and activities during the unit of work, including the final essays. There are limitations of this approach however. In using self-reports of the students, I relied on their articulations of their reflections of their experiences. The participants have chosen what they wanted to

reveal to me. Some of them revealed their connection with the issues to me privately. However, I did not pursue their feelings. They were only recorded as part of answers to general questions in the interviews. Students sometimes chose not to discuss some of these issues in forum small groups, nor publicly in class discussions. Also, because most of the students knew me as a former teacher, they might have told me what they thought I would want to hear, rather than giving their honest opinions. This is an unknown factor.

Journal entries were limited to the thoughts that the students chose to share or bothered to record. The data reflect what they chose to write at the time.

Review of the interview transcripts by the participants was not always possible. The pre-unit student interviews were transcribed and considered before the post-unit interviews. This allowed me to recapitulate on areas where I may not have fully explored students' ideas in the pre-unit interview. It was not possible to transcribe the post-unit interviews and have them available for review by students before the end of the year. Because this was their final year of high school, many students moved to another centre for employment or to go to university. It was not possible to track them for review of their comments. Although the teacher was given an opportunity to read and review the transcript of his interview, he only made two one word changes, and did not want to alter any of the main ideas.

Since teacher planning and thinking is crucial to the design of professional action in the classroom (Barry & King, 1998), I felt that it was essential that the teacher took ownership and was instrumental in the planning of the unit of work. He was provided with some pertinent background information about teaching social and ethical issues and about using reflection as a tool for learning.

There is no doubt that the teacher interpreted what was required to enhance learning in this context. His interpretations were likely to have been related to his own previous teaching experiences, but were limited to some extent. Brookfield (1995) has linked teacher action to knowledge, skills and how the interactions are established within the classroom. The teacher's decisions were probably based on thoughtful and systematic (though often implicit) assumptions about the students, the subject matter, the teaching/learning environment, and the teaching process itself. Therefore the decisions

are very contextually based and represent his interpretation of how the teaching should take place.

I chose to use the teacher's responses (from comments made during classes and from his interview) as a way of gaining insight into his perceptions of the teaching and learning context.

4.7 Chapter Summary

This chapter has provided a detailed description of the research process used in the present study. It has provided an outline of how data were collected and analysed. It also has given a framework for presenting and interpreting the findings in the following chapters. In the description of the unit of work in Chapter 5, some further detail about these issues is also given.

I have chosen to use students' experiences in a classroom as an ecologically valid way of assessing how activities were perceived and implemented. A constructionist epistemology allows the building of insight into how features of tasks, authority, evaluation and students' perceptions dynamically interact within the classroom. I have attempted through the range of methods outlined in this chapter to describe learning in this context:

- by focussing on individuals as well as the learning context;
- from the students' and the teacher's perspectives using interviews and observations rather than paper and pencil scales;
- by relating processes and products rather than just products to personal frameworks and
- by examining learning processes (knowledge and use of strategies) through a range of interactive classroom activities.

Chapter 5 The Unit of Work

5.1 Overview

This chapter describes the overall approach of the intervention that is the focus of the research reported here, and the specific activities used for the unit of work on bioethical issues with the year 13 class. The approach takes into consideration many aspects from previous studies on teaching about social and ethical issues as discussed in Chapter 2 and methods for promoting more self-regulated and intentional learning (Chapter 3). The approach draws on the underlying epistemologies for learning in bioethical contexts. It includes the establishment of students' existing ideas, the processes of inquiry, open discourse and promoting metacognitive behaviours.

A scheme proposed by Aikenhead (2000), already described in Section 2.2, outlines the spectrum of possibilities of implementation as an expression of the relative importance of the social and ethical aspects. The approach used in the present research is similar to his fourth category, *Singular Discipline Through STS Content*. In category four, a curriculum achievement objective drives the inclusion of social and ethical aspects and there is no prescribed science content, which was the case for this implementation (Section 1.4). It is noteworthy that there was no student textbook that covered the science content for this part of the year 13 biology course that is the focus of the present study.

There are some differences between this intervention and the examples given by Aikenhead (2000). In the unit of work that was the intervention, there was not a prescribed set of lessons or modules equivalent to other category four examples given by Aikenhead (2000), such as the ChemCom units from the American Chemical Society (1988) and the Dutch PLON units (acronym for physics in a social context; see Eijkelhof & Kortland, 1988). In contrast to the STS approaches used in ChemCom and PLON, the unit that was the focus of the present study did not emphasise the technological aspects (in this case detection methods or treatments of cancer). If students were interested, they investigated technological aspects individually. The science content selected either by the teacher or the students was biological and related to the questions students derived for themselves. The content coverage is not prescribed by the curriculum document. What content should be covered then becomes a dilemma. Also there is a dilemma associated with establishing how much conceptual knowledge

an individual student needs to have in order to meaningfully engage in higher order discourses (Fensham, 2001), which are essential for learning in socio-scientific contexts.

The purpose of not describing content in this section of the curriculum is so that there is freedom to choose, and there is an openness to accommodate advances in technologies. As mentioned previously, secondary teachers of biology in New Zealand follow school departmental guidelines, which outline possible sequences of delivery and resources, but teachers have a lot of professional freedom to choose how they interpret this. Students were assessed on their in-depth understanding of the bioethical issues, but not as extensively as on the pure science content.

Often the focus of including social and ethical dimensions into science contexts has been to derive solutions to the indicated issues (Fien & Williamson-Fien, 1996). In the present study it was not the intention for students to resolve the bioethical issues, but rather to increase students' awareness of the multiple perspectives related to them.

In order to get students to be more responsible for their own learning, I considered it important for them to reflect on what they already knew in terms of the issues and in terms of their procedural knowledge for researching and writing essays. Therefore the approach in the classroom included activities to help students evaluate their ideas about the bioethical issues and about their own learning. In Section 5.2, I outline how various aspects were prompted: accessing prior knowledge (Section 5.2.1), promoting inquiry (Section 5.2.2), considering a range of viewpoints and affective aspects through discourse (Section 5.2.3), and ways of evaluating the students' ideas about the issues and about their learning processes (Section 5.2.4). Characteristics of the teaching that facilitated these are also highlighted in this Section 5.2.5.

The activities for the unit of work were negotiated between the teacher and myself. We had both previously facilitated this section of the curriculum many times. Our aims were to use activities that would increase students' awareness of the social and ethical issues as well as help them to use information processing skills and learning strategies for evaluation, so that they would be self-directed in their inquiries. The activities are described in Section 5.3.

I discuss some of the perceptions of the unit of work in terms of its merits and improvements in Section 5.4. The activities considered to develop students' thinking

about the bioethical issues are discussed more fully in Section 6.8. I elaborate on the perceptions of the activities, which developed the processes of learning in Section 7.7.

5.2 General Approach to the Unit of Work

5.2.1 Accessing Prior Knowledge

In a constructivist view of learning, identifying and acknowledging prior knowledge is fundamental (Osborne & Freyberg, 1985). Students already had some background knowledge and had notions about what ought to be done socially or ethically to deal with the issues associated with cancer.

The pre-unit questionnaire (Appendix 4) was used as a research instrument to assess students' prior knowledge of the bioethical issues. A group brainstorming exercise at the beginning of the unit of work (Section 5.3.1) initiated reflection on existing biological, social and ethical knowledge (see Appendix 3 for examples). The inquiry approach also encouraged students to investigate/research relevant content material (Section 5.3.7) using self questioning as recommended by Blakey and Spence (1990), Evans and McCann (1993) and Jarvis *et al.* (1998). Exploring students' beliefs or feelings was instigated through values clarification and values analysis. For example personal accounts of cancer patients on video clips, and case studies and activities that required students to relate these situations to themselves, created opportunities for students to evaluate affective perspectives. Such activities required them to apply their prior knowledge, rather than merely identify it. These included a continuum activity where students had to rank cancer types according to their preventability (Section 5.3.3) and a treatment choice activity where small groups were given a scenario about lung cancer and had to discuss and give reasons for their choices (Section 5.3.10). The latter two activities were the beginning of the interactional component that was important for airing and sharing students' opinions.

5.2.2 Promoting Inquiry

In Chapters 2 and 3, I have outlined the advantages of using inquiry as an approach to learning about bioethical issues. It was very important to the unit of work to incorporate ways to get students to be proactive and interactive in their learning through student-centred activities involving self-questioning through inquiry. The stages of the classroom inquiry process outlined by Lane Clark (Keown & Crocker, 1996, p. 14)

were followed. Students were given explicit instructions on the skills required for researching (Section 5.3.7), note making ("notes on notes", Section 5.3.8) and how to sort relevant from irrelevant information ("trash and treasure", Section 5.3.9). At each stage of the inquiry process, students were encouraged to ask themselves questions, as recommended for increasing meta-learning by Bakopanos and White (1990). Some students wrote these questions into their journals (Section 5.3.2).

Because many activities were carried out in small group or whole class situations, where students were required to evaluate their ideas, it could be considered as similar to a community of inquiry approach as explained in Section 2.3.5.

5.2.3 Promoting Discourse

In order to delve into the underlying issues in depth, Dawson and Taylor (1998) advocate that the classroom environment should allow open discourse in which students' beliefs can be articulated, disclosed and examined non-judgmentally. Activities were incorporated to promote social interaction as a way of mediating and extending individual meaning making. Because the aim of analysing bioethical issues in this way was to expand pluralistic notions, students not only needed a "sounding board" for their own ideas to clarify them, but also needed to hear what their peers thought, so that they were made aware of differences of opinion. Students were encouraged to discuss issues as they arose. There were also planned activities that relied on discussion (Continuum on the preventability of types of cancers, Section 5.3.3; videos, Section 5.3.6; Choices of treatments scenario, Section 5.3.10; Euthanasia scenario, Section 5.3.111; Ethical Considerations from International Instruments on Human Rights, Section 5.3.112).

5.2.4 Prompting Metacognition

The teacher assisted students in planning, monitoring and evaluating their work through questioning and a range of procedures, some of which have been outlined by Costa (1991). Prompting students to use thinking processes was part of the everyday learning, as recommended by Resnick (1987). In Section 3.7, I proposed two main agendas for supporting evaluative constructivism so that students can take responsibility for their own learning. These are:

1. cueing students to come up with an intention, that is, get them to ask "What do I need to know or do?" in regard to planning, monitoring and evaluating, and

1. indicating that there are choices in the ways/directions to proceed.

Although the teacher did not embrace these as explicit agendas, elements of them were included. Prompting students involved the teacher asking both individuals and the whole class questions. The analysis of issues in bioethical contexts is controversial and is related to an individual's feelings and beliefs. Each student is required to evaluate 'What do I think?' Encouraging students to ask their own questions or cueing them to consider one thing they have learned today, have been two of techniques used in the PEEL project to help students use metacognitive processes (Bakopanos & White, 1990). The bookmarks given to students to use in conjunction with their journals contained prompts to help students reflect on what they thought and what they needed to know (Section 5.3.2; Appendix 7).

Prompting also involved the teacher modelling procedures that could be used to plan an essay (Section 5.3.14) and how to use a checklist for evaluating essays. Instigating self and peer assessment of essays also helped students to evaluate their thinking and writing (Section 5.3.15).

The element of student choice was inherent in the approach. Most of the students set their own agendas for planning individual research, choosing the two types of cancer they wanted to investigate and deriving the key words and key questions that would drive their work. They were also free to choose which written resources and other sources to use for their research. The teacher emphasised several times during class work sessions that there were not necessarily right answers, indirectly indicating that it was up to the students as to how and what they wrote in their essays (Section 5.3.14). Providing opportunities for students to choose what content to focus on and how they should proceed, is probably more important than has been emphasised in previous studies where reflective, metacognitive and intentional learning has been the focus. If information and activities are presented to students without alternatives, there is no need to use evaluative processes.

5.2.5 Characteristics of the Teaching

The role of the teacher was vital. He was aware of trying to maintain "objectivity, balance and neutrality" and because students wanted him to give his

opinions on the issues, that maintaining objectivity, balance and neutrality was difficult. When asked for his opinion, he prefaced statements with "Well it depends on..." or "If you looked at it from the patient's point of view.." and other phrases to indicate to students that there were multiple perspectives.

An open and accepting classroom climate is also important so that students feel comfortable about giving their opinions (Dawson & Taylor, 1998) and sense that there is a "spirit of inquiry" rather than indoctrination (Geddis, 1991). The teacher established this culture by modelling mutual respect. He insisted that only one person spoke at a time, allowed wait time after asking questions and accepted all students' answers. He also did not allow individuals to dominate during whole class discussions, nor allow students to put each other down. He deferred his authority and power by allowing students to discuss issues in small groups and by allowing multiple interactions between students during whole class discussions.

When personally relevant and personally challenging topics are being covered in the classroom, it is important that students feel a sense of community and trust, so that if they reveal anything, it is accepted sincerely. The importance of cancer as a personally relevant content context was evident in this class. Eleven of the 16 students in this study had a relative or friend who had been affected by some form of cancer. Many students also found cancer issues personally relevant because the topic moved them to reflect on their own lifestyle choices, particularly attitudes to exposure to the sun and smoking (Section 6. 6).

These 17-18 year olds took the "respect for one another" approach seriously. No significant issues of personal disclosure or discomfort arose that I was aware of, despite the degree of personal relevance. It was therefore also essential that the teacher maintained a safe, open and accepting classroom climate.

At several times during the unit of work, the teacher used socially, contextual, idiosyncratic examples to illustrate either opinions about the bioethical issues (Section 5.3.10) or processes in researching and writing essays (Section 5.3.14). This type of modelling, that includes multiple perspectives on thinking, is considered especially important when teaching about controversial issues (Geddis, 1991) and when incorporating metacognitive processes as part of the learning activities (Costa, 1991). Several students reported that the way the teacher usually related aspects of biology to

interesting, real-life examples was one of the characteristics they appreciated about his teaching.

As mentioned in Chapter 3, deferring power and setting up a classroom environment that promotes reflective and self-directed learning to occur is important in *evaluative constructivism*. The teacher involved had a policy of asking questions rather than telling students the answers. He also used his professional judgement about how much direction/guidance groups or individual students required. Knowing how much guidance to give and when to leave students to their own devices is problematic for teachers, particularly if students consider that the teacher should tell them what to do.

5.3 Descriptions of Activities

In this section, the activities incorporated into the unit of work are described, in the chronological order that they were carried out. In some instances I indicate the ways the teacher and the students saw the purposes and consequences of the activity.

5.3.1 Brainstorming

Students were introduced to the topic "cancer" by brainstorming ideas in 6 groups of 2-4 students. They were encouraged to collate their ideas on A3 sheets of newsprint. For example groupings of ideas included treatments, types of cancer, causes, effects on the body etc. (Appendix 3). The brainstorming activity showed that students had significant prior knowledge about types of cancer, treatments, alternative therapies and some of the social and ethical issues associated with cancer. The teacher was surprised to note their depth of knowledge. He had not used brainstorming in previous years at the beginning of this unit of work.

Mr S (iv): It showed up that they knew far more than what last year's group knew, and I think that is probably because of some students having personal experiences on it. They might also be getting more information through the media nowadays, but that was certainly interesting.

Student reactions to the brainstorming activity, as revealed in interviews, were positive and are given in Section 6.8.1.

As a result of what they had written, the teacher told them that they already had a good overview of the content. This gave them confidence that they were going to study a topic they already knew something about. They were also told that they would need to choose two types of cancer to investigate in detail. The teacher suggested they

should collect information over the forthcoming two-week holiday break and look for newspaper articles and relevant references.

5.3.2 *Learning Journals*

Students were given small notebooks to use as learning journals. In addition they were also given bookmarks (Appendix 7), inspired by Foggarty (1991) and Shuell (1988), that contained theory-embedded cueing devices or "thinking tools" (McTigue & Lyman, 1991) to encourage memory recall and to help students record their thoughts and ideas during the unit of work. The prompts on the bookmarks included:

Something I Learned Today...
What does what I've found out today mean?
It seems important to note
I want to...
A question I have is....
I'm lost with....
I disagree with..... because.....
What I need to do now is.....
I can't decide if.....
I'm stuck on.....
I wonder...
What I need to do now is...
I'm wondering why.....
One point of view is....
How...

It was emphasised several times during the unit that the responses to these prompts were thinking records for them to record their ideas. The students were encouraged to write questions into their notebooks as a guide for their research.

The use of the journals varied. The average number of entry days was 5, including the two students (Daniel and Tulane) who made no entries at all. Students only tended to write in their journals when they were reminded and given time at end of the lesson to do so.

Student journals were collected at the end of most sessions to give feedback on progress and "feed forward" in the form of questions the students might like to consider. The idea of commenting in journals in this way was to encourage and promote greater usage of the learning journals, and to indicate their importance.

There were many examples where self-questioning was promoted by the use of the bookmarks given out with the journals. Most of the journal entries were in the form of lists of information students needed to find out, which showed monitoring of learning

and some planning. Other entries were questions that students were wondering about or simply just statements about what had surprised them or that they had found interesting.

In contrast, other students did not find the journal useful, either because these students did not like to write their thoughts or they thought it was too time consuming. After observing that some students were not writing in their journals I asked them, "What was the purpose of the journal?" Their use of it depended on what they saw as its purpose. Mitchel, Marianne and Liz considered that the journal was for me, the researcher, so they asked questions in order for me to answer them. The real purpose of the journal, as a reflective, self-directive tool, was not obvious to them. They saw the journals more as an evaluation check for the researcher, as illustrated by Mitchel's, Marianne's and Liz's comments below and other comments in Section 6.8.3.

Mitchel (co): [The purpose of the journal was] for us to keep in contact with you. In the journal I wrote a few questions and the reason I wrote those questions was because I didn't know the answers. So I was expecting you to sort of answer them for me and then you said to keep writing yourself questions.... For you, to see how we were going.

So, even by the end of the unit Mitchel had not seen that asking himself questions could help focus his intention on what was required.

Marianne (co): [The purpose of the journal was] more for you. Usually I'd remember the questions in my head. For you to see what we were thinking.

In a way, Marianne was correct, in that the students knew the journals were being used as a research instrument. The entries in journals certainly provided valuable evidence of students' planning, monitoring and evaluation. This purpose was made clear to the students as part of the research briefing.

Marianne, I suspect, was quite naturally self-reflective and did not use the journal extensively to write down questions because she did this naturally and could remember them. Perhaps if the advantages of using the journals for clarifying learning needs had been stated more often, students may have been more aware that the intention was for their benefit.

Liz stated that she found writing in the journal difficult.

Liz (co): [The purpose of the journal was to write] notes for you to see how we were getting on. I kind of found it hard to write in my own journal. The things I asked weren't really

important. I didn't really care about the answers. The prompters weren't useful.

Even though Liz's comments about the use of journals were quite negative, an analysis of her journal entries revealed that she had 6 separate entries (more than the average 5) and that she wrote 14 questions (compared with an average 3.5 per student). Some questions she wrote were quite personally relevant (Section 6.8.3). She also answered some of her own questions in her journal and included some of the ideas in her essay. This suggests that Liz used her journal to help her think and learn about the bioethical issues, even though she stated that the journal was not useful.

Several students considered that the journal was for their own monitoring, as indicated by the following statements.

Samantha (iv2): It was for me and then it was for you. To help me get into writing things down and working out what I needed to know, but it was also for you, to see where we were up to.

Niome (iv2): It was for me. It gives you a greater depth of understanding. More of a focus on what we're doing. When you've written down what you think, you're more likely to focus on it.

Despite the reticence of some students to use their journals, the teacher considered that using the journals helped the students to focus on what they needed to do, as illustrated below.

Mr S (iv): The journal writing, some were keen to do that, I think that they got keener as they progressed, they could see the value of it, but initially they couldn't quite see the point of it apart from using it as a diary just to remind them what they have to do. They were actually talking to themselves, they had never done that in a material way before. I think the kids don't spend near enough time looking at their own performance for a period or for a section of time. The journals forced them to do that.

Researcher: Would you use the journals again?

Mr S: Yes.

Researcher: Where could you see that that they might be useful? Is it just in this sort of a research type unit?

Mr S: I think it could be used in other sections [of the curriculum] especially things that are academically difficult like genetics, where you teach a thing and you don't know whether they have picked it up properly or not until you actually test them at the end (*implying there was a monitoring function*). And a lot of them are too scared to

ask because it [the content] just looks so complicated they just don't want to ask about it. So the journals, I think were a good idea but certainly the prompting questions needed to be there because they didn't know how to start to talk to themselves on paper unless they had some specific things to look at.

5.3.3 *Continuum of Preventability of Types of Cancer*

Each group of students was given a set of cards with the names of cancers on them. They were instructed to order these from the most preventable to the least preventable. The purpose of this activity was to get them to discuss and share information about each type of cancer to apply their prior knowledge. It also helped them to think about what they did not know or needed to know about each cancer type. Some students wrote down the order that their group derived into their journals (Awar, Vincy, Terri and Lois). The teacher's comments reinforce that this activity helped to explore students' prior knowledge and that some of this prior knowledge had been gained in informal settings.

Mr S (iv): So once again that reinforced what was shown in the brainstorm, that some of the cancers, they knew of them but they didn't really have any [substantial] knowledge on them and others they had some direct knowledge on. Like they seemed to know that melanoma is preventable, a direct result of the TV campaign probably, but they weren't too sure about a lot of others and most of them didn't realize that liver cancer is often a secondary cancer anyway. They didn't know that there were stages like that.

The teacher also commented on how this activity linked to the ethics issues.

Mr S (iv): What came out of that [the activity] was that some things are theoretically preventable but not practically preventable, like theoretically you can get rid of basically melanoma, just don't let anyone outside, or cervical cancer, we didn't spend a lot of time discussing that, but that is probably [related to] an STD, so all you have got to do is say right, no sexual activity and you prevent it. It is very preventable but it is not practically. And what came through from that later on in the ethics was the lifestyle of New Zealanders. [They] typically don't like to be told what to do, and that comes into ethics doesn't it?

Researcher: Yes. So do you think the kids have picked up on that in their essays?

Mr S: Yes, the lifestyle thing they have. The ones that didn't think about the government making up rules, a lot of them said that they should legislate that play areas of primary

schools are covered, they [the government] can do that, but obviously they wouldn't go any further than that. You've got to be practical.

5.3.4 *Teacher Instructed Background Information*

There were three distinctively teacher-directed lessons on the nature of cancer, the aetiology of cancer and the meanings of key words related to cancer such as metastasis, oncogene, malignant, carcinogen etc. The content about specific types of cancer was purposely not covered in class because students were expected to research the details about the incidence, treatment and prevention of two types of cancer individually, from the resource materials provided.

The teacher used overhead transparencies to present information. Each time a new transparency was shown, the teacher would discuss the main ideas and ask the students to write down only the information they thought they needed. According to the students this is how the teacher usually delivered notes. Despite his instructions, some students copied the notes word for word and were not discriminatory in their note taking (Mary, Vincy, Sally). These students did not use discriminatory strategies (Table 7.3).

Several students made comments in their post-unit interviews that background information from the teacher was valuable.

Daniel (iv2): Usually when the teacher gives background information that is good too, because you are used to the teacher doing that.

Liz (iv2): Background information. That was good because you had something to work from, a base.

The students were accustomed to teachers giving them information rather than having to decide what they needed to find out. Some students would have preferred more teacher-directed instruction. They considered they were better at copying and repeating information rather than making decisions about what information to include in their essays.

The teacher's comments below about how students liked being given information, indicates that he knew some of them preferred to be told what to do and that some of these students were unaccustomed to independent inquiry and self-directed learning.

Mr S (iv): Then the background information I gave them, some of it was me getting them to take notes, but I did provide some notes. They liked that, mainly because it is what they are

used to I think, at school. Especially the ones like Marianne who are very efficient in their working, they don't like to be mucking around having to find stuff. If I already know, they want me just to tell them, and they remember it. They don't want to waste time. [The students are thinking] "To hell with discovery, just tell me."

The teacher considered that for some students, teacher-directed information was seen to be an efficient way of gaining the important information and saved time, whereas for others it was linked to not knowing what to do or just simply being lazy. Despite his acknowledgement of what students would prefer and empathy towards this approach, he wanted the students to take a more active role and responsibility for their own learning.

5.3.5 Barrier Crossword on Terms

This is a paired reverse crossword where each student is given a copy of the crossword with half the answers already written on it. Each student makes up the clues orally for the words appearing on their half of the crossword. They give these clues to the other student who fills in the answers on their version of the crossword, and vice versa. Most students had to look words up in reference books before they made up their clues. By having to rephrase what the words meant, a greater understanding was achieved. This was especially important in a topic such as this where there were many new words. Students were quite familiar with this sort of activity. This may be why they did not comment on it as an activity that influenced their learning.

Most students did not complete the activity in the half lesson that had been allocated to it. The teacher suggested that they continue to find out the meanings of the words they did not know in their own time. Some students wrote the words they needed to look up in their journals which indicated a planning strategy (Vincy, Terri and Lois).

5.3.6 Videos

Three videos were shown on separate days. The first one - "Cancer - Beating the Odds" - followed the cases of 4 people with cancer. The teacher wrote key words on the board as the video progressed and discussed what they meant at the end of the video. This video was very emotional and included personal stories of people with mesothelioma. The mother in the video was crying as she explained that she felt helpless "our son was dying of cancer and we couldn't do anything about it." This brought tears to many students' eyes. The students were also appalled at the lack of concern by employers in the video, about asbestosis. The students commented (Section

6.8.4) that this video, because of its personal nature was quite "shocking". They also appreciated seeing what people who had muscular atrophy looked like.

The other two videos, "Cancer - The Facts", and "Genetics - a popular guide to the principles of human heredity", gave biological information in a factual way.

The teacher's comments indicate that students responded more to the first video, and its personal stories, rather than the factual documentary-type videos. I consider that it was because of the personal, emotional nature of this video.

Mr S (iv): The videos that we used. One was well received and one wasn't. One is getting a bit dated now. There's one there called "Cancer - the facts", that was a commercially prepared one but those sorts of educational videos aren't nearly as absorbing as the TV type docu-drama or documentary things.

Researcher: That have the personal people?

Mr S: Yes. I presume it is because of TV that they get used to watching a story rather than just seeing information and charts and things.

5.3.7 *Researching /Inquiry Process*

Students were given the Student Research guide (Appendix 11) that had been written by the teacher. This hand out gives an outline of the skills needed for this unit. It takes account of different learning styles and emphasised that students would be required to think critically and independently and that they would need to self-direct their own learning. The teacher referred to each section of the sheet and highlighted each section. The only time he referred to this sheet (during my observations) was at the time of issue. Such a valuable summary could be referred to more often, to remind students of the processes they need to use.

Students were given approximately six lessons for independent research, but were expected to spend their own time locating and sorting appropriate information. Some students used this class time profitably (for example, Charlie, Lois, Ann, Vincy, and Mitchel), whereas others talked (Terri, Marianne and Kay) or were not organised in taking notes (Tulane, Mary and Sally). Awar found it difficult to take notes in class, due to his difficulty with English. Despite this, he produced a reasonable essay by working on it in his own time.

Other more detailed perceptions of the activities used to make researching and essay writing skills explicit are reported in Section 7.7.

5.3.8 "Notes on Notes"

This is a way of annotating notes and is also one of the activities recommended in the PEEL activities (Baird and Northfield, 1992). The students were shown how to write notes on a narrower page than usual and leave space for note making at the right hand side. This activity was not widely used and certainly not emphasised by the teacher. He had not incorporated this way of annotating notes previously. The research materials that were given to students were not pre-formatted with increased margins to allow space for making notes. The research materials were from newspapers, journals such as *Scientific American*, *Time* and *Newsweek* as well as text material from the Cancer Society. Reformatting them would have made this activity more accessible but would have taken considerable time.

5.3.9 Instruction on "Trash and Treasure"

This activity elaborates on a way of discriminating information in text given by Grant (1998). It involves searching text with key words or specific questions in mind. The text used as an example of this process is given in Appendix 12. The teacher demonstrated how to go through the text, on an overhead transparency by crossing out irrelevant information and leaving relevant information untouched. This is a very evaluative procedure.

On previous occasions, students had been instructed to take notes only on the important points, but many admitted that this meant they still copied word for word. This was the first time these students had been shown an activity that illustrated how you could have some key questions, sift through the information sentence by sentence, discard most of it ("trash"), or value parts of the text which corresponded to the key words or answered the questions ("treasure").

The teacher commented that those students who were discriminative were able to sort the relevant information and apply it to the questions.

Mr S (iv): That was that one on the BRCA gene wasn't it, where the kids often just simply take too many notes. It was only the kids that were switched on that read that whole article and then said this only applies to five percent of cases anyway, so it is not that important (*that is, they evaluated the information and applied it to the question*). The others missed that and they wanted to take notes on all

these things that caused this [mutation and incidence] but the key thing was that it [both ovarian and breast cancer] was only in five percent [of people with the BRAC1 mutation].

At the end of the exercise, after students had been given time to read through the text and evaluate it using the questions, the teacher went through paragraph by paragraph with the whole class, asking individual students what they thought was the 'treasure'.

Student comments were very positive about the process, as illustrated by Marianne's comments below. Additional comments are given in Section 7.7.1.

Marianne (iv2): Because quite a lot of people just wrote down the paragraphs, when taking notes and that sort of thing, we haven't learnt how to do note taking properly [previously].

Researcher: How did that help you take notes?

Marianne: It's not so much I didn't know, you should look for the most important point and it is just that you think I can't be bothered, I'll just write it down. Because we were doing a thing [activity] on it, it was like, I'm going to do that, [choose] the most important points and paragraphs and just write them down and try and write out the meaning by yourself so you know it is in your head. The most important notes made me realize that they are best than picking every little sentence, so it actually was quite good and it made me figure out what it meant.

This activity also incorporated a question at the end that challenged students' ideas about the ethics involved with genetic screening. Marianne commented in class, in reference to the emotional aspects of genetic screening, that people deal with information in different ways and that this influences people's lives. Both Sally (Section 6.5.6) and Lois made comments in their journals on the question at the end of the exercise about not advising their sister to have her breasts removed as a preventative measure for breast cancer, if she had the BRAC1 mutation.

Lois (j): If I did have a sister with a gene [for breast or ovarian cancer] I wouldn't advise her to have it removed, until she has been properly diagnosed.

Some students did not find this activity useful. This was probably related to their limited use of the procedure and not experiencing the benefit of its use. Their comments appear in Section 7.7.1.

5.3.10 Choices of Treatment

This activity was designed by the teacher but based on the idea that specific scenarios are useful for students to be able to relate to the social and ethical considerations from a personal perspective, as mentioned in Chapter 2.

The following scenario was written on the board.

You have been diagnosed with lung cancer. Your options are:

Surgery - 5% success rate after a long period in hospital. You will have reduced lung function.

Chemotherapy - This is not very successful, it buys time. It is given each month and causes severe nausea for three days each time.

No treatment - terminal?

The students were asked to discuss and write down the pros or cons of each treatment choice and then report back to the class about what the group had decided.

The students enjoyed this activity because it raised a lot of discussion and there were no right or wrong answers. Daniel, Mary and Marianne wanted clarification about the age of the person, the degree of development of the cancer and what symptoms they had. This showed that they realized there were conditional aspects that could influence their decisions. This is the exact intention of the activity. That is, to get students to consider multiple alternatives and what these might depend on.

There were also discussions on the implications of each treatment and what people ought to do. Small group discussions allowed individuals to say what they thought as illustrated by the comments in Section 6.8.2.

The teacher's comments about the activity indicate that he considered "on task" behaviour as important. When he noticed that some groups had not progressed very far and were stuck on the conditional aspects he called the class back to attention and proceeded to get feedback from each group.

Mr S (iv): The discussions, they were quite happy to discuss that but I felt that dealing with one whole group wasn't probably as useful as making them go into small groups but there is a risk putting them into small groups, they are such good mates, that they often get off the topic.

He also commented on his role during small group discussions.

Mr S (iv): I think when there is a discussion, I've got to facilitate it and make sure that I keep bringing in the ones that aren't saying anything.

5.3.11 *Euthanasia Scenario*

The teacher created a handout from a resource by Gordon and Nicholas (1996). This is given in Appendix 13. It included some background information about the ethics of care and the current practices and trends in New Zealand, religious arguments, a cultural perspective and an objection statement. It also described a case study of a 52 year old man who had secondary cancer all over his body and for whom all active treatment had been ceased. The doctor decided to increase the morphine to a lethal dose. Students were asked to discuss whether the doctor should have increased the morphine.

The students enjoyed discussing this issue at length because there were reasons for both sides of the argument, as indicated by their comments below and in Section 6.8.2. By the end of the discussion all students agreed that the doctor should have increased the morphine dose in this case.

The students appreciated having the opportunity to use their own opinions rather than just information that had been learned in the classroom. The following two students' comments also exemplify the student-directed ownership of the discussions.

Mary (iv2): I thought it was good. I thought you've got more of a say rather than the other parts of the curriculum. You can put your own opinion in and you knew something about it so it wasn't just what you'd been taught.

Sally (iv2): Yes, it makes you concentrate more. It is easy to tune out if you are just taking notes, you don't really read what you are writing, if you have to put input into it [your own ideas].....You have to know more about what you are talking about.

Sally's comment shows that she thought that discussions provided a more active way of learning for her. Active participation was an inherent aspect of the small group discussions. The comments about "having to know more" indicate that some students felt they had to demonstrate their knowledge when taking part in discussions. There was also a sense that they could use opinion and what they knew from informal sources.

5.3.12 *Ethical Considerations from the International Instruments on Human Rights*

A list of ethical considerations from the International Instruments on Human Rights (Appendix 14) was shown to students on an overhead transparency. They were asked if they could come up with examples for each aspect. This activity was an adjunct

to broaden their awareness of what ethical issues might include. Many had not thought of the legal issues before.

In her post unit interview, Liz commented about how this had changed her thinking about bioethics.

Liz (iv2): I think it's made me think more of like legal things. I thought it was medical /beliefs family, but I never really thought about the bigger picture - in terms of society. It's helped clarify what ethical things are.

5.3.13 Pre-write Paragraph

The idea of this, in literary terms, is to get students to write one or several paragraphs as an introduction that outlines what will be in the essay. It is designed to help "advance organize" what will be written and requires evaluation of the ideas that would be included. Students were instructed to write a paragraph on "Describe the causes, effects and treatments of two types of cancer, including one hereditary type." Motivation for this task was low, probably because students felt they did not have enough information to be able to write something to hand in. My classroom observations note that Charlie chose to read and did not write anything. Niome, Terri, Marianne, Kay and Liz talked about a trip away. Lois and Mitchel wrote, but without reference to any notes they had taken previously. It was the last period of the day. The teacher's comments reflected his frustration with the student's non-compliance on this day.

Mr S (iv): Getting a product out of them was quite tedious and I have found this in previous years. They will sit there and take notes till the cows come home, but they won't actually put pen to paper and give an answer.

Some students did find this a useful activity however, (see comments in Section 7.7.2). The teacher gave feedback on the paragraphs that had been handed in. He explained that in the first paragraph they should restate the question in their own words. He considered that students had difficulty deciphering the essay question.

Mr S (iv): So just reading questions is a skill that they need practice on I think.

Researcher: And writing plans for that question?

Mr S: Or even just rewording the question. [They should ask themselves] "What is the question here?"

Ann, Awar, Mitchel and Vincy all indicated in their interviews that understanding the question was an important part of producing a good essay.

5.3.14 *Essay writing*

Planning

There was no doubt that planning was a very important component of writing the essay. The teacher commented that he thought planning was essential.

Mr S (iv): I think I would practice this planning as I said before, because then if they have got the tools they can do it. That is the main tool before they actually write it is to jot all these things on a piece of paper.

The teacher realised the importance of planning essays and although he thought many of his students had planned it, only 4 said they did. The teacher suggested that it may have been better to get the students to hand in written plans so that he could check their understanding of the question before they went ahead with the essay.

Researcher: Do you think many of them made flowcharts or planned before they did their essay?

Mr S (iv): Yes, they should have. We had been working on just one or two particular essays anyway so they probably had it mapped out. It wouldn't have hurt, looking back now, what I should have given them was a completely different question and said now just do the skeleton spider-gram or whatever you like to call it.

Researcher: The plan for it?

Mr S: Yes, just the plan, nothing else, just so that I know that they are reading the question and seeing what it is in the question that is being asked, because I'm still not sure that they are not going to jump in and answer this years question [in the exam] like they did this one.

Although planning was emphasised several times by the teacher as being very important, many students did not write a plan for their essays mainly because they thought it was too time consuming.

The confidence to write an essay was linked to the students' prior experiences of researching and writing essays. The students identified learning how to organize information and structure essays as necessary skills to write a good essay. Both Mitchel and Liz commented on their previous lack of success with organizing information and how having help with structuring and formatting helped them to write their essays (Sections 8.3.2 and 8.6.2).

Checking- checklist

The teacher showed the students an overhead transparency that outlined essay-writing skills (shown in plain text below). He made comments about each point as he went through them (*italic text*).

ESSAY WRITING SKILLS- *What should an essay have?*

Introduction - *Restate the question the way you understand it.*

The issue and conclusion are stated briefly.

Body - *Paragraphs in logical order. A paragraph is a prescribed bit of information.*

Paragraphs focus on a single key word or idea.

The key word is explained. Facts are used to support this.

Examples. Examples are given.

End the paragraph with a summary sentence.

Conclusion *Relate the key words to the issue*

* *Give your opinion if asked for it. Complete the circle*

* *You've got to plan it.*

* *Check spellink!!*

Diagrams are ok. These things are obvious.

Many students thought they already knew these points so they did not bother to copy them. Awar and Niome were exceptions and wrote the list into their notes (co). The teacher commented that it was probably a reminder for most students.

Mr S (iv): Some got that, some didn't. They would agree with all the check points down there but it was another list and they certainly wouldn't learn it.

Niome commented in her journal that having a checklist helped to organise the information.

Niome (j): I know what information I have and can organise things. Gives more of a structure which makes it easier to work from and see what I need.

The teacher then gave an example of how to use key words/ideas to write an essay about keeping a dog. The class brainstormed the key words that might be useful and the teacher wrote them on the board. Then the teacher showed them how to group the key words by putting numbers next to them. He allowed students to have input into

the lesson by asking questions during the example and indicating that there might be more than one way of planning.

Mr S(co): Has anyone got another way of planning?

Liz (co): In History, we make a generalisation, then put it [the ideas] in a logical order in a list.

This example is one in which the teacher, through his approach, indicated to the students that there was not necessarily a single way of proceeding and implied that they had a choice.

The teacher commented further on the students' prior knowledge of the processes involved in using text structure to both find information and write essays. The SQ3R (Skim, Question, Read, wRite, Review) was a combination of strategies that were reinforced for information processing across multiple curriculum areas at this school.

Mr S (iv): Some of them have already met the SQ3R method on note taking and all that, but a lot of them found it valuable to go through that. Some of them weren't aware of the way well written documents are structured that you don't necessarily have to read the whole thing to find what you want. If you look at say the last sentence of the paragraph you should be able to get a clue of what was there, so you can just quickly scan those bits and hone in on information a lot faster.

Researcher: Do you think they have learnt that from doing this unit?

Mr S: I would say, yes. The ones that already knew it like the Historians, had already been given this somewhere else. But they are still not good at using the key words and referring to those every now and then through their essay and using the right language for that.

5.3.15 Peer Assessment

Evaluation of essays requires critical thinking about what should be included and whether the evidence/information given backs up the claims. Those students who had written essays swapped them and used a marking schedule that was negotiated between the teacher and the students (Appendix 9). The teacher used the same marking schedule to evaluate the essays.

Mr S (iv): The peer check I think was well received. They probably take more notice of their peers than they do of us. I wouldn't be surprised.

Researcher: Do you think they were able to mark them OK?

Mr S: They were overly generous I think, although they were quite critical and with the schedule they came up with

they did keep to that. And the schedule was generous anyway. I didn't want to put them down too much.

His comments indicate that there was a difference between the marks students gave each other and the marks given by the teacher. Despite this, he still considered peer assessment to be a worthwhile activity.

Peer checking of draft essays gave the students new ideas, allowed them to consolidate their ideas and gave them insights into how an essay could be organised, especially where constructive comments were given by their peers (see comments in Section 7.7.6). For some students, it was the most beneficial part of the whole process of writing the essay.

5.3.16 Teacher Assessment

The teacher used the negotiated marking schedule (Appendix 9) to allocate marks as indicated in Table 7.2. He had a very positive approach when he gave oral feedback on his assessment of the essays to the whole class, but was adamant that they should use the processes he had been endorsing.

Mr S (co): Most of you have got far more knowledge than you're letting on. The essays don't do you justice. Almost nobody mentioned the word oncogene. Almost nobody, except Ann mentioned the initiation, the latent and the secondary phases – metastasis etc. You've got to mention those key words.

The teacher also wrote comments on the essays to indicate areas where students had done well and what could be improved

5.4 Perceptions of the Overall Approach

In an approach that promotes *evaluative constructivism*, I have suggested that prompting students to come up with an intention and indicating that there is a choice could help students to take responsibility for their own learning. Had these agendas been clarified when the unit of work was conceived, they may have been emphasised more explicitly during the teaching. Even so, there were elements of these agendas in this intervention (Section 5.2.5).

Self-questioning helped students to plan and derive intentions for what they should do. Prompting students to self-question and providing specific information-processing instruction, also allowed some students to access some of their prior knowledge and monitor and develop control aspects for their learning. Possibly more

emphasis could have been placed on cueing students to generate even more questions, particularly in regard to planning (for a stronger focus on intention) and ensuring that they knew they had choices in the ways they could search for information, summarise it and select what was included. This may have improved the students' abilities and willingness to be more evaluative and hence more self-regulating in their work.

Despite the instructions on how to plan more formally and use information processing procedures for researching and essay writing, it was disappointing that a lot of the information-processing based activities, for example "notes on notes", flow charts and key words/ questions were not widely used during inquiry. Many students stuck with their old habits even though they had been shown examples of alternatives. The teacher had not incorporated these activities into this type of unit before, and did not reinforce their use often. Even so, the teacher considered that there was more emphasis on the inquiry approach in this unit of work than had previously been the case in his teaching of this topic at this level.

Mr S (iv): There was greater individual responsibility taken for the work this year. They weren't just sitting there waiting to be spoon fed. It was a lot clearer this year what they had to go and find out and that it was up to them to do it. No one was going to do it for them.

His comments applied to perhaps 11 of the 16 students. At the other extreme, three students (Daniel, Tulane and Sally) lacked the organizational skills and motivation to take notes adequately and collate what notes they had, which meant they did not complete their essays. Their perceptions of the inquiry process reveal that they were uncomfortable with this approach and wanted to be told "the facts". These students admitted that they did not know where to start without help from the teacher.

The teacher considered that writing the essay was the most beneficial part of the whole unit.

Mr S (iv): Probably the most valuable task in all this here was trying to write the essay. They knew they had the information but they still couldn't put it together in an essay. And some of them, I think you will agree that the essays that we did mark, they were lacking in real [in depth] information even though I knew the kids knew it. They still tend to spend more time trying to put something down that makes sense rather than thinking what they should be putting down.

Researcher: So how could we help them with that?

Mr S (iv): It is probably just practice, isn't it?

These comments indicate that the teacher considered there was still a need to emphasize the biological content in more detail. This is substantiated by the marks allocated to biological content in the students' essays (Table 7.2). The teacher's comments above, though, also imply that he thought practice was the way to improve. He did not mention that evaluation was a strong component, although he had recognised the value in students "looking at their own performance" and that "the journals forced them to do that" (Section 5.3.2).

Discussions on bioethical issues were scattered throughout the unit and incorporated into several activities. The students were more aware of a broader range of factors contributing to bioethical issues as a result of the unit of work. I elaborate on this aspect in Section 6.3. The discussions also provided students with opportunities to develop consensus or respectful disagreement.

The new roles required of both students and the teacher were problematic for some students who were not comfortable with a critical, evaluative approach. Nor were they comfortable with the idea that they should take responsibility for their own learning. This has also been noted as problematic for discussions involving open and critical discourses in a previous study on the teaching of bioethics (Dawson & Taylor, 1998).

5.5 Summary

This chapter has described the activities carried out as part of the unit of work in the present research. I have outlined how prior knowledge was accessed and how inquiry, discourse and metacognition were promoted. The detailed descriptions of the activities together with some of the students' and the teacher's impressions, provide an introduction to how perceptions of what was required, influenced learning decisions. I elaborate on this as I describe the learning outcomes in the following chapters.

Chapter 6 Students' Thinking About Biological, Social and Ethical Issues

6.1 The Organisation of the Chapter

Students' thoughts about the issues associated with cancer were an integral part of this unit of work. One of the main aims of this intervention was to develop the students' awareness and depth of thinking about bioethical issues. Students were required to investigate the biological, social and ethical issues as indicated in the curriculum document (Ministry of Education, 1994).

The activities designed to broaden students' thinking and allow them to reflect and discuss the issues linked with cancer have already been described in Chapter 5. The choice of activities and the way in which the teaching and learning environment was established (see Chapter 5) also contributed to the overall influence of the unit of work.

Consistent with a constructivist approach to teaching and learning (Section 3.2.2) is the establishment of what students know in terms of their prior knowledge. In Section 6.2, I document the students' domain-specific content knowledge about issues linked with cancer, according to their pre-unit questionnaire responses. Since one of the aims of this intervention was to get students to consider the issues associated with cancer in more depth, I describe the changes in thinking about the biological, social and ethical issues, for the 11 students who answered both the pre and post-unit questionnaires in Section 6.3.

Section 6.4 compares the knowledge indicated by the pre and post unit questionnaires, the brainstorm sheets and final essays.

Students had reasonably sophisticated ideas about some of the issues. I have summarised the most pertinent views about specific issues, in Section 6.5, to give an indication of the breadth and depth of the issues considered by the students. Additional aspects related to the level of sophistication of thinking about the issues are given in Chapter 8, for the five individual student case studies.

Section 6.6 indicates how some of the issues associated with cancer were personally relevant to the students involved in this research. Their applications of the issues to society are outlined in Section 6.7.

Since the activities were designed to promote thinking about the social and ethical issues, it was important to determine which activities the students and the teacher considered had some influence on this. In Section 6.8, I discuss several activities that were identified by the students and the teacher as influencing their thinking about the issues.

The final section (Section 6.9) summarises aspects of students' thinking about the social and ethical issues linked with cancer.

6.2 Students' Thinking About Issues Linked with Cancer

Students' thinking about the biological, social, and ethical issues linked with cancer were surveyed using a questionnaire (Appendix 4), administered at the beginning of the unit of work and on the last day of the unit of work. The questions used in the questionnaire reflect the wording ("concepts" and "implications") used in many previous exam questions. The categories for answers in each instance were derived inductively by collating the students' responses into common themes. The issues have been separated into biological (Section 6.2.1), social (Section 6.2.2) and ethical (Section 6.2.3) in line with the areas identified in the Biology curriculum document (Ministry of Education, 1994). Due to class absences on both days when the questionnaires were answered, only 11 students responded to both questionnaires (see Table 4.1 for data summary). The names of students who only responded to one questionnaire are given in italics in relevant data tables throughout the chapter.

6.2.1 Biological Aspects of Cancer

The students' ideas regarding the biological concepts related to cancer (question 2 of the questionnaire) are shown in Table 6.1.

It is noteworthy that five students could not identify the biological concepts (no answer Table 6.1) associated with cancer prior to the unit of work. The post-unit questionnaires indicate that three of these students were able to identify some biological concepts by the end of the unit.

Table 6.1 Students' Responses about Biological Concepts Linked with Cancer.

Answers	Pre-unit	Post-unit
No answer or answer not linked to biological concept of cancer	<i>Daniel</i> Liz Mary Mitchel Sally	Mitchel Sally <i>Samantha</i>
Disease	Awar	
Causes of cancer	Ann Charlie Kay Lois <i>Marianne</i> Niome Tulane	Awar Charlie Kay Liz Mary Niome <i>Vincy</i>
Effects on the body	Ann Kay Lois <i>Marianne</i> Niome Terri	Charlie Kay Liz Lois Mary Terri <i>Vincy</i>
Treatments and how they work	Niome Terri	Ann Charlie Liz Niome Terri <i>Vincy</i>

According to the responses they made in the post-unit questionnaire, Mitchel and Sally had not grasped any biological concepts associated with cancer by the end of the unit. There is evidence from their written work however, to suggest that they had some ideas but just did not write them in the questionnaires. Sally did not write an essay, but she scored 1 mark in her paragraph for causes, effects and treatments. In his essay, Mitchel scored 6 out of a possible 16 for causes, effects and treatments of cancer (see Section 7.3). Therefore, although not indicated in his post-unit questionnaire, Mitchel did identify some biological concepts in his essay.

Question 8 of the questionnaire was "What are the **biological implications** of the topic you have chosen for your investigation?"

The categories have been derived from the students' answers and are given in Table 6.2.

Table 6.2 Student Responses about the Biological Implications Associated with Cancer.

Answers	Pre-unit	Post-unit
No answer or answer not linked to biological implications of cancer	Ann Awar <i>Daniel</i> <i>Kay</i> Mary Mitchel <i>Tulane</i>	Ann Awar Terri
Effects on the body	Charlie Liz Lois <i>Marianne</i> Niome Sally Terri	Charlie Kay Lois Mary Mitchel Sally <i>Vincy</i>
Effect of treatment		Liz Niome
Prevention		Niome
Problems		<i>Samantha</i>

Table 6.2 shows that by the end of the unit most of these students could describe some biological implications of cancer. It was difficult to verify whether Daniel and Tulane knew what biological implications were by the end of the unit, since they did not answer a post unit questionnaire nor hand in any written work which could have indicated this. Most students already had developed broad ideas about the biological aspects prior to the unit as shown by their pre-unit answers. It is important to note though that overall, the number of biological implications, as categorised above, increased from pre to post-unit questionnaires.

Daniel, who gave no answer for this question, stated that he simply did not know what the word "implication" meant. Since "implications" has been a word often used in exam questions, it is important that students understand the wording of the essay question so that they can respond to it. Several students commented in their interviews that understanding what the essay question meant, or "unpacking the question", helped them to know what to write in their essays. Some students also used the essay question to help direct their research (see discrimination column in Table 7.6).

6.2.2 *The Social Implications of Cancer*

Pre and post questionnaire responses for question 4 of the questionnaire "What are the '**social implications**' of the topic you have chosen for your investigation?" are given in Table 6.3.

As for the biological aspects of cancer, students also had notions of the social implications of cancer both at a personal level and for society as a whole prior to the unit. I give examples of how students considered the issues to be personally relevant in Section 6.6, and socially relevant in Section 6.7.

There was a distinct shift in some student responses as shown in Table 6.3. Even though less students completed the post unit questionnaire compared with the pre-unit questionnaire, there were increases in number of students' responses for 5 of the 7 categories after the unit.

Table 6.3. Student Responses to 'Social Implications'

Answers	Pre-unit	Post-unit
No answer or answer not linked to social implications of cancer	Ann Awar <i>Daniel</i> Kay Liz	Awar <i>Samantha</i>
Personal effects: depression, stress, coping, side effects of treatments	Charlie Lois Mitchel Niome <i>Tulane</i>	Charlie Kay Lois Mitchel Sally <i>Vincy</i>
Not able to do what you want	Lois	Lois
Prevention or treatment?	<i>Marianne</i>	Charlie Niome Sally
Social responsibility	Charlie Lois Mary Mitchel Niome Sally Terri <i>Tulane</i>	Charlie Liz Lois Niome <i>Vincy</i>
Family responsibility	Charlie Sally	Ann Charlie Lois Mitchel <i>Vincy</i>
Cost	<i>Marianne</i>	Ann Charlie Kay Lois Mitchel Sally
Passing laws to limit behaviour eg. no smoking		Liz Niome Terri <i>Vincy</i>

6.2.3 Ethical Concepts

Question 6 of the questionnaire asked "What do you think people who are responsible for making decisions about treatment for diseases base their ethical reasons or decisions on?" The answers have been categorised in Table 6.4. Although prior to the

unit most students could give answers for what people considered before they make ethical decisions, the number of students' answers increased in the post-unit questionnaires.

Table 6.4 Students' responses for bases for ethical decisions or reasons.

Answers	Pre-unit	Post-unit
No answer or answer not specifically related to the question	<i>Mary</i>	Awar
Societal Values		Charlie
Legal rights	Ann <i>Daniel</i> Niome	Kay Lois Sally Terri
- beliefs/attitudes	Liz Kay Mitchel	Lois Kay Sally <i>Samantha</i> <i>Vincy</i>
- cultural		Lois <i>Samantha</i>
- moral	<i>Marianne</i> Terri	<i>Vincy</i>
Personal Issues - cost	Lois	Ann Liz Niome Sally

Answers	Pre-unit	Post-unit
- values	Niome	Niome
- patient choice	Kay Sally	Kay <i>Vincy</i>
- effect on family	Kay Lois Sally	Charlie Liz Mitchel Niome Sally <i>Samantha</i> <i>Vincy</i>
- age		Ann Liz Niome Sally
- effect on career		Lois Mitchel
- emotion	Lois	Niome
- experiences (e.g. pain)	<i>Marianne</i>	Liz Ann Charlie Kay Lois Mitchel Sally
Medical Treatments - pros and cons	Awar Liz Lois Mitchel Sally <i>Tulane</i>	Ann Charlie Mary Sally <i>Samantha</i>
- resources and advancement of knowledge		Ann Liz Sally

Ten out of sixteen categories in Table 6.4 had an increase in response in the post-unit questionnaire. Overall, according to these responses, students became more aware of the ethical dimensions related to decision-making about cancer by the end of the unit of work.

Question 7 asked "What are the **ethical implications** of the topic you have chosen for your investigation?" Although this is a similar question to the previous one, in that it was designed to see what students identified as ethical issues, quite a few students wrote different answers. These have been categorised and are shown in Table 6.5.

Table 6.5 Students' Responses to 'Ethical Implications'.

Answers	Pre-unit	Post-unit
No answer or answer not linked to ethical implications of cancer	Awar <i>Daniel</i>	
Personal effects	Charlie Lois Terri	<i>Samantha</i>
Societal Values		
- legal rights	Mary	Sally <i>Vincy</i>
- beliefs/attitudes	Liz Mary Niome <i>Tulane</i>	Kay <i>Samantha</i>
- cultural		<i>Samantha</i>
- moral	Niome	Ann Awar Liz Mitchel Niome Sally <i>Vincy</i>
- social responsibility	Ann Charlie Lois Mary Mitchel Niome Sally Terri <i>Tulane</i>	Charlie Liz Lois Niome <i>Vincy</i>
Medical treatment effects	Ann Kay Liz <i>Marianne</i> Terri	Ann Charlie Lois Mitchel <i>Vincy</i>
Cost money into research versus treatment		Lois Niome Terri
Confidentiality		<i>Vincy</i>

Answers	Pre-unit	Post-unit
Use of trial treatments	Sally	Lois Marianne Mary Niome Sally <i>Vincy</i>
Euthanasia	Lois Sally	Charlie Lois Mary Terri <i>Vincy</i>

In Table 6.4, the increases in response in the second questionnaire are quite obvious. The number of students' responses increased for 8 out of the 12 categories. Three of the categories had a decrease in response.

Questions 6 and 7 of the questionnaire were very similar but worded differently. A comparison of the answers to these in Tables 6.4 and 6.5 also highlights how important the wording of questions are in eliciting responses.

6.3 Changes in Students' Thinking About Issues

This section analyses whether students' knowledge about or views of the issues changed. The categories of answers in the pre-unit and post-unit questionnaires were tallied for each question. The differences between the number of categories for each questionnaire are given in Table 6.6. The students who responded to both questionnaires are listed alphabetically.

Table 6.6 Differences in the number of pre and post-unit questionnaire categories

Student	Biological concepts	Biological implications	Social implications	Bases for Reasons/ Decisions	Ethical implications
Ann	-1	0	+2	+4	0
Awar	0	0	0	-1	+1
Charlie	+2	0	+2	+3	+1
Kay	0	+1	+2	+1	0
Lois	-1	0	+	+1	+2
Liz	+2	0	+2	+3	0
Mary	+2	+1	-1	+1	-1
Michael	0	+1	+1	+1	+1
Nione	-1	+1	+1	+2	+1
Sally	0	0	+1	+3	0
Terri	0	*	0	0	-1

* no answer provided in second questionnaire

When comparing the changes in the number of categories between the pre and post questionnaires, over all the categories for each student (looking across rows in Table 6.6), all students except Terri had an overall positive change. I suspect that Terri did not treat the questionnaire very seriously, since she did not even bother to answer the question on biological implications in her second questionnaire, yet she had clearly indicated some biological implications in the pre-unit questionnaire. Her essays also show an increase in the number of social and ethical implications compared with the number of issues mentioned in her first questionnaire response (see Section 6.4). Of all the students, for all questions, Charlie and Liz had the most positive changes.

For biological concepts linked with cancer (Table 6.6), three students had an increase and three students had a decrease in the number of categories between questionnaires. Overall, there was little change in the number of biological concepts linked with cancer. Four students showed an increase in the number of categories for biological implications between the pre and post unit questionnaires.

The number of categories relating to social implications increased from the pre to the post questionnaire for 8 of the 11 students and decreased for Mary. Similarly, for ethical implications, there was an increase in the number of categories for 5 students and a decrease for 2 students. This shows that overall, their ideas about the social and ethical implications broadened by the end of the unit.

For question 6 of the questionnaire, "What do you think people who are responsible for making decisions about treatment for diseases base their ethical reasons or decisions on?" (Table 6.6), there was an increase in the number of categories for 9 of the 11 students. This indicates that at the end of the unit, most students were able to state more factors that needed to be considered for making ethical decisions.

Further evidence that students broadened their ideas about the social and ethical issues is provided from their post unit interviews (iv2). When students were asked "Do you think this unit of work or doing this essay changed your way of thinking about the ethical ideas at all?" five of the sixteen students said that their ideas had not changed. Examples of how other students recognised the influence this unit of work, in terms of broadening their thinking and promoting a more balanced viewpoint, are given below.

- Ann (iv2): Yeah, I know I am more broad about it, I feel I'm more aware of all the contributing factors now, whereas before if I thought it was an old person and they are suffering you should just let them die, but now I think well, they've got family and I can see all the contributing factors now.
- Charlie (iv2): I think I have a wider understanding of it now, I guess it affects a lot more than just the individual patient. I thought I had a narrow view that it affects the patient and the immediate family, but now I guess it affects the whole of society, which is different. Like society has to decide about cancer and has to make decisions as a whole.
- Sally (iv2): Yes, because at the start when you don't really know anything, you just think that the government should save everyone with a disease and give it all free. Then you realize that you can't and that people bring it on themselves all the time, and they know all the risks, that it is not fair to give them all free treatment as it is to someone who didn't know or couldn't do anything about it, like hereditary type things. Like smoking ones, you know how people get told to stop it and then the cancer moves, and so I don't think they should be given as much free treatment if they have been told about all the risks and told to stop.
- Lois (iv2): I think it's made me think more of like legal things. I thought it was medical, beliefs, family, but never really thought about the bigger picture – in terms of society. It's helped clarify what ethical things are.

All of these statements suggest that these students had some preconceptions about what the social and ethical issues were. Their comments also reveal that the unit of work helped them to clarify and expand on these ideas.

The teacher also commented on how he considered the unit had broadened the students' ideas.

Teacher (iv): They are more aware that there is more than just their one point of view. I think that they have got a better understanding now of it from the patient's point of view, from the family's point of view.... whereas before they probably they wouldn't have considered that those other points of view really existed.... wouldn't have thought about it much.

6.4 Tracking Content Knowledge

In this section I track the written evidence of each students' content knowledge. Prior content knowledge is taken from the original answers given in the pre-unit questionnaire and the students' responses in the brainstorm activity. Table 6.7 records the number of answers in a particular category. The brainstorm analysis is somewhat inferential for each student. The totals may represent the ideas of other students as the brainstorms were carried out in small groups. For example Awar has quite high values for his brainstorm categories (causes of cancer , treatments and social and ethical implications) but he did not identify these in either his first or second questionnaires (see Tables 6.1-6.5). The other students in his group for the brainstorm were not part of the study group. Samantha and Vincy were absent for questionnaire 1 and the brainstorm analysis. Therefore they have been excluded from the analysis. Daniel and Tulane have also been excluded, since they did not hand in any written matter by the end of the unit. Tracking for Kay, Mary and Sally, who produced a paragraph only, is presented separately in Table 6.8.

Tables 6.7 and Table 6.8 show that most students improved on the number of biological effects noted in their essays, compared with the number that they stated in their first questionnaires. This is in contrast to the lack of changes noted in the number of categories between the pre-unit and post-unit questionnaires for biological concepts and implications (see previous section). Of the students who completed questionnaire 1, Niome was the only student who did not have an increase.

Table 6.7 Tracking of Content Knowledge

Categories: C - Causes of cancer
 BE - Biological effects
 Tr - Treatments
 SI - Social and ethical implications

Student	Pre-unit Questionnaire	Brainstorm	Essay	
Ann	2 BE 2 SI	absent	1 C 3 BE 0 Tr 8 SI	4 C 0 BE 3 Tr 4 SI
Awar	1 BE 2 SI	8 C 0 BE 11 Tr 4 SI	3 C 7 BE 3 Tr 1 SI	
Charlie	1 BE 3 SI	6 C 8 BE 3 Tr 0 SI	4 C 8 BE 4 Tr 2 SI	
Liz	0 BE 2 SI	4 C 9 BE 2 Tr 1 SI	2 C 7 BE 3 Tr 6 SI	2 C 6 BE 4 Tr 2 SI
Lois	3 BE 8 SI	6 C 7 BE 4 Tr 5 SI	4 C 4 BE 4 Tr 6 SI	
Marianne	4 BE 8 SI	4 C 9 BE 2 Tr 1 SI	6 C 6 BE 3 Tr 2 SI	6 C 6 BE 4 Tr 2 SI
Mitchel	0 BE 7 SI	6 C 7 BE 4 Tr 5 SI	0 C 3 BE 3 Tr 1 SI	
Niome	5 BE 5 SI	8 C 5 BE 3 Tr 0 SI	4 C 1 BE 4 Tr 6 SI	
Terri	4 BE 4 SI	8 C 5 BE 3 Tr 0 SI	5 C 7 BE 4 Tr 3 SI	1 C 2 BE 4 Tr 7 SI

Table 6.8 Tracking of Content Knowledge for Students who Produced a Paragraph only

Categories: C - Causes of cancer
 BE - Biological effects
 Tr - Treatments
 SI - Social and ethical implications

Student	Questionnaire1	Brainstorm	Paragraph
Kay		4 C	2 C
	2 BE	9 BE	8 BE
	5 SI	2 Tr 1 SI	1 Tr 1 SI
Mary		6 C	3 C
	0 BE	5 BE	1 BE
	5 SI	2 Tr 2 SI	2 Tr 0 SI
Sally		6 C	2 C
	1 BE	7 BE	0 BE
	5 SI	4 Tr 5 SI	0 Tr 1 SI

Interestingly, there were less social implications identified in the brainstormings than in the first questionnaires for most students. This may reflect that the questions in the questionnaire prompted students to think of the social implications. Also, students may have been more focussed on the biological effects and types of treatments, rather than the social implications, when brainstorming their ideas.

The number of social and ethical implications identified in students' essays was disappointing. It seems that the students did not make use of the greater number of concepts or ideas generated as a result of the brainstormings, nor what they had identified in the questionnaires, in their essays. Only four students had an increase in the number of social and ethical issues mentioned in their essays compared with the number mentioned in their pre-unit questionnaires (Table 6.7). Students tended to expand on particular issues rather than extend the range in their essays. Perhaps there could have been modifications as to how the brainstorm results were used later in the unit. Copies of the brainstormings could have been given to all students so they could use them as a prompt when students were planning their essays, for example. These data also confirm that although students were exposed to a range of social and ethical implications throughout the unit and were able to articulate what these were (questionnaire and interview responses), they still may not have seen them as being important to include in

the essay. That is, their perceptions of what should be included in the essay in terms of biological facts may have overridden their inclusion of bioethical issues. There is some evidence to suggest this in students' comments about what constitutes a good essay and what they thought could be done differently (Section 7. 6.1).

6.5 Students' Thinking About Specific Social and Ethical Issues

The intervention was designed to develop students' awareness of the bioethical issues associated with cancer. One of the interesting aspects of the research is to discover that the students had quite sophisticated views about some of these social and ethical issues. This section gives examples of the in-depth nature of their thinking about specific issues. The research process itself, by asking students questions about the issues, no doubt had some effect on this. Usually, students would not have a chance to articulate their views one-on-one with the teacher. The effect of this overall is uncertain.

6.5.1 Euthanasia

Euthanasia was probably the most controversial issue for most students as indicated by the number who noted it as an issue in their questionnaires, journals, interviews and essays. Students were given a specific euthanasia scenario during a class work session, as described in Section 5. 3.11. Some examples of students' comments about euthanasia in general, are given below.

Liz (e): Cancer is a long-term disease and in most respects people experience blinding pain. And a few of these people would rather die in what they consider to be a dignified and practically painless measure which they consider to be the ultimate cure. However euthanasia is seen under the crimes' act as assisting suicide, and is punishable by law. Euthanasia in most places in the world is illegal. In this case personal choice is overruled. To take a life is still considered the most immoral act there is.

Lois (iv2): I still think that if you've got cancer, and if you want to die, you should have a choice, like euthanasia.

Marianne (iv2): I think it is very complicated. I think that people should have a right to die in a natural state but I realize it is not really possible because there is so much red tape that has to be gone through and it is not fair on the doctor. The person that you have asked to kill you or whatever... they have to be really willing to do it and there isn't going to always be someone that will do that, and also you have to prove honestly that they are in an advanced state... they are not going to recover and that sort of thing. There are grey areas where people could be abusing their power to

commit euthanasia. So I don't think it is ever going to be possible but I think people should be able to go.

Sally (iv2): I think there should be euthanasia. It would have to be very strictly regulated. There would have to be no other option, I think, but it would be really hard on the doctors who carried out the euthanasia. They would have to be really OK with it.

Researcher: Why would it be hard for them?

Sally: The stress of killing someone.

Researcher: Why do people question stuff about euthanasia? Why is it an issue or a problem?

Sally: Some people see it as murder and others say that it should be all right if you are in pain and there is no other course of treatment. They should be allowed to die with dignity. Some people have religious stuff, so there are issues with murder.

The comments above indicate that the social and ethical dimensions related to euthanasia were very much at the forefront of these students' thinking, for example dignity, personal choice, morals, abuse of power, legal issues and religious issues.

6.5.2 Cost

Many students recalled the social justice aspects linked to the relative costs of prevention and treatment. Many saw the dilemma faced in making decisions about health spending, as exemplified by the essay quotes below.

Charlie (e): Social issues arise when society makes decisions about cancer. For instance, people have to decide whether we should spend our money on cancer prevention or treatment.

Lois (e): While some of the money would go to the treatment of cancer, the prevention of the disease is far more important, as if it can be prevented then there would be no need for the expenses of the treatments.

Niome (e): Another question is how much money should be put into cancer research, and should this be put into cure or prevention? To put all resources into prevention would be cruel to patients and their families yet without a great deal of research into the prevention of cancer it will never be remedied.

Samantha (e): Whether to put money into preventatives like information adverts and campaigns, subsidising healthy and safe products or put money into cures and research is a very conflicting issue.

Terri (e): This same situation has caused a financial stalemate into the direction of money into either treatment or prevention or research, the latter including such things as education, legislation, advertising and the creation of treatments such as gene therapy. ...To purely direct all funds under the preventative methods would undeniably decline [deny money allocation to] the amount of future cases, but what of those who have already been diagnosed?

Lois (e) Because of such a high death rate, cancer is a far more worthy cause to put money towards, far more worthier, than say, the genetic manipulation of farm animals, or crop plants.....However, all the treatments are highly costly and while people are being treated, money would be spent more wisely on preventatives.

There were also some comments about how decisions about treatments may be different if individuals were paying for their own treatment rather than the public health system. For example, during class, Marianne responded to the teacher as follows.

Mr S (co): But there might be implications, like as you say whether to have an organ transplant for example if you have got a liver that is defunct.

Marianne(co): Or people with money should be able to pay for their treatment.

Vincy also commented on this aspect in her post-unit interview.

Vincy (iv2): Maybe if the person was paying for the treatment, if it is public everyone else is paying for it but if the person was paying for it, you could keep them alive.

Researcher: Yes. Why paying for it, how does that affect the treatment?

Vincy (iv2): It's their money so they can say what they want done to them.

Researcher: What if they don't know what's being done to them?

Vincy (iv2): I suppose you could nominate a family member or your whole family to make decisions for you once it got to that stage. Before you were really bad you could say I want you guys to decide.

Vincy also wrote about the cost factor in her essay.

Vincy (e): Social implications can be often that cancer patients become high users of the health budget. I feel it is better to invest money into improving medicines as if we can improve your chances of not contracting cancer, then we won't have to concentrate on trying to treat it once it's developed.

6.5.3 Treatment Issues

Treatment issues were discussed at length in the activity that revolved around a scenario about choosing treatment for a person with lung cancer (as described in Section 5.3.10). Some of the discussion is recounted in Section 6.8.2, where I give the students' comments during this activity.

There was also some concern over the testing of treatments and the efficacy of using certain treatments as Niome and Terri recount in their essays.

Niome (e): Medicine also causes debate. Many people would rather have natural treatment such as herbal remedies or acupuncture but these aren't always made readily available and can be overly expensive. Many drugs being used are still in a testing stage and may not be entirely safe to use. Surgery is also a big decision and as many patients relapse some believe it is of little worth. Often it can cause scars and mutilations that can be difficult to come to terms with.....

(later in her essay) One may also ask who should be given the priority of treatment. Should it go on age, attitude or amount of money or if you are a smoker who has knowingly put your life in danger? Some people believe we shouldn't even put our resources into terminal patients since they argue they are going to die regardless of how long their lives can be postponed and they are just sapping taxpayers' money.

Terri (e): The question of treatment is itself merely an indicator of more, harder to answer questions, as the brutal truth is - most people with cancer, and all of those with metastasized cancer have a fairly bleak future. Provided for them at this time, are the three care options of chemotherapy, radiotherapy and surgery (average 5% success rate) and none which seem to be the answer at this time.

6.5.4 Religious Beliefs

Tulane explained that her ideas were related to her religious convictions and she showed openness and curiosity into the ideas of others so that it would help clarify her own ideas. When asked if there were any ethical issues that she had identified she answered

Tulane (iv2): Mainly just the religion thing. Because I am a church-goer, just the religion thing basically.

6.5.5 Human Rights

The comments below indicate that some students became more aware of how changing legislation could affect legal and human rights.

Lois (e): To encourage cancer prevention in New Zealand, the government could make laws banning carcinogenetic [carcinogenic] products, legislate things such as shaded school sandpits to stop children from getting melanoma. The government could enforce carcinogens disposal and put warning labels on high cancer risk food products. Subsidization for sunscreens and healthy living programs might work, as well as scare tactics.

Niome (e): Smoking is responsible for 30% of cancer deaths. This raises the issue of how far the government can and will go in order to try and remedy this situation. Smoking, such an efficient killer could be banned in New Zealand but the social implications this would bring about would be devastating causing resentment towards the government and could most likely provoke a black market cigarette/cigar trade. It also dredges up the question of how much influence should the government have over our life.

Terri (e): A basic ethical code demands that human dignity and worth must be respected, as well as a right to the best medical health care and gives a direct opposition to ignoring the sick.

The following essay extracts also indicate how students considered the legal aspects as being important, and reinforces the teacher's perception that students, as a result of the unit, now considered some the legal aspects (see teacher's comment Section 5.3.3).

Liz (e): Banning smoking for the good of public health creates problems: black markets for cigarettes for those who are addicted, not to mention the political implications and arguments about basic personal liberties. Freedom to choose.... *(and later in the essay)* As the individual must decide his or her own code of ethics in dealing with this disease, so must the collective body of society. In this the rights of every person in society must be considered..... Human dignity, equality, protection, privacy and freedom are among each person's rights. But what about euthanasia?

(It is interesting to note that she does not answer the last question in her essay.)

Samantha (e): Once patients are dying from cancer strong ethical concerns arise. The biggest being euthanasia, where the doctor can intentionally end the patients' life. Religion

and spirituality can play big parts in this issue. Euthanasia is seen as the caring option by some people. If the patient is in intense pain but others don't agree. Section 11 of the Bill of rights states that "everyone has the right to refuse to undergo any medical treatment" so this also has to be considered.

Terri (e): Another common ethical stretcher that arises from the worst cancer cases, is the choice of euthanasia for the patient. Something, which at this stage is not a legal option in N.Z., but often greatly desired by the very sick. It is a question that has met both opposition and support and has become very much a current issue in N.Z. society.

6.5.6 Personal Factors

There was some indication that students considered the personal or emotional aspects that occur when someone is diagnosed with cancer.

Marianne (e): The social implications of this disease are widespread as the families and friends of patients must also deal with the suffering and trauma of loved ones.

Niome (e): For women with breast cancer the decision to have a mastectomy can be very difficult.

Although Niome did not elaborate on this statement, she had thought about what it would be like to have a breast removed. Perhaps this was linked to the question at the end of the "Trash and Treasure" scenario, as indicated by Sally's comment in her journal.

Sally (j): I can't decide if I could have the opportunity to know or not about whether I had the mutation BRAC1, whether I'd want to know or not. It's like the question, if you had the choice, would you choose to know or not when you'd die?

6.6 Personal Relevance

Eleven of the sixteen students in the study group considered that cancer was personally relevant because they knew someone who had had cancer. These people included siblings, parents, aunts and uncles or grandparents. Niome included this as a reason why cancer is a current issue in her essay.

Niome (e): The incidence of cancer in our society is causing much concern as in the long run it is fairly untreatable and most people have had some personal connection to someone who has had this illness if not having developed it themselves.

Interestingly, Tulane commented that cancer is not an issue for Samoans because of the low incidence in Samoan people.

Tulane (iv2): I have got a friend who has got leukemia. She's all right. It's not very common amongst Samoans. I have heard of no one with cancer in my church or in my family. Things come up with diabetes and high blood pressure and things like that but not really cancer.

Many students found the topic personally relevant because it made them think about lifestyle choices as shown by the following quotes and essay extracts.

Awar (e): Cancer can be prevented in many different ways including not smoking, going easy on alcohol, industrial precaution or banning of use of non-essential hazards, eating a balanced diet e.g. low in fat and including plenty of fresh fruit, vegetables and fibre, taking care in the sun i.e. using sunscreen lotions or creams, wearing hats and T-shirts and sunbathing.

Kay (iv2): I think it makes you more aware of the actual effects of it, like lots of people smoke. I suppose it makes you think about you have to be careful about things like sun and everything. People don't really care about and think that nothing is going to happen to them later on and that kind of thing. I think I have learnt more about the biology side of it, most of the real stuff has been drummed into us before about not smoking.

Lois (e): To prevent disease there are several precautions which people can take themselves. For instance stop smoking and chewing tobacco, maintain a healthy diet, avoid sun exposure, reduce alcohol intake and avoid oestrogen treatment and exposure to industrial hazards and ionizing radiation.

Marianne (iv2): Next year I am going to do food science and that sort of thing [at university] and I'm really interested in the effects diet has on the things that happen to us later, diseases, just everyday sort of life. But that's not a specific sort of cancer.

Mitchel (e): Skin cancer has taken many lives throughout the world, but N.Z.'ers are at a greater risk as N.Z. has the highest rate of skin cancer per capita - and as the sun is becoming stronger each year, this figure is still increasing.

Sally (e): What makes doctors and scientists angry, is that the major carcinogen of lung cancer is tobacco smoke, which, in the main is self-inflicted. Tobacco smoke accounts for 1/2 of all cancers & a 1/3 of all cancer deaths.

When Samantha was asked in her post unit interview if cancer was personally relevant for her she replied

Samantha (iv2): Only skin cancer, the sun and everything like that 'cos I am always being told to check my moles and freckles so I am interested in skin cancer because of that. And I always wondered what breast cancer did, I always wondered about the cancers because it is such a big deal. It is interesting.

Samantha included some of the causes related to lifestyle in her essay.

Samantha (e): Smoking is a major social factor and concern along with alcohol, fatty diet, sun and lifestyle.

Vincy also related how smoking was a lifestyle issue for her family. She wanted to give up smoking.

Vincy (iv2): My dad smokes heaps and my mum is always going to him "you will get lung cancer" and amongst me and my friends we always talk about [how we've] got to stop smoking.

Researcher: So it is an issue then isn't it?

Vincy: Yes and women sunbathing and stuff. We shouldn't do this but we do it anyway.

She backed this up with a statement in her essay about smoking and the effects of diet and sun on the incidence of cancer.

Vincy (e): Smoking. The number of toxins found in cigarettes and the degenerative effect they have on the body are overall responsible for 1/5 of all cancer deaths. Lastly, a bad diet. This along with an outdoors lifestyle is responsible for the rest.

6.7 Social Relevance

A requirement of the essay is to justify why the incidence and control of cancer is a current issue. Some examples of how students extended the relevance of cancer to society and particularly to New Zealanders are given below.

Ann (e): The increasing occurrence of cancer in the last decade has caused cancer to be a current issue. The fact that it is a major cause of death in New Zealand and the lack of cures is a real concern worldwide. It is at present a controversial issue for New Zealanders as 6 people have died waiting for radiation treatments and 100 people are still waiting.

Charlie (e): Cancer is a disease that claims the lives of one in four New Zealanders. It is a disease that is very complex, with many social, ethical and biological issues encompassing it. Cancer is a current issue because at present very little is

known about it's processes. A cure is far from being discovered, and the incidence of cancer is on the rise.

Liz (e): Today cancer is an issue of importance, and has been becoming increasingly worrisome over the last 20 years. It is currently the second most common cause of death in N.Z. Each year approximately 5-7000 people die from cancer with an average of approximately 10,000 new cases diagnosed per year. That means 1 in 3 New Zealanders will deal with cancer in their lifetime. Cancer is known as the disease of age. Sixty-five percent of all males who have cancer are over 65 and in 53% of woman and because humans are now living longer due to advances in health and education. This combined with our growing population, and ability to recognise cancer as a separate disease means cancer is fast becoming [identified as] our deadliest killer.

In her concluding paragraph she wrote:

Liz (e): Cancer's aggressive nature and frequency in today's society plus the fact that it is has many contributing factors makes it a contemporary issue of importance in every person's life.

Niome and Terri also elaborated on how cancer affected society in their essays.

Niome (e): Though cancer is by no means a modern disease it has a great impact on modern day society. This is because of a dramatic increase in cancer victims and our inability to provide entirely effective treatment for this illness and to devise a way to prevent it. In 1993, 12,700 New Zealanders developed cancer and 7000 died from it. Two thirds of New Zealanders are statistically susceptible to melanoma and one out of each 26 people will die from it.

Terri (e): It is a situation particularly central in N.Z. with our aged population (as cancer tends to develop in older tissue) and our leading number of melanoma and breast cancer cases, the latter placing N.Z. 7th in the world.

(and later in her essay) Due to the steep up rise in the incidence, cancer has moved from being a taboo subject to the greatest fear of every person and openly spoken about. To the average New Zealander, cancer is becoming as common an issue as the plot on Shortland Street [a New Zealand television situation drama], and we can only hope that this [talking about it] is a good thing.

6.8 Activities Identified as Important for Developing Thinking about Bioethical Issues

The activities in the unit of work have been described in detail in Chapter 5. In this section, I discuss the activities highlighted by the students and the teacher, in the post unit interviews, as being important for influencing their thinking about the social and ethical issues associated with cancer. Other activities that were identified as helping the learning process, are discussed in Chapter 7.

6.8.1 Brainstorming

Students worked in small groups to brainstorm their ideas about cancer at the beginning of the unit. Comments from Lois and Mary indicate how brainstorming helped them to identify the important aspects of this cancer topic.

Lois (iv2): Brainstorming was useful because other people had thought of things that you didn't think of. It made you think. Because it was at the beginning, it made you think.

Mary (iv2): Because you have got everybody else's views on what we were actually talking about, and that gave you an idea of how much they knew and how much you knew yourself, so you didn't feel dumb or anything.

Because the brainstorms were carried out in small groups, students were exposed to a wider range of ideas than they would have come up with individually. Note that in most instances, as shown in Tables 6.7 and Table 6.8, the number of items for many of the categories was greater in the brainstorm analysis than in the pre-unit questionnaires or in essays. This shows there was greater identification, in most categories during the group brainstorm. Their collaboration helped them to come up with more ideas than they would have individually.

6.8.2 Discussions

Central to this approach were the small group and class discussions. Although discussions have been used throughout schooling for these students, the significance here was that they played a major role in allowing students' to hear other people's ideas, feelings and beliefs in a science context. Students' comments about the discussions as an approach have already been given in Section 5.3.11.

The results of the group discussions on treatment options for a person with lung cancer (Section 5. 3.10) are given in Table 6.9. The groups for this discussion were Group 1 (Terri, Liz, Ann, Kay and Marianne), Group 2 (Charlie plus 3 others not in the

study group), Group 3 (Daniel, Tulane, Mary, Vincy), and Group 4 (Mitchel, Lois, Sally, Samantha). Awar and Niome were absent for this activity.

Table 6.9 Group Consensus on Treatment Options

Treatment type	Group 1	Group 2	Group 3	Group 4
Surgery pros	cure straight away, prolong life, better quality of life	could survive but a small % chance		
Surgery cons	trauma, have to wait, could be worse anyway	reduced lung function, small chance of surviving, cost great, family concerns.		cost, possibility of dying, loose lung function, loss of money through not working, depression
Chemotherapy pros	may be treated		greater chance of living than stated	biding time, less invasive
Chemotherapy cons	on-going pain, sickness, expense, affects immune system	cost	is not as successful as surgery	depression, nausea, family pressures, draws out the process
No treatment pros		no cost		more time to prepare, save money, more accepting
No treatment cons				pain

Group 1 was very vocal and several students talked to each other at the same time. They tended to agree with each other. They talked so much that they did not get to the "no treatment" option. During the feedback to the whole class, Kay indicated that the group thought there were conditional aspects that would influence the type of treatment chosen. Similarly, when reporting back to the class, group 2 also mentioned that it was different for everyone and it depends what else you have got wrong with you. Several others joined in the conversation.

- Kay (co): If you were young, it would be different. Everybody's lifestyle is different. Age, advanced stage, what you've got on in your life.
- Mr S (co): Some people are very concerned that they would lose dignity by going into hospital, so it's very complicated.
- Terri (co): (bursting in) And crazy religions that say you shouldn't have any treatments.
- Kay (co): You could have, if you wanted.

Most of the class broke out in talk at this point until Daniel yelled "Order please!"

Group 3 spent a lot of time discussing the modifying factors that would determine the choices. The following extract is from their conversation.

- Tulane (co): What about smoking?
- Daniel (co): If you're young and fit...
- Mary (co): I reckon you've got more than a 5% chance of living...
- Daniel (co): Chemo is not so successful. It may be more than 5%.
- Tulane (co): You could have the surgery, then the chemo later. Could you have combinations?
- Researcher: Well there's ways of having combinations of treatment. You could have radiotherapy and chemo. It depends on.... What does it depend on?
- Tulane (co): On the people.

Group 4 identified more aspects related to personal aspects, for example, time needed to recover, loss of money, lengthening the treatment process, more time to prepare for death and more accepting. These aspects relate to people's emotions and feelings rather than the biological consequences or effects of the treatments. Mitchel also commented on the disappointment aspect if the surgery was not successful.

- Mitchel (co): There are high hopes that you're going to get rid of it with surgery. If it doesn't work, you're more disappointed.

- Mr S (co): If you're a smoker, you can still carry on having a fag and not worry. That might be important. The old nicotine is a strong influence. [The thought of] Dying, it really crystallizes your thinking.

Group discussions not only resulted in consensus, but also revealed a wider range of views when groups reported back to the class. This allowed students to become more aware of other points of view and the conditional aspects associated with making ethical decisions.

Daniel's perceptions of the discussions were as follows.

Daniel (iv2): You tell what you think [in small groups] and then you tell the class and they will come back and say, no I think this. Most people have the same ideas, like in our group which we sort of got corrective surgery to get fixed, but it also depends on age and stuff, that's what got through [from the whole class discussion].

The discussions that arose from the euthanasia scenario were quite dynamic. Essentially the students had to discuss background issues, such as the ethics of care, current practices in New Zealand, religious arguments and cultural perspectives associated with euthanasia. The scenario about whether to increase the morphine dose for a 52-year-old man who had secondary cancers all over his body, prompted the following comments.

Samantha (iv2): Yes and it was whether the doctor should have given him more morphine. Yes I thought he should have because the guy only had a week to live and he was in heaps of pain and so he might as well die the easiest [way rather] than stretch it out a week.

Researcher: Would you have thought that before this unit? Has that changed?

Samantha: Probably not [thought about it before this unit]. I would have just thought "keep them alive as long as you can", you don't really think about all the pain involved.

There were many additional comments about the euthanasia activity which are given in Sections 5.3.11 and 6.5.1.

There was also a sense that the discussions developed students' knowledge through dialogue and social interaction. Several students had identified that they learned well orally (see Table 7.1). Particularly for some, it was important to hear other people's opinions and banter a little.

Researcher: So how else did the discussions help?

Daniel (iv2): You see another person's perspective and it is pretty good. You think yours is right and then you hear other people's ideas and it makes you think different. It gives you more knowledge. Stuff that interests you, like that sort of stuff gets into your head easier, like when you talk about it and try and make your point clear. It seems to stick in your head more rather than people telling you or when you are not interested. You're just writing words down. [when the teacher is giving notes]. You get a different point of view talking to them and [then you] try and make a comeback

[giving your own opinion or defending your view]. You sort of take it in as well.

Ann (iv2): Yes they [the discussions] just helped with the general background and stuff. Helped to make my own conclusions. Gave you more information about it, [reconsidered] my own opinions and stuff.

6.8.3 Journals

Journals were used to a varying degree by the students. The use of journals was often linked to the students' perceptions of their purpose, as mentioned in Section 5.3.2. Those students who saw it as a research instrument did not ask as many questions or use it as a "sounding board" for their thoughts.

Some students did use the journals to ask themselves questions that drove their work. For example Liz wrote the following.

Liz (j): What cancers are most common in teenagers? How much does our childhood health determine our future health? e.g. Sun exposure - skin cancer? What else can have dangerous effects? How can hot drinks, fats and alcohol lead to some cancers? Can you get cancer anywhere or just anywhere you have fat or muscle or blood?

The following examples illustrate how some students wrote in their journals about ethical issues in general.

Sally (j): I find the ethical issues really difficult, as there have been so many different circumstances. I've come to the conclusion there are no right and wrong issues.

Ann (j): What I've learned today is the importance of preventatives for cancer. It made me think of ethical issues.

Other examples of how the journals were used are given in Sections 5.3 and throughout Chapters 7 and 8.

6.8.4 Videos

One video in particular prompted students to consider personal and emotive aspects surrounding the effects of cancer and choosing cancer treatments. Specifically, the students were appalled at the lack of concern that employers in this video showed about asbestosis. They commented that the video, because of its personal nature, was quite "shocking".

Sally (j): It's strange that people have totally different views about asbestos. There is clear evidence that asbestos is

dangerous but then the bosses of the factories say it's totally safe. How can they blatantly lie about that?

Researcher: Why was it shocking?

Sally (iv2): That asbestos was around everywhere, and all these people are unaware, like people who spray the wheel [to] get the dust out; they were unaware that this was causing cancer.

Researcher: So are there ethical issues related to that?

Sally: The authorities, how big a price they put on people's lives. It is like they are more interested in their profits.

6.8.5 *Essays*

Most students who wrote an essay included some social or ethical issues (Table 6.7). Examples of what students wrote have already been given in Sections 6.5-6.7 to illustrate students' thinking about specific issues.

The students tended to elaborate on several issues in their essays rather than try to include as many issues as possible.

6.8.6 *Teacher's classroom influence*

There is some evidence that what the teacher said in class influenced the students' thinking. His anecdotes, stories and examples added interest. I have given several examples below to show how he illustrated ideas with examples during class sessions.

Mr S (co): What are ethics?"

Kay (co): Morals.

Mr S Yes, you're right. It's what's determined by society in general, isn't it?

He then proceeded to explain how morals change with time in history, and gave the example of how when he was young, a movie was rated R21 if it implied an immoral act such as adultery, but that the ratings have changed nowadays. He then discussed how the general health of patients, affects how they are treated and gave an example that was in the news last year of a man who was refused kidney treatment because he also had dementia. The teacher also elaborated on the cost factor in making decisions about treating people.

Mr S (co): For the first time in our history, the cost of medicine is outstripping the money available. Keeping people alive today is more possible than previously.

He also indicated some ethical issues around trialing new medical treatments.

Mr S (co): There might be a medicine on the market that they think is the major cure but they won't let people take it because it hasn't been properly tested. So there's an ethical question there. You can't go trialing drugs on people.

Marianne (co): What if they're willing?"

Terri (co): I think if you're going to die anyway and it's your last chance to survive you'd try it anyway.

Students certainly included cost factors and who should be treated as well as drug testing as ethical issues in their questionnaires (Section 6.2) and their essays (Section 6.5). The extract below from Terri's essay is an additional example of this, and has been included here to show the similarity with what Mr S said to the class above.

Terri (e): The fast rising incidence of cancer in N.Z. are outstripping our resources to cope with them and this precarious situation is creating a contemporary issue of social, ethical and biological implications.

Some students also mentioned the point Mr S had made about trialing drugs in their essays. For example,

Niome (e): The testing of drugs also provokes certain questions. Should animals be used in the testing of drugs? What is the value of animal life in relation to the life of a human? How reliable are these tests as animals do not always react to drugs and treatment in the same way we would?

Niome's comments also reflect the uncertainty and plurality of the issues. She did not try to answer her questions or solve the issues, but rather acknowledged that there were unresolved aspects of the issues.

6.9 Summary of the Students' Thinking about the Bioethical Issues Associated with Cancer.

A comparison of the number of issues identified in the pre and post questionnaires indicates that the students' awareness of social and ethical issues increased for the class as a whole (Tables 6.3, 6.4, 6.5). Out of the 11 students who answered both questionnaires, the number of categories of social implications increased for 8 students, of ethical implications increased for 5 students and 9 students showed increases in the number of categories for factors that are used when making ethical decisions, in the post-unit questionnaire (Table 6.6). Some students' and the teacher's comments from interviews substantiate that they broadened their thinking about the

social and ethical issues by the end of the unit. Part of the reasoning was that they had not had need to reflect on their ideas about the bioethical issues linked with cancer previously. The fact that there were few social and ethical issues indicated in the brainstorm analyses (Table 6.7) attests to the fact that they did not necessarily come up with these ideas spontaneously. It seems that when the question stems in the questionnaires prompted students, they were able to think of a wide variety of issues. There were also some instances where students accommodated what the teacher said in class into their essays, particularly in regard to "cost" and "social factors".

The breadth and depth of students' thinking for specific social and ethical issues are indicated from their comments and essay extracts. There was certainly a wide range of issues mentioned. The students have shown by their comments that the issues of cancer are not only relevant and interesting to them personally, because of family and friends who may have had cancer, but that they may also consider lifestyle choices because of their awareness of the causes of cancer (Section 6.5.4).

It is difficult to estimate the development of citizenship responsibility. This would depend on students' actions and decisions regarding the issues in the future. There was certainly extension of relevance of the issues to society at large, as indicated by essay extracts in Section 6.7. It is likely that students who developed reflective processes about the issues may be able to use them to make important decisions for themselves and act as informed citizens in the future. Future behaviour in terms of lifestyle choices and social decision-making can only be speculative and was not targeted as an aim of the research process.

The unit of work enabled students to question their ideas about the issues linked with cancer. Specific activities that students identified as helping them to explore the social and ethical issues were brainstorming, discussions, journal writing, videos, and writing the essay. These types of activities, where students discuss and evaluate the issues, might also be suitable for adapting to other controversial issues.

Chapter 7 Students' Learning

7.1 Introduction

This chapter describes aspects of students' learning in relation to the unit of work. As mentioned in chapter 3, there are many influences on student learning and only some of them have been investigated in this study. I have divided the influences investigated here into aspects that relate to students' knowledge, awareness, and control of learning processes. Motivational aspects were not investigated directly, although some inferences can be made from information gained from student interviews.

Section 7.2 describes students' perceptions of their abilities in a general sense. Section 7.3 gives information on the specific essay outcomes. In Section 7.4 I compare students with regard to their knowledge and use of specific learning strategies (declarative, procedural and metacognitive).

Prior knowledge of learning processes is documented in Section 7.5, followed by a discussion of other influences pertinent to this context on learning outcomes in Section 7.6. Tasks in the unit of work that students perceived to promote learning are discussed in Section 7.7.

Since producing an essay was the intended product outcome of the unit of work, for analysis I grouped students into the following categories according to the quality of essays they produced: "Invisible Product", "Satisfactory Product" and "Quality Product". Students in the "Invisible Product" category did not hand in a final essay. Students in the "Satisfactory Product" category produced essays that ranged in marks from 13- 24/ 40. Students in the "Quality Product" category wrote essays with marks between 26/40 – 32/40. Both the "Satisfactory Product" and "Quality Product" categories were further subdivided into "Satisfactory Multiple" and "Quality Multiple" groups to indicate students who had produced more than one essay. The students were allocated to groups as given below. The students within each group are ranked by their essay mark.

Category	Students
"Invisible Product"	Daniel, Tulane, Sally, Mary, Kay
"Satisfactory Product"	Mitchel, Vincy, Awar, Samantha
"Satisfactory Multiple"	Ann
"Quality Product"	Niome, Lois, Charlie
"Quality Multiple"	Terri, Liz, Marianne

7.2 Students' Perceptions of Their Abilities

General questions were used in the pre-unit interview to explore students' perceptions of their learning (Appendix 4). The pre-unit interview responses were categorised into the learning awareness categories of "good at" (i.e. what students perceived they were "good at"), "help with", and ability perception with regard to essays and exam performance. These are summarised for each of the 16 students in Table 7.1. The responses represent perceptions prior to the start of the unit of work (except for Samantha and Liz whose post-unit interviews incorporated the questions in the pre-unit interview).

In general, there was a correspondence between the level of awareness of learning processes and what students achieved. In the "Invisible Product" category, Daniel and Tulane said that they learned well orally. The other students in this category (Kay, Mary, and Sally) did not identify their preferred learning style. All of the students in this category recognised that they needed to develop their organisational skills and that their work could be improved with more effort.

Students in both the "Invisible Product" and "Satisfactory Product" categories identified what they were "good at", or "needed help with", but only in broad terms. Their reasons were not necessarily linked with knowledge of their own abilities and use of learning strategies or skills. For example, Awar considered his difficulties all stemmed from his lack of knowledge of and ability to use English. Ann, Mitchel, Samantha and Vincy recognised their need to organise their time, to plan more and structure their work but did not say how they would do this.

Table 7.1 Ability Perception (D = difficult, E = easy)

Group	student	"good at"	"help with"	Essay writing perception	Exam prediction
Invisible Product	Daniel	remembering learning orally, Physical Ed	making decisions, making notes, writing/organisation	D, style, bad luck with questions	pass
	Tulane	working with people, research learning orally	not good with numbers	E, if understand D, if "not fluent"	low
	Sally	creative tasks	solving problems organisation	E, if creative D, if need to follow structure	55
	Mary	group discussions	explanations, interpreting instructions, content, note making organisation	D, understanding the question	low
	Kay	languages	essays in english	E, history D, english	pass
Satisfactory Product	Mitchel	plotting ideas physical ed, team work	remembering, sorting information	D, structure and formatting, "I don't know where to start"	to pass
	Vincy	essays	hard to concentrate Structure, planning	D, structure, never plans	45%
	Awar	anything without english	anything with lots of English	D, never done essays before	low
	Samantha	problem solving	Organising study, time management	E, if have all the information	70 based on previous marks
Satisfactory Multiple	Ann	independent study	memory recall organisation understanding the essay question	D, remembering main points, structure → E when understand the question	50- 55
Quality Product	Niome	creative writing	essay writing oral presentation abstract recall	E, interest and understanding important	55 - 60
	Lois	researching comprehension	planning essay memory recall	D, not enough info, → E	60
	Charlie	memorising problem solving, essays	statistical info knowing content requirements	E, chunks info and uses pictures	good mark if plan
Quality Multiple	Terri	explaining	mathematical formulae	E if know info	60+ linked to effort
	Liz	listening, discussions dictation	structure of essays formulae in maths and chemistry	D, connecting ideas, structure understanding the question	60
	Marianne	remembering	interpreting abstract ideas	E for factual recall D for interpretation	60+

In contrast, students in the "Quality Product" category articulated an awareness of their learning more specifically. Most of them identified specific skills that they needed help with. For example, Niome described how she needed help with recalling abstract ideas rather than the more generalised categories of recall or memorising. Charlie mentioned that he needed help with searching for statistical information and Marianne said that she needed help interpreting abstract ideas. These are specific skills.

Students in the "Invisible Product" and "Satisfactory Product" categories all identified that they had some difficulty in writing essays. Awar claimed he had never written an essay prior to this unit of work. Some students in all groups suggested that ease or difficulty in writing essays depended on whether they understood the question (Mary, Tulane, Liz, Niome) or if they had enough factual information (Samantha, Lois, Marianne, Terri). Others (for example, Ann, Sally, Mitchel, Vincy, Liz,) identified structure and style or knowing how to write as being important for determining the level of ease or difficulty in writing essays. Although many students in the "Quality Product" category claimed that essay writing was easy for them, there were exceptions to this. Lois, Liz and Marianne identified essays as being difficult, which I think is related to their high expectations of themselves.

For most students, their perceptions of their own achievement in the end of year exam were inflated (Table 7.1). Students probably had an unrealistic idea of the level of difficulty of the exam and were inaccurate in their self-evaluations of their own ability. They were also optimistic and probably did not want to appear incompetent. The students in the "Invisible Product" category were more realistic in their assessment of their marks. Although most of the students in this category would have liked to pass the exam, they realized this was not probable, considering the low effort they afforded to their studies. Lack of effort was the reason given by Daniel, Kay, Mary and Tulane for their own lack of progress.

Some students realized that their self-perceptions of their own ability were inaccurate. For example, Mitchel and Vincy both stated that in general, they always thought their essays were good after they had written them, but were disappointed when they got their marks. To address this Mitchel sought help from the teacher to check whether he was "on track" for his pre-write paragraph and also from Lois, in an attempt to improve.

7.3 Essay Outcomes

Table 7.2 summarises the marks I allocated to the essays.

The marking schedule used for the essays is given in Appendix 9. The 4 marks not shown in Table 7.2 (total/40) were for explaining why cancer was a contemporary issue. Possible marks for each section are in brackets. For those students who produced two essays, the first mark in a column is for the first essay. Marks for the "Invisible Product" category refer to the pre-write paragraphs.

Table 7.2 Essay Marks

Group	Student	Marks				
		Structure (10)	Issues (10)	Causes Effects Treatments (16)	Total 1 (40)	Total 2 (40)
Invisible Product	Daniel	0	0	0	0	
	Tulane	0	0	0	0	
	Sally	1	0	1	2	
	Mary	0	0	5	5	
	Kay	0	4	4	9	
Satisfactory Product	Mitchel	4	3	6	15	
	Vincy	5	6	7	20	
	Awar	9	5	9	24	
	Samantha	10	8	5	24	
Satisfactory Multiple	Ann	6 6	8 4	4 7	22	19
Quality Product	Niome	8	6	9	26	
	Lois	9	6	12	31	
	Charlie	10	6	12	32	
Quality Multiple	Terri	8 9	7 7	12 6	29	25
	Liz	10 7	10 6	8 8	32	23
	Marianne	8 8	5 5	12 13	27	28

7.4 Learning Strategies

The data presented in Section 7.4 focus on students' conscious knowledge and use of learning strategies. The analysis from multiple data sources (pre or post unit interviews, journal entries, observations of their class work or as evident in essays) were collated into a separate metamatrix table for each of the sixteen students (see Appendix 10 for examples). The tables presented in this section are given as visual summaries of students' knowledge and use of strategies derived from the metamatrix tables. The shaded cells in Tables 7.3- 7.5 indicate students' acknowledgment of prior knowledge

or use of those strategies. I discuss the prior knowledge components of these tables in Section 7.5. I elaborate on how 5 individual students applied specific knowledge and use of learning strategies in Chapter 8.

7.4.1 Knowledge and Use of Declarative Strategies

Declarative strategies have been divided into three categories; locating and focussing information, schemas and elaboration, based on Derry's (1990) categories as described below.

Locating and focussing information includes using text structure to identify important points, underlining or highlighting important words or phrases, or using key words or key phrases to search information.

Schemas include the use of concept mapping or any graphic organisation to structure, order or rank text, the use of mnemonics such as G.E.E. (Generalisation, Explanation Example) and visualisation techniques for memorising.

Elaboration includes explaining ideas (**e**), answering questions and using generative note making strategies (**q**), and summarising or paraphrasing (**s**).

Students' knowledge and/or use of these strategies is shown in Table 7.3.

Table 7.3 Knowledge and Use of Declarative Strategies

Group	Student	Locating/ focussing		Schemas		Elaboration	
		know	use	know	use	know	use
Invisible Product	Daniel	✓		✓			
	Tulane	✓		✓	✓	✓	q
	Sally	✓	✓	✓		✓	q
	Mary	✓	✓	✓	✓		
	Kay	✓		✓		✓	s
Satisfactory Product	Mitchel			✓	✓	✓	s
	Vincy	✓		✓		✓	s, q
	Awar	✓	✓	✓	✓	✓	q
	Samantha	✓	✓	✓	✓	✓	e
Satisfactory Multiple	Ann	✓	✓	✓	✓	✓	e, s, q
Quality Product	Niome	✓	✓	✓	✓	✓	e, s, q
	Lois	✓	✓	✓	✓	✓	e, s, q
	Charlie	✓	✓	✓	✓	✓	e, s, q
Quality Multiple	Terri	✓	✓	✓	✓	✓	e, s, q
	Liz	✓	✓	✓		✓	e, s, q
	Marianne	✓	✓	✓	✓	✓	e, s, q

indicates student acknowledgement of prior knowledge or use.

The use of declarative strategies was linked to students' perceptions of their use. For example many students knew about using key words or key questions for focussing on information, but did not choose this strategy because they did not perceive it as being useful. It is difficult to know how much experience students had had with any of the strategies. If there was little experience of a particular strategy or if there was little success experienced when using the strategy, it is likely that students perceived those strategies as not useful. The extent of prior experience in using strategies is difficult to determine, and students' perceptions of their levels of success of prior experience even more so.

7.4.2 Knowledge and Use of Procedural Strategies

The procedural strategies have been divided into three categories: generalisation, discrimination and practice/ effort.

Generalisation strategies are those where summaries or overviews of a particular idea are constructed.

Discrimination strategies are those where information is sorted according to relevance or importance. Students who used the "trash and treasure" exercise (Section 5.3.9) or their own modifications of it, were classified as having used discrimination. Other students also showed evidence of using discrimination from the structure and choice of content in their essays.

Students scored positively in the **Practice/effort** category if they perceived that practice or effort was important for writing a good essay. Those students who wrote multiple drafts or multiple essays were automatically considered to use practice or effort.

The students' knowledge and use of these strategies are summarised in Table 7.4.

Table 7.4 Knowledge and Use of Procedural Strategies

Group	Student	Generalisation		Discrimination		Practice/ effort	
		Know	use	know	use	Know	use
Invisible Product	Daniel	✓				✓	
	Tulane	✓		✓	✓	✓	
	Sally	✓		✓		✓	
	Mary			✓		✓	
	Kay	✓				✓	
Satisfactory Product	Mitchel	✓					
	Vincy	✓	✓	✓			✓
	Awar					✓	
	Samantha	✓	✓	✓	✓		
Satisfactory Multiple	Ann	✓	✓	✓	✓	✓	✓
Quality Product	Niome	✓	✓	✓	✓	✓	✓
	Lois	✓	✓	✓	✓	✓	✓
	Charlie	✓	✓	✓	✓	✓	✓
Quality Multiple	Terri	✓	✓	✓	✓	✓	✓
	Liz	✓	✓	✓	✓	✓	✓
	Marianne	✓	✓	✓	✓	✓	✓

indicates student acknowledgement of prior knowledge or use.

Table 7.4 shows that although many of the students in the “Invisible Product” and “Satisfactory Product” categories knew what they should do in terms of making generalisations, discriminating between types of information and that practice could be helpful, they did not use these strategies. Students in the “Quality Product” category showed a greater awareness and use of these strategies than students in the “Invisible Product” and “Satisfactory Product” categories. It is likely that the extent to which they used these strategies was also greater, but this is undiscernible from my data. The trend of greater knowledge and use of procedural strategies with quality of essay(s) is obvious.

7.4.3 Metacognitive Awareness and Control

Metacognitive awareness and control includes perceptions of the purpose of the current teaching/learning activity, and of personal progress through the activity. Perceptions of the purpose of some activities are discussed in Section 7.6 where the students’ evaluations of the various classroom activities are reported.

Students' perceptions of their personal progress through activities were not questioned directly but were gauged from comments made throughout the post unit interview, journal entries and classroom observations.

The strategies identified here which develop metacognitive awareness and control were planning, monitoring by checking on progress, using information from peer- checking or setting priorities, asking evaluative questions and making decisions about the learning process. Planning, monitoring and evaluating learning processes are strongly linked with intentions for learning and choosing or making decisions about what should be done. Awareness is linked to knowing the strategies whereas control is linked to using the strategies. Although self-questioning can be a planning and a monitoring strategy, it is highlighted as a separate category in this analysis specifically to illustrate the use of questioning in journal writing. Table 7.4 summarises whether students knew and used these strategies.

Table 7.5 Knowledge and Use of Metacognitive Strategies

Group	Student	Planning		Monitoring		Self-questioning	
		Know	use	know	use	Know	In journal
Invisible Product	Daniel	✓					0
	Tulane	✓		✓		✓	0
	Sally	✓	✓	✓	✓	✓	3
	Mary	✓		✓		✓	4
	Kay	✓		✓	✓	✓	2
Satisfactory Product	Mitchel	✓		✓	✓	✓	2
	Vincy	✓	✓	✓	✓	✓	3
	Awar	✓		✓	✓	✓	2
	Samantha	✓	✓	✓	✓	✓	4
Satisfactory Multiple	Ann	✓	✓	✓	✓	✓	3
Quality Product	Niome	✓	✓	✓	✓	✓	10
	Lois	✓	✓	✓	✓	✓	5
	Charlie	✓	✓	✓	✓	✓	5
Quality Multiple	Terri	✓	✓	✓	✓	✓	4
	Liz	✓	✓	✓	✓	✓	14
	Marianne	✓	✓	✓	✓	✓	5

indicates student acknowledgement of prior knowledge or use.

Table 7.5 shows that students who used metacognitive strategies (planning, monitoring and self-questioning) tended to produce better quality essays. Planning by writing lists or paragraph headings, deciding on the logical order to write the content, reflecting on what they needed to find out or do, and general outlining strategies were more evident for these students. As a group, they also showed a greater amount of reflective thinking when self-reporting and asked more questions in their journals.

7.4.4 Summary of Knowledge and Use of Strategies

The trend in the data is apparent. Those students who produced better quality essays had more knowledge of declarative, procedural and metacognitive awareness and control strategies. They also made use of these strategies when researching or writing their essays. Many students in the first two groups in Tables 7.2, 7.3, & 7.4 knew of strategies that could help them, but did not use them. They were less aware of specific ways in which they could help themselves and less willing to employ learning strategies. In Alexander & Schwanenflugel's (1994) terms, this is a "utilisation deficiency" which may be linked to a lack of sufficient knowledge about the strategies

not used and how they might be helpful. In other words, they may have had an unsophisticated understanding of the use of the strategies they did not use.

It is also essential to note that although students can be made more aware of the strategies, it is only when they use them that the strategies become helpful. It is simply not enough to know. Practising or repeating learning strategies may enable retention. Individuals may have differing needs regarding how much practice or repetition they need in order to accommodate the strategies. It is also likely that students need to experience success in the use of strategies before they regard them as being useful.

It is likely that combinations of these strategies interact in mutually supportive ways. The holistic nature of the use of these strategies should not be understated. Combinations are undoubtedly important. When the uses of these strategies are combined, there is a much greater likelihood that the learning outcome is of higher quality.

Some students used learning strategies instinctively. For example, Terri and Marianne did not write an essay plan because they considered writing plans was too time-consuming. The structure of their essays though showed evidence of planning. These students were also more persevering in that they recognized the value of producing more than one essay.

Perhaps the need for conscious use of strategies decreases as the behaviours they once mediated become more self-starting (Flaveil & Wellman, 1977). This could explain why some of the more able students appeared to have more automatic processes for researching and writing, and did not state that they reflected on or monitored their work. It is likely that they had already (automatically) evaluated their work.

7.5 Prior Knowledge of Strategies

This Section examines the research question:

“What kind of relationship if any, is there between students’ prior knowledge of learning strategies and their use in researching and essay writing?”

During the student interviews, many students said that they knew about various strategies prior to this unit of work. However, information about each student’s prior knowledge of strategies is somewhat inferential since it emerged as a result of questioning them in a general sense before the unit of work, rather than questioning them about their knowledge of specific learning strategies. This means that there are

gaps in the documentation of self-reports of prior knowledge of strategies in Table 7.6. An assumption that the gaps in Table 7.6 represent lack of prior knowledge could be misleading. It may be that they simply did not disclose their knowledge. However, the table is useful nonetheless because, in a general sense, what they did disclose (and thus assumed to be their prior knowledge) can be mapped onto the previous three tables (see shaded cells in Tables 7.3, 7.4 and 7.5). The categories in Table 7.6 are the same as the categories used previously for declarative and procedural knowledge (Tables 7.3 and 7.4) and metacognitive strategies (Table 7.5). Self-questioning has been included in the monitoring strategies for the purposes of this analysis.

In general, prior knowledge of strategies and achievement in essays are positively related. This trend is more obvious for the procedural and metacognitive strategies. That is, the number of shaded cells increase in the lower parts of Tables 7.4 (procedural strategies), and 7.5 (metacognitive strategies).

Table 7.6 Prior Knowledge of Strategies

Category	Student	Type of Strategies							
		Locating/ focussing	Schemas	Elaboration	Generalisation	Discrimination	Practice/ effort	Planning	Monitoring
Invisible Product	Daniel		visualisation	never summarised					
	Tulane		G.E.E. mind maps		own words	uses questions		headings	self-check
	Sally	headings questions		questions with further points		"definitive"		headings	reviews mother check
	Mary	key words							
	Kay		ordering concept mapping essay structure		main points			written	
Satisfactory Product	Mitchel					plans in sections			
	Vincy	important words		summarising	condenses	uses questions			
	Awar	key words	brainstorm					important points	
	Samantha	key words highlight	lists	explanations		uses questions		written	self-check checklist
Satisfactory Multiple	Ann	key words key questions	linking	summarising	main points	sorting		in head, not written	checks essays

Category	Student	Type of Strategies							
		Locating/ focussing	Schemas	Elaboration	Generalisation	Discrimination	Practice/ effort	Planning	Monitoring
Quality product	Niome	key words skim read		questioning	main points own words	uses questions		in head not written	reviews note making checks essays
	Lois	key words	memorises GEE	questioning		categorises (interesting/ important)	rewrite for "perfection"	ordering/ headings	lists revises each days work
	Charlie		memorises in chunks icons visualises S.E.X.	questioning summarising		memorises bits uses questions	done a lot	in head not written	self- check self-questioning
Quality Multiple	Terri	key words	bullet points numbers GEE	summarising		by meaning related to the main point	effort important		check writing
	Liz	key sentences		questioning summarising		sorting	recognised ease with practice		
	Marianne	key words	visualises	questioning	main points	relevant to key question			checking note making

Although there are limitations in the documentation of prior knowledge, students' awareness as a result of the unit is apparent when the prior knowledge summary (Table 7.6) is mapped onto the declarative, procedural and metacognitive strategy tables as shaded cells. Where knowledge or use of strategies is indicated in unshaded cells (✓), this indicates a possible advancement as a result of the unit of work.

The knowledge and use of strategies in unshaded areas of Table 7.3 indicate that Mary, Mitchel and Niome advanced in terms of schema use and Kay, Mitchel and Awar in terms of elaboration strategy use. A similar scan of knowledge and use of strategies in unshaded areas of Table 7.4 indicate that Lois, Charlie, Terri and Liz advanced in terms of generalisation strategies and Ann and Marianne in terms of practice/effort. In Table 7.5, Vincy, Terri, Liz and Marianne appear to have taken up planning, Kay and Mitchel some monitoring strategies and Mary, Kay, Mitchel and Terri self-questioning. As indicated earlier, any conclusions using this data are inferential, and therefore these should not be given too much weight. There could be some merit though in developing ways to map prior knowledge onto evidence of strategies from multiple sources in future studies.

An aim of the unit of work was to highlight learning strategies so that students would be more aware of them. The intention of modelling, cueing or prompting strategy use was to enhance students' control and self-regulation over their own learning. In theory, highlighting the strategies ought to increase students' ability to process information more effectively. It may give the students "tools" to help them process information and be more self-reflective and self-regulating in their learning (as mentioned in Chapter 3).

Many students transferred knowledge from other subject areas to help them strategically in researching and writing their essays. This was especially the case for students who previously had taken either history or geography where key words, key questions and strategies for paragraph structuring had been taught. Awar, Mitchel, Ann and Terri had not done either history or geography. Despite this, Mitchel was the only student who indicated that he did not have a strategy for locating or focussing on information.

There was also a sense that students needed reminding of strategies so that they could use them. For example, Marianne commented on this.

Marianne (iv1): Often when the teachers give you projects to do they say to write down key questions then you do it, but I don't necessarily do that by myself [without prompting].

Cueing or prompting certainly helped students to get started and may be necessary if they have not had enough experience of using strategies for them to have become internalised as skills.

It is interesting to note that most of the students in the "Quality Product" group reported using some form of self-checking for essays prior to the unit of work. These students probably made use of reflective processes naturally since they seemed somewhat more attuned to metacognitive processes than students in the other groups.

Borkowski, Carr and Pressley (1987) have suggested that if a student is highly familiar with content, then strategies involving selection, monitoring and revision are important. If content is unfamiliar, strategies such as rehearsal or reorganisation are likely to be more important. Students in this study demonstrated some of these tendencies. For example, students in the "Quality Product" group had identified that they needed to acquire sufficient or detailed content information to write a good essay. This suggests some evaluation of how much content and/or the depth of content they thought was needed to write a good essay. In contrast, students in the "Satisfactory Product" group identified that they needed to develop organisational methods to help their work advance (Table 7.1).

It is interesting to note that Mitchel had identified organising information as something that he needed help with prior to the unit of work (Table 7.1) and mentioned in his journal that learning about some aspects of organization, in this unit had helped him to write his essay.

Researcher (j): What else helped you to write the essay?

Mitchel (j): Learning the correct layout, what's needed in each paragraph.

Vincy had identified that structuring and planning were areas she needed help with in the pre-unit interview (Table 7.1). She showed evidence of having done this in her essay.

Vincy (iv2): That cancer essay I wrote was the first essay I have ever planned in my life.

Researcher: Did the planning help?

Vincy: Yes.

Researcher: How did it help?

Vincy: You can see exactly what you had to write down. It was all there. You have got all the information and you are not making it up as you go. That was better because I also used that in my english essays.

Her last comment also illustrates that she considered she transferred the process of planning to her english essays.

There are also indications that students' past success with particular strategies influenced their perceptions of the usefulness of the strategies and therefore their use of them, as mentioned in Section 7.6.

7.6 Other Influences on Learning Outcomes

It is likely that the decisions students make regarding their learning, particularly about whether they will use a strategy in a learning situation, is based on a complex interaction of personal characteristics (student factors) and contextual factors.

Student factors include developing personal motivation and an ability to concentrate on the task at hand, time management and their beliefs about the teaching and learning roles within the classroom. There are many other influences that no doubt affected learning but the contextual factors highlighted in this section are the timing of the unit within the biology course and absenteeism.

7.6.1 Student Factors

Motivation/ability to Concentrate on Tasks

Motivational aspects influencing the group were multi-dimensional and had links with interest in the content (Section 6.6), goals for achievement (Table 7.1) and the ability to deal with distractions. I will now summarise the motivational characteristics of students as grouped by their essay outcome categories.

The "Invisible Product" group

All of the students in this group showed low motivation to complete work for various reasons. Cancer as an issue was not personally relevant for Daniel. Although Sally, Mary and Tulane knew people who had cancer it was not an issue of great concern for them. Kay had an aunty who had breast cancer and considered cancer an important issue.

All the students in this group wanted to pass the bursary exam, but had low expectations for their results because of the amount of effort they were putting into their work (Table 7.1) and possibly because of their performance in biology prior to this unit of work.

They could all identify that they were not good at avoiding distractions. When asked about them, Daniel described his main distraction as thinking about other things.

Daniel (iv1): If your mind is not in class and you are thinking about what else you should be doing.

Kay thought that everything was a distraction and then admitted that she was lazy and unable to avoid distractions such as television and talking to friends.

Mary (iv1) also spoke of thinking about the weekend as a distracter as well as when the subject is "a bit too boring, you can't really understand it, so you turn off and think of other things". Sally spoke of being tired and not enjoying the work, as distracters. She preferred to spend her spare time in the dark room on her photography assignment rather than attempting to write her essay. Tulane identified music, church and kickboxing as distracters although she also admitted that she procrastinated a lot and thought about other things like the weekend instead of her work. Students in this group used distracters as excuses for not being motivated.

The "Satisfactory Product" group

All of the students in this category considered cancer relevant to them personally (Section 6.6). Awar wanted to be a doctor, so his interest in cancer was high. Mitchel's grandfather had lung cancer. Vincy's father was being screened for bowel cancer and she was a smoker. Therefore Mitchel and Vincy considered that they knew a little about cancer already. Samantha had been told to check her moles and wondered about the effects of breast cancer (journal entry).

Their interest in achieving well in the essay and their interest in their exam success was less evident than in the "Quality Product" group. None of the students in this category intended to go to university in the following year. Although Awar wanted to be a doctor, he considered that his lack knowledge of the english language would limit his achievement in

the exams and intended to repeat this year of schooling. Except for Samantha, students in this group expected a low mark in the end of year exam.

Distractions for this group were also common to the other groups, especially regarding thinking about other things they could be doing instead of writing essays. That is, Samantha and Vincy spoke of distractions as "drifting off" and not concentrating on what they should be doing. Awar tended to give up sometimes when he did not understand what he was reading.

The "Quality Product" group

Except for Terri, these students were interested in cancer as an issue because of personal connections with people who had had cancer (Section 6.6). By comparison with the other two groups, these students were all motivated to achieve well in the end of year exam and believed that they could achieve reasonable marks (Table 7.1). Since the essay question in the exam was relatively predictable, they saw it as an area where they could prepare more easily than for other sections of the curriculum.

Their ability to deal with distractions was not obviously different from the other students during classroom observations. In fact, Marianne and Terri often distracted each other by talking, as did Liz and Niome. Terri knew that it was difficult for her to concentrate in class and admitted that she talked too much. She overcame this by working independently at home. The students in this group found it easier and were more perseverant when they worked independently, especially in their own time.

The major differences in motivation between the groups of students were linked strongly to what they wanted to achieve in the end of year exam and what they thought they could achieve. The "Quality Product" group were driven by the intention to do well in the exam. Secondly was an intrinsic interest in the content, particularly if students knew people who had cancer. The relevance of the content was linked to intrinsic interest and played a part in their motivation.

Time Management

The differences in outcomes between students in the "Invisible Product", "Satisfactory Product" and "Quality Product" groups can be in part attributed to their

organisational abilities. In general, when students in the first two groups were asked what they would do differently if they were able to do this unit all over again, they spoke of their need to be more organised and to manage their time more effectively. This can be linked to their lack of use of learning strategies (Tables 7.3, 7.4 and 7.5) and also to their perceptions about their own roles (personal responsibility) or response ability to choose appropriate ways to use learning processes. In contrast, students in the "Quality Product" group had a broader knowledge base of ways to organise themselves and conduct their learning. I elaborate on their beliefs about their responsibilities in the next section.

Students' Beliefs about Teaching and Learning Roles

The "Invisible Product" group

Kay differed from the other students in this group because she could work well independently (although she admitted that there were many distractions), whereas the others required teacher support to begin their work. Daniel, Mary, Sally, and Tulane were not prepared to ask the teacher for assistance when needed. Daniel would ask for clarification on specific details but not in regards to "what do I need to do?"

The "Satisfactory Product" group

Vincy had strong views about what the teacher should be providing. She found the approach taken by the teacher confusing because he was not telling her what to write in her essay. She thought that the teacher should give her the information she needed and then she would "know".

- Vincy (iv2): It probably confuses you a bit more. It wasn't as straightforward as I thought it would be, the whole cancer issue. I thought it was quite muddled up.
- Researcher: What was confusing?
- Vincy: Just the way he wasn't telling us you need to learn this and this and you need to know all these things about cancer. He kind of said, pick your one, and learn.
- Researcher: So why do you think he did it t... way? Because he did it purposely.
- Vincy: He wants us to go out and do the work and learn. I don't actually know. He wanted us to do it instead of just being fed

the information. But I think we are just so used to being fed it that it's not going to work.

Researcher: So normally people would just give you the information?

Vincy: Yes, but this is like do it yourself. And we're like, what do we do now? That was quite hard. I found it quite hard actually.

Researcher: So you are saying that usually you don't go out and find out yourself?

Vincy: You can but usually he gives you the basic facts. Everything that you need to know is usually given to you by the teacher and then you can go and get more if you want. But this was different.

Other members of this group were not as adamant about the role of the teacher but there is some evidence that, particularly Mitchel, did not consider he was in charge of his own learning (see Section 8.3).

The "Quality Product" group

In general, the quality product group considered that they should work independently on their essays and were able to do so. Chris, Ann, and Lois indicated that they liked or preferred to work independently. For example Lois stated how she liked to work independently.

Lois (iv2): I thought it was quite good how it did work like we just basically first of all got ideas, what type of stuff we might research and then we got to research them ourselves. That's how I like to work anyway. I thought it was quite good.

In contrast, Liz, Marianne and Terri recognised that it was important for them to develop their own ideas but wanted to get the highest possible marks in the exam. They considered that if the teacher had given them more content information, they stood a better chance of gaining higher marks. Liz's comment is given in Section 8.6.2. Marianne and Terri's comments about this are given below.

Marianne (iv2): I think I needed to know more about what effects cancer has on you if it is not treated. I know all the internal cancer cells are dividing and all that sort of thing but on an actual person experiencing cancer what happens to them. I also thought there should have been some prior teaching on specific

cancers rather than leaving that up to individuals to go and do their own research.

- Researcher: But do you think everyone would do the same thing as what the teacher had taught? That is the danger of that. Part of this was to get you to do more researching skills.
- Marianne (iv2): Well then more of a structure for it. Set the task rather than saying "you have got to know about some cancers, so go and do that".
- Terri (iv2): I would want more information shoved in my face. It was just hard motivating myself to pick 2 cancers, do it myself, then work in a classroom environment because I can't do that. I can do it at home fine, it is just in class I can't.

The teacher considered that for some, teacher-directed information was seen to save time, whereas for others it was linked to not knowing what to do or that some students were simply being lazy. It was obviously a new mode of operating for some students.

7.6.2 Contextual factors

Contextual factors mentioned here are the timing of the unit of work (at the end of the academic year) and absenteeism.

The Timing of the Unit of Work

This unit of work was carried out at the end of the academic year and was the last unit to be completed before students revised and sat the University Bursary exam. Students felt under pressure at this time of the year and there was a sense of "latent panic" as is usual for students in this year group prior to a major set of external national exams. Many knew they ought to be managing their time so that they could accommodate some study towards the exams, but other distractions impeded this for most students. For some students the timing influenced the amount of effort/time they were prepared to expend on monitoring their progress and revising their essays. I have no doubt that the amount of time spent and how effectively they used their time was influenced by the looming exam "latent panic" syndrome.

Students were affected differentially by the pressure of the exams. For example, students in the "Invisible Product" category assumed that they were not going to pass the exams, so put very little effort in to monitoring or revising. In general, the students in the other two categories were more conscientious and managed their time more effectively.

Further, the trends in the learning strategies data above (Tables 7.3, 7.4 and 7.5) reflect the ability of students to deal with this influence. That is, those students who knew and used strategic combinations of methods for information processing, planning, monitoring and evaluating their work, also had more effective time management skills. All of the students in the "Invisible Product" group considered that they needed to organise either their time or their work more efficiently. Mitchel, Samantha and Vincy in the "Satisfactory Product" category also spoke of the need to be more organised.

Lois commented on her awareness of running out of time. When asked what she would do differently if she were able to do this unit of work all over again, Lois commented:

Lois (iv2): Spend more time researching the different types of cancer and getting more detailed information on that, because now I am running out of time to do it. I'm now concentrating on other things. So I would definitely spend more time researching the information.

Students' commitments to out-of-school-activities, particularly part time jobs were mentioned by several students as preventing them from spending more time on their essays. Although Charlie stated that he would not revise his essay after getting feedback from the teacher because he was quite happy with his mark, he elaborated by saying that he did not have time because of work commitments.

Absenteeism

Participation time was reduced by absenteeism. Because I was not observing the class every session, I did not keep absent records on a daily basis. Many students were absent for several days during this unit of work due to sickness (Maria, Niome, Terri, Sally). Daniel was absent for approximately two weeks due to regional school sporting commitments. Kay was also absent for approximately half the class sessions because of a timetable clash, making it difficult for her to catch up on her work. This factor alone had a huge effect on these students' abilities to work on their essays in the classroom. If they were absent when information processing was modelled or did not experience cueing or prompting of the strategies, it is less likely that they would use them.

It is interesting that Marianne, Niome, and Terri were able to complete very good essays despite their absences and apparent level of being distractive and distracted in class. This is probably due to their prior knowledge and experience in using a range of learning strategies that may have enabled them to work independently, in their own time. Their motivation to achieve good marks was also high.

7.7 Perceptions of Activities which Developed the Processes of Learning

Students' comments about aspects of the unit of work have already been discussed in Section 6.8. However, the activities which data suggests were most influential on the development of learning processes are reported here. The activities have been described in Section 5.3. The students' and the teacher's comments given in this section not only give their perceptions of the activities but also reveal the subtleties and applications of learning processes that occurred.

7.7.1 Information Processing Activities

Two activities were used to help students to be more discriminating in regards to note making ("Trash and Treasure" and "Notes on Notes"). The 'Trash and Treasure' activity illustrated how to sort relevant from irrelevant information. It was considered to be a powerful technique by most students. They completed note making in a much shorter time than they would have done previously. Positive comments are given below.

Charlie (iv2): "Trash and Treasure" [was useful] because it shows that out of two pages, and it may have been more and out of that, I only really found a few lines that I really needed.

Researcher: So how was that useful?

Charlie: Because all that other stuff was just trash I thought, 'cos I only really needed to know three sentences and other people were writing whole pages of notes and I wrote three sentences and I think I probably learnt just as much as them.

Mitchel (iv2): "Trash and Treasure", I found that really good. The only thing with that is some things you might think aren't useful, but they are, so you don't really take down the notes.

Researcher: So how was it useful for you? Why was it useful?

Mitchel: Well there was information you didn't need to know, so instead of writing out pages and pages of stuff that you wouldn't use, you just kept the good stuff.

Sally (iv2): Yes, because I'm used to just writing notes in biology and I'm just sitting there writing and then you think I didn't even need half of that, so it is good to not to be afraid to cross out stuff. You don't need to learn it all.

Researcher: And just keep the most important stuff?

Sally: Yes, and that way you will have a better chance of remembering it.

Some students did not find the "Trash and Treasure" activity useful. Daniel thought the process was confusing. He thought that misinformation had been included and you had to sort what was correct. He was not paying attention during the instructions for this activity.

Daniel (iv): I thought that ["Trash and Treasure"] was just jumbling up your mind. I only like to read things which are true not stuff that is wrong.

Vincy thought that it was difficult because it required decision-making about the material.

Vincy (iv): "Trash and Treasure", I didn't really like that very much. It wasn't that easy because you were left to yourself to decide what information you want. No one is telling you if you actually need it or not.

This statement reinforces her views about the roles of the teacher and student in the learning process (Section 7.6.1).

"Notes on Notes" is a way of annotating notes as explained in Section 5.3.8. The students were shown how to write notes on a narrower page than usual and leave space for note making at the right hand side.

Ann (iv2): Learning to take "Notes on Notes" because usually I just write everything down and then I don't learn it all, it usually just goes in one ear and out the other, but if you've just got a little bit you tend to memorize it a bit better, so that was good

Kay (iv2): Yes. If I didn't know something I am the type of person to try and find it out. Some of the other notes I wrote something down and then write a question mark beside it because I want to know what it is, but I don't have actual statistics or something like that. If I come across something that is a bit vague that makes me [use annotations]. I haven't really done enough to know.

Ann and Kay were the only students observed to use this procedure in class. Kay's comments above imply that she used this technique on the notes she generated herself, to help herself monitor her work. Since students were not given printed material with large margins for writing in, they may not have automatically remembered "Notes on Notes" as a technique they could use. Most reference material was from pre-existing text in journals or books. Producing new resource material with wider margins would have been a big demand on the teacher.

Another information processing procedure was to help students to structure their paragraph writing by using key ideas, generalisations, examples and explanations. Many students knew how to do this from previous experience in geography or history and valued their use as illustrated by Lois and Sally's comments below.

Lois (iv2): I sort of knew [about key words]. My essay [that I wrote] is how I write the history essays.

Sally (iv2): I've done heaps of essay writing, so I know how to write them and then you get what the question is actually asking for and then you write it all down and then you brainstorm and think of everything and then try and make paragraphs out of those. I put the most important thing, what I know most about first, then you write down little examples and stuff and then order it and then put the stuff I am not too sure about, I put later on.

It was disappointing that a lot of the information processing based activities, for example 'Notes on Notes' and key words/questions, were not widely used. Many students stuck with their old habits even though they had been shown examples. The teacher had not incorporated these activities into this type of unit before, and did not reinforce their use often.

7.7.2 *Pre-write (paragraph)*

Only seven students handed in their paragraphs to the teacher. This was partly because students were going in and out of class for sports and cultural photographs during this lesson. The pre-write activity was designed to get students to write down some preliminary ideas. Many students did not see it as being important because there was no deadline for handing it in and no assessment mark attached to it. One student suggested that

they should have been given tighter deadlines for completing the paragraph. In general, the comments about pre-write paragraphs were very positive.

- Ann (iv2): And it stayed fresh in your mind, you have everything, it is actually a really good idea.
- Liz (iv2): Pre-writes were good. You kind of know what you're already going to write and you get good feedback.
- Tulane (iv2): Putting ideas on paper, because you have them all but they are not very definitive. By writing them down it makes them more concrete in your head.
- Charlie (iv2): That [pre-write] was good because I found the first paragraph I wrote was really bad. I think the more practice I did the better I got. I think practicing was the best thing to do with this cancer essay and the more practice I do, the better I get.

Pre-writing a summary paragraph requires knowing what you intend to include in your essay. When this activity was carried out, most students probably had not chosen what content they would include in their essays. This would have made it difficult for them to know what to write. Stronger emphasis on how the pre-write paragraph linked to planning could have been beneficial to students.

7.7.3 *Planning*

Five students had a specific heuristic approach to planning their essays which was consistent with the checklist provided. Although three other students agreed that planning was important, they considered their planning was non-existent. In fact these students did plan, as shown by the structure of their essays but in a non-conscious way. They did not write plans. Some planning was enhanced when students wrote key words, key questions and lists in their journals. Several students thought it was important but still did not write a plan (see Charlie's comment Section 8.5.3 and Liz's comment Section 8.6.3). Lois described how she would start out with an intention to plan but then not follow it through.

- Lois (iv2): Because how I write, I just plan a little bit but I never stick to my plan.

There is some indication that Lois considered planning was time consuming. Most students recognised that planning took time. Some students evaluated whether planning was worth the effort. For example, even though Lois acknowledged that her use of planning

was limited, she recognised the importance of planning and asked whether it would be good to write a plan in the exam.

Lois (iv2): In the exam you have got like the essay question, will it be too time consuming if you write big essay plans, before you write the essay just in case you didn't finish the essay in the exam the examiner could go back and see [that] you know?

Both Marianne and Samantha described how they planned their essays. Their final marks reflected their prior organization.

Marianne (iv2): Basically I broke the question up into what it was looking for. I did write a plan that might be in my book. I broke it up and then I worked out what I wanted to know and I put an introduction and then I put what cancer is, just give the background information and discuss why people get it and how to treat it, the biological steps going through the explanation of cancer. [The] Ethical and the implications of it and that sort of thing. I just wrote down the order of the things I was going to talk about.

Samantha (iv2): I've done heaps of essay writing, so I know how to write them and then you get what the question is actually asking for and then you write it all down and then you brainstorm and think of everything and then try and make paragraphs out of those.

Researcher: Good. So how do you order what you are going to write down?

Samantha: We are doing heaps of that in English at the moment. I put the most important thing, what I know most about first, then you write down little examples and stuff and then order it and then put the stuff, I am not too sure about what I put later on.

There was a positive relationship between students who planned their work and the quality of their essays.

As mentioned in Section 5.3.14, the teacher realized the importance of planning and thought that he could have emphasised it more and given definite deadlines so that he could check students' understanding of the question before they proceeded with the essay.

7.7.4 Checklist for Essays

The whole unit focussed on the final production of an essay. The teacher went through a list of essay writing skills which elaborated on what to write in each section of

the essay and how to focus on the essay question. The essay checklist helped students to identify what they needed to do.

- Mitchel (iv2): Once he put it up on the board and we went over what had to be in there and I worked out what I didn't have in there, which helped.
- Sally (j): The essay checklist was helpful. It gave concise information in a clear format with some thought provoking topics - things I hadn't thought about before.
- Nina (j): I know what information I have and can organise things. [It] Gives more of a structure which makes it easier to work from and see what I need.
- Vincy (iv2): Yep, there's a lot more preparation than normal. I used to write essays just off the top of my head, just write, write, write, and it feels quite strange having to do all these little things before you write it but I guess it is better because you know exactly what you are doing.

7.7.5 *Monitoring of Learning*

Some students made use of key questions/key words to direct and monitor their note taking and writing.

- Ann (iv2): Well I tried key words. I tried to make sure that I had words like say metastasis and like the later stage and things like that. I made sure that the biological things were in there, so the person marking will know that I know stuff.
- Researcher: You said you asked yourself some questions. What made you ask yourself some questions there?
- Awar (iv2): Yes I was trying to understand. I didn't know that much about cancer and I just said, "what causes cancer?" and I had to go out and it made me try to concentrate.
- Researcher: So did that help in thinking "what did I need to know?"
- Awar: Yes. It helped me write my essay because I didn't know how to start my essay so I wrote down some questions and then I answered questions and from there.
- Tulane (iv2): Because I know that when I go through my notes the question is right there and the answer is straight underneath and you won't have to go digging around.

Although Tulane commented on the usefulness of key words, there was no evidence that she actually used them.

Monitoring through journal writing varied as mentioned previously in Section 5.3.2. However, in general, writing in journals helped students to focus on what they needed to do and allowed them to plan and monitor their work. Comments about the usefulness of the journals have been given in Section 5.3.2 and 6.8.3. Although journals were not used extensively, the prompts in the journals seemed to help students to get started. The teacher and the students probably understated the usefulness of the journals for monitoring learning. It must be remembered that this was the first time students had used journals in this way.

7.7.6 Peer Assessment

The students who completed essays swapped them for peer checking during class time. Students were asked if the peer check activity was useful as part of the final interview. Samples of their replies below indicate that peer checking gave them new ideas, allowed them to consolidate their ideas, and gave them feedback on progress, especially when constructive comments were given. For some students, it was the most beneficial part of the whole process of writing the essay.

Lois (iv2): That worked when you got other people to check it. That worked because Terri checked mine and then she wrote down a whole list of other stuff I could do. Like I didn't have any defined causes or something for my essay and she gave me a whole checklist of what I can do.

Charlie (iv2): Yes, I think it did [help] just to see because she had different ideas to mine and I think it was good to read someone else's and our teacher gave us an [other student's] essay, half an essay and I got 33 out of 40 and I read through that [other essay] and that was actually a lot of help. It has got to be the thing that helped me most, just to see someone else's essay, what they did and they got quite high marks.

Peer checking was beneficial to the reader/marker as it gave the students ideas and insights into what could be written and how it could be structured. Students also learned from negative examples.

Sally (j): It made me realize what else I can include in my essay.

Samantha (iv2): It points out the little things that you didn't see. It can help clarify your sentences to make them mean more. Like changing a few words around or adding more in. It gives you more marks [helps you to improve].

Ann (iv2): Well you can see where other people go wrong and you can make sure that you don't do the same things, and you get a few ideas on how it is structured, because I read Marianne's and hers is really good. Her's was structured really well and she had good key words and stuff like that. From reading that you could see that she actually knew quite a lot.

Researcher: How did that help your essay then?

Ann: it helped because you know because reading someone else's you know what makes a good essay, having key words, having it well structured and she had it flowing really good.

Daniel (iv2): It helps just reading what you should be doing, it is good to know what you should be writing about and how you should be writing, what style. Some people have different styles. Some people go straight into it and others just wing around it, but overall it is about the same. You learn that by watching other people do their work and it is good.

Sally (iv2): It points out the little things that you didn't see. It can help clarify your sentences to make them mean more. Like changing a few words around or adding more in it gives you more marks.

However, some students were too afraid to put their peers down by giving negative feedback. There was also uncertainty as to how to allocate the marks when marking someone else's essay because some students felt that they did not have the appropriate background to know what could be included as either information or examples.

Lois (iv2): Yes [it was useful], but not marking them though. It is quite hard to mark them and find exactly what you have to take in. The information [was good] as well. Yes, it did help but the marking did as well. I didn't realize that there were four marks just for examples of causes and that's heaps.

Lois' comments imply that marking allowed her to realize more fully, how the marks were allocated.

Mitchel (iv2): I think it was good to read other people's essays to get ideas and think what you have missed out and that sort of thing, but I really think that writing comments and giving them marks wasn't very good because at that stage half of us didn't know what was right and wrong anyway because we hadn't had the marks and so you couldn't say that's wrong because you don't even know that. But also it's not fair to tell someone they have got a low mark or something like that. You have to give your friend a high mark otherwise they are going to be mean.

Mitchel's comments highlight the frustration that students can experience if they do not know enough information to be able to evaluate whether what was written was adequate or not. They need to know the depth of content required or text conventions for structuring written pieces of work. This would apply to evaluating their own essays as well as others. Even so, just reading another student's essay seemed to be helpful for most students.

7.8 Summary of Perspectives on Learning

The knowledge and use of strategies, as indicated for these students, is positively related to the quality of their essays. Strategies are likely to work interactively in that one may affect the effectiveness of another. Students who used planning in combination with monitoring, produced better quality essays (Charlie and Liz).

Although many students knew about many learning strategies, they did not necessarily action them. The reasons for this will be discussed in Chapter 9. It seems obvious, but students must actually put strategies into action for them to be useful and have an effect on their achievement.

It is interesting that practice as a strategy may not necessarily be effective by itself. Although Ann wrote two essays, neither of them were quality ones. This could be a reflection of the fact that she handed both of them in at the same time, and had not received feedback on the first essay before writing the second. Perhaps this shows that she did not use practice in conjunction with monitoring or planning. This finding highlights that producing more essays is not necessarily better. The extent of evaluation of the essay-writing process or the essay itself, in between drafts, is very likely to make a difference. Knowing what is required and acting on this knowledge, will influence the effectiveness of the evaluation.

There are strong indications that students' abilities to manage tasks in terms of time, their motivation, and their beliefs about their role in their own learning, influenced what they did. There were also modifying effects from external influences such as time pressures caused by the proximity of external national exams and other activities that prevented students being present in class, or working on their research or essays in their own time.

The activities in the unit of work that students reported to be most beneficial for their learning processes were the checklist and the peer assessment of essays. The

comments about these activities not only indicate their usefulness but also reveal student understandings about their roles as learners, what they perceived were the purposes of the tasks and how they made learning decisions to activate particular learning strategies. I elaborate on these ideas in chapter 8 by providing specific examples of the degree of awareness and control over learning for 5 case studies.

Chapter 8 Case Studies

8.1 The Purpose of the Chapter

In this chapter I describe the learning characteristics of five students. These descriptions expand on the data in Chapter 7 and provide specific examples of the relationships between students' awareness and control of their learning and their achievement. In this way, I elaborate on research questions 5, 6 and 7 (Table 4.2):

"What kind of relationship, if any is there between students' prior knowledge of learning strategies and their use in researching and essay writing?"

"What evidence is there that the intervention helped the students to be self-monitoring and self-regulating in their learning?"

"What other factors, regarding the teaching and learning environment in this context, might influence the way in which students learn about social and ethical issues?"

As mentioned previously, the students were grouped according to the quality or quantity of essays they produced, as follows.

"Invisible Product"	Daniel , Tulane, Mary, Sally, Kay
"Satisfactory Product"	Mitchel , Awar, Vincy, Samantha
"Satisfactory Multiple"	Ann
"Quality Product"	Niome, Lois, Charlie
"Quality Multiple"	Liz , Marianne, Terri

I have already indicated in Chapter 7 how individuals in these groups were similar and yet different.

Any of the 16 students could have been described in these case studies to illustrate the salient ideas that arise in this investigation. However, I have purposefully chosen one student from each category (in bold type above) to illustrate how, to varying extents, they used learning strategies and monitored their learning.

I will now explain why I chose these students. Daniel was chosen from the "Invisible Product" category because he is an example of a student who appears to have good intentions but does not follow through with them at all. He comments positively about

many of the activities in the unit, despite his high absenteeism. He was not concerned about achieving well and deliberately chose to be idle. I discuss his characteristics in Section 8.2.

Mitchel (Section 8.3) was chosen from the "Satisfactory Product" group because he had identified prior to the unit that he needed help with organisation. Although he had good intentions, his awareness of strategies was generalised. He was aware of the executive processes of planning, monitoring and evaluating but lacked an awareness of specific strategies and the choices he could make. Therefore he did not apply these processes. Mitchel reported that he gained organisation skills as a result of the unit of work.

Ann is in a category of her own, "Multiple Satisfactory". This is because she wrote two essays that were considered satisfactory. They were both handed in to the teacher at the same time, so there was no editing of the first essay before producing the second. She was perseverant in her work, but this was not enough to ensure that she wrote quality essays. I discuss her knowledge and use of learning strategies in Section 8.4.

All students in the "Quality Product" category had experienced a similar inquiry approach in either geography or history. This suggests that prior experience made a difference. Charlie's learning characteristics are discussed in Section 8.5. He was chosen as a case from the "Quality Product" category because he could articulate how he used learning strategies effectively. In fact he designed some of his own and very deliberately used them to write a quality essay. He rationalised his time and knew that editing and changing his essay after it had been marked, probably would not gain very much.

Liz was chosen as a case example from the "Multiple Quality" category. Her characteristics are described in Section 8.6. She wrote two essays because she was very achievement driven and knew that this part of the course was one that might gain her marks in the final exam. Her comments about aspects of the unit of work were not always favourable, yet she actively used the artefacts (checklists and journal prompts) to her advantage. She considered that the extra effort required to write a second essay was worth it.

In each of Sections 8.2 - 8.6, I initially outline some background information about the case study student, and then describe characteristics of his/her learning under the categories considered important for enhancing self-directed learning by Wang and Peverley

(1986). These categories are: Learning Awareness, Use of Strategies, Monitoring Progress, and Integrating and Extending Knowledge and Motivation. The descriptions have been derived from the metamatrices for these students (Appendix 10). Additional evidence from the pre and post unit interviews, students' journals, classroom observations and essays are used throughout.

8.2 Daniel

8.2.1 Background Information

Daniel is an example of a case in the "Invisible Product" group. He was a very active sportsman who had had success in athletics, basketball and rugby. On entering school, he had been placed in the top stream class because of his natural ability to memorise information. He was very confident that he could do it (anything) and achieve well if he wanted to, probably due to successes in some aspects of schoolwork in the past. However, he lacked the organisational strategies to structure independent research or writing. This was also a characteristic of the other students in the "Invisible Product" group. He was also easily distracted, and distracted others during class sessions. This tendency showed a general lack of interest in writing the essay. He did not write a pre-write paragraph nor produce a final essay.

8.2.2 Learning Awareness

Daniel's comments indicate that his awareness about his own learning was generalised. He did not talk about using specific strategies.

His comments about essay writing and about planning before the unit of work indicate that he was aware of his lack of prior knowledge.

Daniel (iv1): I am not really good at making and reading notes and that sort of stuff.

Daniel (iv2): It [planning] would help I imagine, because what I know is pretty limited too, so it is quite hard.

Daniel recognised that he had a limited background in both declarative and procedural knowledge. He knew that he learned well orally (Table 7.1). I am not entirely convinced this was linked to his Samoan heritage although Tulane, the only other Samoan in the study group, also expressed her preference for learning orally.

Researcher: Do you know how you learn best?

- Daniel (iv1): Just learning orally.
- Researcher: You know that you prefer to learn by listening?
- Daniel: Yes, because when I write things down I just write them down without thinking. I do not actually learn it. It just comes by talking and if it is interesting. If it is interesting, I learn. I am not good at sight-reading [interpreting what I read].

At least this statement shows that he was aware of not evaluating information when he wrote it down. Corroborating the above statements are his very positive comments about the usefulness of the discussions (Section 6.6.2).

He considered that he was good at remembering facts when there was a purpose for remembering them. I had also observed this as his teacher in previous years. Daniel was easily distracted if he was not interested in the content or if the activity was not interactive.

- Researcher: Do you know why you do better at memorising things? How come you are good at memorising things? Have you got ways of doing that?
- Daniel (iv1): It is probably because it seems simple, that I am memorising for a purpose. Learning for the sake of it doesn't seem attractive to me. I really have it in my mind but I don't actually bring it up to the end of the exam or something and then once I have memorised it, I can hold onto that thought better. Until when I need it, then I sort of chuck it out the window again.

He found decision-making with regard to what content to include and how to write essays difficult, as explained both prior to and after the unit of work as indicated below.

- Researcher: So why is writing essays difficult for you?
- Daniel (iv1): It is sort of, deciding [what] aspect of, selecting the right words to say that...
- Researcher: So writing is something....
- Daniel: The actual style. Styles and ways of writing.
- Daniel (iv2): Because I don't have a clue about what to do, you know. I don't structure right and sort of, that is probably why english is quite hard, because there is a lot of essays and that, and I wanted to get good marks and I was not getting what I was thinking I [should be] was getting. It wasn't enough to pass.

The last statement also indicates that he evaluated his procedural knowledge as lacking.

8.2.3 Use of Strategies

There was no evidence that Daniel ever planned his work. In fact he stated in the pre-unit interview that he did not even take notes from text sources. Rather, he would read and then just write the essay later, with little checking for quality.

Researcher: How do you get the information, background information that you need?

Daniel (iv1): I have never done that. Really just off my head. I just make up a lot of grudge really.

Researcher: So you would just read something and compile it all in your head and just download it onto paper?

Daniel: I would download when writing. I will be thinking and writing. Then maybe do a second copy, but most times it is the first copy and I just write in my best sentence. I know these things, then I will probably look over the book and change a few words, sometimes.

Daniel (iv2): I just write. I haven't set it out right, I just write. Probably if I had to I could learn about it [how to structure an essay] in half a day, she'll be right.

Even though he knew that essays could have structure, he was not prepared to put time or effort into deliberately using strategies to structure his writing.

Daniel (iv1): There's always been generalise and there's always been... I have stuck to it in a way but not completely.

Researcher: Will you put that structure into these couple of paragraphs that you are going to hand in?

Daniel (iv2): I don't know. It depends on how much time I have got. Not really. Always a basic structure but usually I don't structure things a lot really. In the exam, I just like to get down as much as I know and hopefully it's the real article [good enough].

Daniel had a "Knowledge Telling" approach to writing rather than a planned or structured approach. He also recognised that he did not learn how to use the strategies that were advocated as part of this unit. Instead he copied the notes provided by the teacher.

Daniel (iv2): There were a lot of things that I didn't pick up on too much.

Researcher: How did you take notes?

- Daniel (iv2): I just wrote them down.
- Researcher: Straight out of the book?
- Daniel: No, just from what Mr S. had given us.
- Researcher: How did you know what you wanted and what you needed to put in?
- Daniel: I just wrote down everything.

As an example of how Daniel did not discriminate information, when taking part in the 'Trash and Treasure' activity he misinterpreted it (Section 7.7.1) and thought that the idea was to find the misinformation in the article rather than discerning degrees of importance within the pieces of information. The above comments are another indication of his impulsiveness and lack of evaluation with regard to what he needed to write. He was also aware that the strategies might be useful if he had used them and actually did the work.

- Daniel (iv2): That stuff [the strategies] only really helps me if I did the thing. I didn't really do it eh. That's the problem.

8.2.4 *Monitoring Progress*

Daniel identified that he needed assistance to write essays (Table 7.1). He did not work well independently and acknowledged that his output was related to effort.

- Daniel (iv1): [I] need help in doing my work. I find it hard to work [by myself]. If I did [work by myself] my mark would be a lot better. I could achieve harder than what I am.
- Researcher: In general would you be able to complete things without help from the teacher?
- Daniel (iv1): No, I usually have help. I complete things with heaps of help, help from teachers.

Daniel did not "pass first base" in terms of taking his own notes and certainly did not provide any evidence of using information obtained from the teacher-directed sessions, nor class discussions, even though he thought they were useful (Section 6.6.2).

Daniel made no effort to use his journal, even when reminded in class. He did not have a copy of the research guide (Appendix 11) because he was absent the day it was handed out. He had no intention of writing an essay and showed little interest in actually doing so.

- Researcher: If you were able to do this unit all over again, what would you do differently?

Daniel (iv2): I would be there, and try to get as much information as possible from everything. Just not being there was a real disadvantage because I didn't know the basic facts about cancer, because I wasn't there. I probably could have taken more understanding of the notes Mr. S. gave us, like read them carefully and try to understand them. [I should have] Collected more information.

To some extent Daniel's absences did prevent him from knowing what he was supposed to do. However, even during the times he was present he was not attentive, misinterpreted information and was easily distracted and distracted others. He recognised that he was quite dependent on the teacher. He was not self-directed, self-regulating nor intentional.

8.2.5 *Integrating and Extending Knowledge*

Daniel commented about his lack of prior content knowledge.

Daniel (iv2): I didn't know what it [cancer] actually is or what it can affect.

The answers he gave in the pre-unit questionnaire on biological and social concepts and implications (Tables 6.1- 6.5) indicate that he wrote, "don't know" for most of the questions. He had very little prior content knowledge.

Daniel considered that the teacher-directed instruction was useful because he was used to the teacher doing that. My classroom observation notes indicate that he needed to be guided and directed by the teacher when taking notes, even to help him get started. Daniel provided no written evidence of integrating or extending his knowledge either about content or learning processes.

8.2.6 *Motivation*

Daniel became a professional football player part way through the year of this study but remained at school until the end of the year. He was absent for two weeks of this unit of work due to his commitments away from school to perform in the National athletics competitions. Other students such as Marianne, Niome and Kay were also absent for a substantial period during the unit but, unlike Daniel, were motivated to catch up on notes and what they had missed (Section 7.6.1). Daniel also had no real concern about cancer since it had not affected anyone he knew and it was not really an issue for him, even though he asked several personally relevant questions during class and made very positive

comments about the class discussions (Section 6.6.2). He had mentioned several times that the content or ideas had to be interesting for him to be motivated.

Daniel (iv1): Learning things for the sake of it, doesn't seem attractive to me.

His low motivation was reflected by his behaviour in class. He disrupted the class often by calling out inappropriate comments or talking to other students about the school social, the weekend or any other topic of personal interest (co). His attitude to contributing to the class and to his work could be described as impulsive and attention-seeking. He had a lot of physical energy.

The teacher recognised his disruptive tendencies.

Mr S (co): Ah, you won't get much out of him. He avoids handing in work [because he hasn't done it]. He's a bit immature in some ways and is no good around the girls. I have to shift him to the back and then he's fine.

When Daniel was shifted to the back of the classroom, he worked more constructively although he would jiggle his foot or leg or tap his pencil on the desk (co).

He wanted to go to university, but not in the near future. Therefore his mark in the end of year exam was not important to him.

Daniel (iv1): I'd like to get a pass. It's not too much of a concern because I know how hard it is to pass. Whatever comes really. The work I put into it will tell on the results.

He was very confident in his ability to achieve well if he "put his mind to it", but because he had already acquired a paid professional football contract, it wasn't important for him at this time.

Daniel (iv2): I feel that if I want to do well at something, I can do it, do well in anything, but it is my choice if I want to put the work in. But I think I will find it easy to pass because I'm starting to put the work in.

He considered that whether to participate and the how much effort he put into his work, was his choice. He chose not to put effort in, during class time.

8.2.7 Summary of Daniel's Characteristics

Daniel is an example of a case in the "Invisible Product" group since he did not write a pre-write paragraph nor produce a final essay. His characteristics indicate a

combination of little motivation and little knowledge about the biological content associated with cancer or learning strategies (Tables 7.2- 7.6). As a result, he did not use his time in class effectively, especially for self-directed research. His lack of knowledge probably precluded him from being able to plan, monitor or evaluate his work.

He did not use any of the information-processing strategies, nor the monitoring strategies that were part of this unit of work (including making no entries in his journal). This was due to his absences and his lack of motivation. Perhaps his public attribution of failure to lack of effort was a face-saving attempt to dismiss the possibility that his lack of success could be due to lack of ability.

The behaviours he showed indicated this. For example he showed a disinclination to undertake tasks, was less hardworking than others when undertaking a task and gave up more readily. He had impulsive tendencies and a lack of understanding, both of content and process.

His portrayed confidence to achieve well if he wanted to was probably related to being able to memorise content easily. However, he lacked the organisational strategies to structure independent research or writing, particularly for an extensive study on a topic he knew little about. This was also a characteristic of the other students categorised in the "Invisible Product" group.

Daniel did not indicate a strong personal interest in cancer as an issue except in one instance during class, where he asked about a mole on his leg. Cancer does not seem to be prevalent amongst Samoans. Therefore it is likely he had not had the experience of a friend or relative coping with the personal and social implications of having cancer.

8.3 Mitchel

8.3.1 Background Information

Mitchel showed some characteristics similar to other students who produced a "Satisfactory Product". Like the other students in this category, he had a limited knowledge of what was required to write a good essay. Although he knew of some learning strategies, he used them sparingly.

Mitchel differed from others in his category in that he had not taken biology in previous years. He acknowledged this as a problem, but was willing to try to address it.

Time for researching and revising drafts was an issue for Mitchel. He had a job after school and played a lot of sport.

8.3.2 *Learning Awareness*

Mitchel thought that he was not very able at essay writing (Table 7.1) but considered that doing this unit had helped.

Mitchel (iv2): I just think because I've always had a problem writing essays that I feel that I could write a good essay now, in that end of year exam. This has definitely helped me.

Later in this interview he reiterated this statement.

Mitchel (iv2): I think with the way my essays were to start with, any sort of help would have done the majority [made a difference].

The blank cells in Table 7.6, which indicate there were no entries for Mitchel's prior knowledge of strategies substantiate this last statement.

However he did identify that he preferred working with others.

Mitchel (iv1): Physical education is my subject. Anything working as a team, I feel. [When] You have more than one [person], you get more ideas, talk it out and get the best answers.

He indicated in the classroom that he did not have existing strategies for organising or sorting information.

Researcher: So when you jot all this information, what are you going to do with it, in terms of making a summary or making notes?

Mitchel (co): That is the problem. That is what I have problems with, getting it together.

Mitchel's assessment of his learning needs was in general terms. He mentioned that he tried to remember "it all" but he did not mention a strategy for doing this. He also knew that what he was doing was not effective.

Researcher: What is it that you find tricky about biology?

Mitchel (iv1): A lot of terms. Just trying to remember it all. I have been studying quite a bit lately and it is just not working.

8.3.3 *Use of Strategies*

He did not make use of key words although he said he had used a few questions. When he wrote these questions into his journal he expected me to answer them rather than using them as a guide for his research (Section 5.3.2). This fits with his strategy of getting

others to help him. So, although he thought that asking questions was a good idea, in his mind it was to get someone else to answer them rather than finding out the answer for himself. He was not using the strategies as the teacher intended them (Section 5.3.2). My feedback about "keep writing yourself questions" in his journal had little purpose for him. It was obviously not clear to him that writing questions was a strategy for planning, monitoring or directing his research.

In the past he had had difficulty discriminating between useful and not useful information. He was still not confident in choosing the valuable information.

Mitchel (iv2): "Trash and Treasure", I found that really good. The only thing with that is some things you might think aren't useful, but they are, so you don't really take down notes.

Researcher: So how was this useful for you? Why was it useful?

Mitchel: Well there was information you didn't need to know, so instead of writing out pages and pages of stuff that you wouldn't use, you just keep the good stuff.

Mitchel considered that the essays he wrote were good ones. He had no real personal benchmarks as to how to judge whether an essay was good or not, and was therefore disappointed with the marks he received.

Mitchel (iv1): I always think I have [written a good essay]. When I am finished, I am really impressed with it. I get the marks back and I am not really pleased. I always think I have done a good essay.

This is an example of what Hacker (1998) calls an "illusion of knowing."

8.3.4 *Monitoring Progress*

In identifying whether he planned work prior to the unit, he spoke in general terms rather than specific schemas. For example in the pre-unit interview he stated very broadly:

Mitchel (iv1): I have a plan on what I am going to use on an assignment.

After the unit he explained how he discriminated between relevant and irrelevant information and organised the information into sections.

Mitchel (iv2): I did that just jotting down everything that is relevant and working out what I needed and what I didn't and putting into sections.

Researcher: So you organised it into sections. How did you decide what sections to have?

Mitchel (iv2): Sort of what went with what, just depending. Like I did the breast cancer with mammograms and that comes into sort of treatment and causes.

Researcher: So how did you plan your essay, or did you plan it?

Mitchel (iv2): I just wrote it.

Since he did not indicate any evaluative aspects to his planning processes, and said that he just wrote his essay without planning, I have indicated in Table 7.5 that he knew about planning but had no real tactic for doing so.

There was some evidence that Mitchel monitored his progress in his learning journal.

Mitchel (j): Need more info on specific types of cancer, treatments, causes, effects. Practice essay writing. Still having problems with wording and making it flow.

Although he had identified practising writing as a useful strategy, it would not be helpful unless he also addressed the other issues he mentioned.

When Mitchel received his prewritten paragraph back from the teacher, he acknowledged in class that he needed to make stronger connections between his ideas.

Researcher: Will you change what you've written?

Mitchel (co): I'll need to link my ideas more.

He considered the checklist for the essay was a good way to check his essay.

Mitchel (iv2): Once he [the teacher] put it up on the board and we went over what had to be in there and [then] I worked out what I didn't have in there, which helped.

One characteristic where he differed from others in the "Satisfactory Product" group was that he strategically sought feedback from the teacher. My observation notes indicate that he did this frequently when writing his pre-write paragraph and essay in class time. This emphasises his lack of self-monitoring and that he tended to rely on others to indicate where changes were needed. He preferred to work with others, rather than independently, and set up a buddy/study arrangement with Lois out of school time on his own accord. Getting feedback from someone else was a good strategy. It was his way of external monitoring. He did not work in an independent way very effectively.

8.3.5 *Integrating and Extending*

Mitchel was one of the students who handed in a pre-write paragraph. However he made no attempt to subsequently modify what he had handed in. He wrote a very general opening paragraph in his essay (see Appendix 8).

Researcher: You wrote a little paragraph first and handed it to Mr S. and then you got that back and then what did you do to that to make this essay?

Mitchel (iv2): I sort of kept the same paragraph in my final essay and then from there, I just worked through from the top and on every point I did another paragraph to make up my essay.

Although he realized that each paragraph should have a generalisation, an explanation and an example, this was not evident in his final copy. His essay included paragraphs that contained more than one main idea.

He read Lois' essay as part of the peer check exercise. This was useful for him to extend his ideas. Even so, he commented (Section 7.7.6) that it was difficult to allocate marks to someone else's essay if you did not know what should be included and that friends do not give low marks to each other because that would be mean.

Unfortunately he did not integrate any of the information either regarding content or structure from Lois' essay to his own. Her essay was on a slightly different question to his, and he just skimmed through it because he considered that the content was not linked to the content of his essay. He had not made the connection that he could use her essay to learn about how essays were structured or about general characteristics that make a good essay.

Also he could not identify what he could do to improve his essay at the end of the unit or what he might do differently.

Researcher: If you were able to do this unit again, say you had another four weeks and you could redo the whole thing, how would you do it differently?

Mitchel (iv2): I don't know if I would [do anything differently] because everything you have covered in here is what we needed to go over.

Mitchel considered that he could write a much better essay now than prior to the unit of work. He scored 13 /40 for his final essay because it lacked structure and content. His essay did not include any social or ethical components even though he had taken part in

the classroom discussions and remarked to another teacher during class about the asbestosis video.

Mitchel (co): That video the other day. That was amazing!! It was about asbestosis. There was a boy who got lung cancer from changing clutch linings!!

He also commented about euthanasia in his post unit interview.

Mitchel (iv2): I'm still not 100 percent certain one way, but I think if they choose to let themselves go, then we shouldn't be the one stopping them. If they are in that much pain, they want to just head off or whatever.

Perhaps his lack of inclusion of bioethical issues in his essay was linked to his perception that the biological content was more important.

There were some indications that Mitchel had realized the pluralistic dimensions surrounding decision-making regarding treatments for cancer. For example, in his post-unit interview he explained how personal factors might influence how a person chooses their treatment.

Researcher: So have your opinions about how people go about making decisions changed?

Mitchel (iv2): It depends on the person really, like we were talking in class a wee while ago, depending on their job, their lifestyle that all depends on what sort of decision is going to be made. If there is someone that has got family, got a job, then their decision to get treatments would be higher than someone who is on the dole [unemployed] bumming around.

Unfortunately, Mitchel did not transfer these dimensions to his essay.

8.3.6 Motivation

It could be that although Mitchel wanted to pass the exam, and appeared to have great intentions to do well, he was disadvantaged by not having adequate prior content or procedural knowledge for researching or writing an essay, as mentioned in Section 8.3.2 (also see Table 7.6). Mitchel had not taken biology in year 12, so he perceived that he had a disadvantage. His overall motivation to do well was not linked to a long-term goal of using biology in the future. He was taking biology because it was interesting, rather than for links with his intended career. Also he did not mention in his interviews how the topic of cancer might have been personally relevant for him. However, he had an inherent interest, since

his grandfather had died of cancer. Because of this, he was motivated to find out more information.

8.7.1 Summary of Mitchel's Characteristics

By the end of the unit of work, Mitchel knew and used more learning strategies than he used prior to this unit of work (compare Table 7.6 with Tables 7.3-7.5). This is a very positive outcome and he was pleased to have improved his abilities to write essays, even though he did not score very highly.

His overall knowledge and use of strategies was probably linked to his lack of experience and success with them in the past. He had not taken history or geography in previous years, subjects which seemed to have an influence on other students' awareness and use of key words and key questions. He lacked knowledge about text structure organization and therefore did not write an essay with a clear logical structure. This lack of knowledge prevented him from achieving a good mark in the essay.

Despite the efforts of the teacher to help him during class and give him oral and written feedback on his writing, he did not integrate this information sufficiently to write a good essay. Mitchel admitted that he had little prior knowledge, which is why he sought help. He also thought that any help improved his essay writing capabilities compared with what they were at the beginning of the unit.

Mitchel found it difficult to work independently. He relied on others to monitor his progress as shown above by his statements about working better in group situations, expecting me to answer his journal questions, forming a buddy/study situation with Lois and that he frequently sought help from the teacher, especially when writing his essay (co).

Other external demands, such as his job after school and sporting commitments, occupied a lot of his out of school time. Biology was an interest subject for him because he did not intend to use biology directly in his career.

his grandfather had died of cancer. Because of this, he was motivated to find out more information.

8.3.7 *Summary of Mitchel's Characteristics*

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8.4 Ann

8.4.1 Background Information

Ann was considered by the teacher to be a steady worker who always completed tasks set. Although Kay or Liz occasionally distracted her, she appeared grounded in her work philosophy, sensible, used logic to work through tasks and showed ability to reason (co). Her confidence in answering questions from the teacher showed that she was reading and assimilating information from a range of resources. She knew that practising essay writing was beneficial which is why she completed two essays. Ann preferred self-directed, student-centred learning and worked well independently during the class research sessions.

Ann is the only member of the group "Satisfactory Multiple". She wrote 2 essays of satisfactory quality and was working on a third. Her interview comments, journal entries and essays indicate that she used learning strategies and processes to help her evaluate her learning intentionally.

8.4.2 Learning Awareness

Ann was reasonably astute at identifying her own learning needs. She considered she was good at recalling factual information and finding things out for herself (Table 7.1).

Ann (iv1): I prefer to do activities in the classroom where you are actually not sitting down the whole time.

Researcher: Do you know why you do better at... when you are actually doing things like that?

Ann: I think it is because, you are just not copying things straight down, you are actually finding it out for yourself, so you can remember them better.

Interestingly, Ann did not ask the teacher questions in front of the whole class but preferred to clarify points individually with the teacher as he roamed past her (co). Although she liked to work independently, her reticence to take risks by asking questions or to contribute to whole class discussions in an open forum were confirmed by her following comment.

Ann (iv1): More than anything I would discuss more in a group with people I am sitting with, rather than ask the teacher. [I get] More ideas from them. Talking to other people. It is like one teacher with you.

She identified essay writing as being difficult because she had trouble remembering the main points and connecting them up so that the essay flowed. She also linked the ease or difficulty of writing essays with whether the question was easily understood.

Ann (j): I have trouble understanding what the Q [question] is actually asking.

Ann (iv2): Mr S would explain what it meant and the contemporary issues, so when you get big words it tends to throw you off a bit, you are more likely to write about something else. I think if he's explaining, been through a lot of [exam] papers, so it's covered basically, so the questions are fairly easy to understand.

Some of the vocabulary attached to this unit of work was specialised, which was why the teacher inserted the reverse crossword activity (Section 5.3.5) to help redress students' misunderstandings.

8.4.3 Use of Strategies

Ann was one of only a few students who used all of the information processing strategies. She knew about using key words and key questions from writing essays in geography (Table 7.6).

Ann (iv2): Well I tried key words. I tried to make sure that I had words like say metastasis and like the later stage and things like that. I made sure that the biological things were in there, so the person marking it will know that I know stuff.

She used the "Notes on Notes" technique and the "Trash and Treasure" idea.

Researcher: What about any of these? (*Referring to the list of activities used to stimulate recall*) Did any especially help?

Ann (iv2): Learning to take "Notes on Notes" because usually I just write everything down...and then I don't learn it all. It usually just goes in one ear and out the other, but if you've just got a little bit you tend to memorise it a bit better, so that was good.

8.4.4 Monitoring Progress

Ann showed some self-monitoring strategies (Table 7.5). She planned her research by identifying what she needed to know. She also planned the order of content for her essay in her journal.

Ann (j): Since I have read most of the resources and made notes on the following, what I want to answer in my essay

- * Why controversial?
- * Causes treatments & effects of breast cancer and skin cancer.
- * Incidences and control
- * Biology of cancer
- * Social and ethical

She wrote three questions in her journal, which were linked to clarifying content information about cancer.

Ann (j): What is aging in cells? I don't understand how certain foods prevent cancer?? What causes benine [benign] lumps?

Entries in her journal indicated that she used the prompter statements. For example the questions were based on "something I'm wondering about..." and the following statement was linked to "something I've learned today is..."

Ann (j): From what I've learned today is the importance of preventatives for cancer.

Ann peer checked Marianne's essay and recognised good structural aspects that she could transfer to her own essay. Her comments about using peer checking as a technique were very positive (Section 7.7.6).

She also checked and corrected her work and used the provided checklist as a guide as indicated by the following comments.

Ann (iv2): Well with having a checklist you can just go through and make sure you know what you have got and it helps with understanding the questions.

Ann (iv2): Well I read through the question first and then I summarised the question again at the beginning of the paragraph, sort of like my introduction, because if I summarise it, then re-word it, then I can definitely make sure that I can understand it. Then from there I go back and see the order it is in or how it flows. I just put them flowing onto each other, like the biological I had that going after the causes and then for the social and ethical, they kind of go together.

Ann (j): The essay checklist helps as I want to know all the possible things in the essay which we may get. I want to cover everything.

Ann also was reasonably accurate in her self-assessment of her progress.

Ann (j): I feel I need to learn more facts, the solid stuff to back up my issues. I've started to do some research, which I find incredibly interesting and useful.

Her essay marks, (Table 7.2) indicate that she did not write enough about the causes, effects and treatments of cancer, thus substantiating her self-evaluation above.

To her credit, she was willing to make alterations to her essays based on feedback from the teacher. She also had learned from previous experiences in writing essays that practice seemed to improve what she wrote. Given this, it is surprising that she handed in two essays at the same time. If feedback were important to her, it would have been more logical to get feedback before handing in the second essay. Her comments indicate her willingness to modify what she had written.

Ann (iv2): Well I will read through and see what he said and then see how I can improve it. Probably write another one, because I wrote two essays instead of one. I did that in all my subjects. It's just good practice.

Ann (j): What I've found is good for learning is doing a lot of practice examples and having them marked the way the examiners mark, then you know exactly where you have gone wrong.

Her comments below about using the marking schedule also indicate her willingness to monitor and modify her work.

Ann (iv2): It helped to realize what you have to be [write], how many marks are allocated to that, so how much you should go into depth and write about.

Ann (j): Having a marking schedule is the best help with writing an essay. You then know how much depth to go into each attribute and the importance of it in relation to the rest of the essay.

8.4.5 *Integrating and Extending Knowledge*

There was no doubt that Ann made use of multiple sources of information. She included information in her essay from the videos shown in class, the resource texts and the peer essay that she marked.

Ann was also one of the few students who referred back to the brainstorm activity as a reference for writing her essay.

Ann (iv2): At the beginning it was really good to have a brainstorm to see what we can pick up from it and its good because we

have still got the brainstorm and I can see what I have already learnt.

Her perception of essay writing changed as a result of the unit. In the first interview she said essay writing was difficult because it was difficult to remember the main points and to connect them. In the post-unit interview she stated that she wanted to write more to get practice and that it's easy when you have the information from researching and can structure it and use a checklist. This was also confirmed by a journal entry.

Ann (j): Essay writing is easy when the question is understood easily... which I often have trouble with the terminology. Also having all the research to back you up.

Ann had also acknowledged the multiplicity and ambiguity of bioethical issues.

Researcher: So have your ideas about what influences how people make decisions changed?

Ann (iv2): I guess the biological, how far it [cancer] is advanced, what treatment is available. I don't know if they like take into account the social things. It's so complicated. I don't actually know myself what's right or what's wrong. There are so many factors that contribute to it. That's why it is so hard with ethics because there are just so many factors that go in to it.

8.4.6 Motivation

Ann was taking biology for interest. She was not intending to go to university the following year but thought that she would get a job in a commerce-related area for a year. She was motivated to achieve a good mark in biology to add to her total exam marks.

Ann wanted to find out more about cancer because she found it really interesting and personally relevant.

Ann (e): I know by what I've learned through the already known carcinogens, may just be enough to save my life.

Ann (iv2): I chose skin cancer because my grandad has just had half his ear cut off because of skin cancer, and I'm just interested because I am really fair [skinned].

The teacher considered Ann to be relatively motivated and hard working.

Mr S (co): Ann handed hers [pre-write paragraph] in, as predicted.

8.4.7 Summary of Ann's Characteristics

Ann could identify areas that she needed help with. She used many learning strategies to help monitor and control her own learning. Despite this and her apparent ability to work independently during class work sessions, her essay marks were only satisfactory. This was mainly because there were gaps in content and she did not use many examples to back up her claims.

There is no doubt that Ann extended her procedural knowledge as a result of the unit. The positive change in her perception of essay writing was likely due to acquiring new strategies and because she had moved towards addressing some of the areas that made essay writing difficult for her.

Perseverance was indicated by the fact that she produced two essays and was writing a third before the exam. However she did not intend to go on in biology. Her main motivation stemmed from a personal interest in skin cancer.

8.5 Charlie

8.5.1 Background Information

Charlie's experiences at this secondary school had been in the top stream classes. He had achieved well, but had not necessarily extended himself (personal observation of teaching him for 3 years). He was motivated in subjects that he "enjoyed". He attributed his success in exams to luck with predicting the questions rather than his use of learning strategies.

My classroom observation notes indicate that he paid careful attention to what was instructed or discussed in class. His approach to learning could be described as reflective rather than impulsive. Charlie purposefully separated himself from other students when he wanted to work independently. This in itself shows a strategy to avoid being distracted.

Charlie was chosen as a case from the "Quality Product" category because he knew and deliberately used many effective learning strategies. His approach was based on trying to use his time efficiently because time was very important to him. Charlie's journal entries and essay showed that of all the students, he integrated and extended his knowledge the most. Niome and Lois, the other students in this category, also knew and used many

effective strategies. They linked the use of these strategies to previous experiences in geography or history, as did Charlie.

8.5.2 Learning Awareness

Charlie considered he had a good memory. He also considered essay writing was easy and had had previous success at writing essays in geography.

Charlie (iv2): It is probably because I was, like in the fifth form, I sort of, I was good in maths up to the fourth form, then I was told I wouldn't pass School Certificate english because I was really bad. I took some of that knowledge in maths and sort of spent more time on english, so then my maths went down and I sort of enjoyed my english more. I just put more effort into that. [Effort was] probably the main reason [I did well].

8.5.3 Use of Strategies

In contrast to Daniel's generalised statement about being able to memorise information, Charlie described how he purposely used a "chunking" strategy to memorise parts of information for easier recall.

Charlie (iv1): Instead of trying to memorize words and stuff, I always memorise bits, even if it's just, it is really strange, like if I have my book and I write in it and if there is a picture [*he drew a doodle on his page to show me*]. I can always remember the picture and if I can remember the picture, I can usually remember the words about it.

So not only did he chunk information, he also used his own little illustrations at the beginning of paragraphs to aid memory recall.

Charlie used a wide range of information processing strategies. His comments about discriminating information are given in Section 7.7.1. Charlie was confident in his choices of content material and confident in his own ability to write a good essay.

He also described how he had memorised the plan for his essay rather than writing one.

Charlie (iv2): I can show you (*then he proceeded to write on my pad paper*). Like in my essay, this is just the way it works out in my head, you have a flow chart, the opening and in that you introduce the question and then you have main point number one, and I think on my one it was about carcinogens. You talk about cancer and then there are two types of carcinogens and I put for example, the first type of carcinogen and then I

talked about lung cancer that was my example... and then the other question was talking about the social and ethical. I just stuffed them all [social and ethical issues] in one paragraph I think, and then a conclusion. So that is why I don't plan it [on paper], I just remember it.

He also asked himself lots of questions which self-motivated him to find out the answers.

Researcher: Just thinking too about the whole thing to do with cancer and ethics and social stuff, can you think of things that made you ask yourself some questions about it? Things that you hadn't thought of before?

Charlie(iv2): Yes it did. I had so many questions about cancer. I found them out as well. I found out about telemers. I thought they were really interesting and I learnt one of my questions that I wanted to know was, if plant cells get cancer as well and I found out that they do, that it doesn't usually kill plants and I think insects can induce cancer in a plant. I thought that was quite strange.

His statement about having so many questions indicates his high level of interest and intention to find out information. Charlie linked the information he found out about telemers and their function in determining the life span of a cell to the concept of immortality (see essay extract in Section 8.5.5).

His use of these strategies was linked to his principle of maximising the efficiency of what he was doing. Although he only handed in one essay, he had drafted and redrafted it several times. He considered that practising writing enabled him to improve (Section 7.7.2).

8.5.4 *Monitoring Progress*

Charlie linked planning with successful outcomes because he knew from previous learning experiences that when he planned he was more successful.

Charlie (iv2): [If] you can have a plan and do exactly what you have been asked, you will definitely get high marks.

His statement also suggests that he used planning to link what was required in tasks to what he did. In other words he evaluated what he needed to do. This is an example of planning becoming a monitoring strategy.

Of all the students, he appeared to have the highest number of separate entries in his learning journal (nine) (as inferred from dates or slightly different writing styles), and he wrote five questions in his journal. He was keen to read the written feedback in response to his entries. Perhaps as a response to getting feedback on his journal entries, he became more interested in using it. For Charlie, peer checking was the most valuable aspect that helped him to write a good essay, particularly since the essay he checked was, in his opinion, quite a good one (Section 7.7.6).

8.5.5 *Integrating and Extending Knowledge*

Charlie showed the most striking examples, compared with other students, of integrating and extending his knowledge. He not only considered the basic content but also questioned how the information he found out applied to wider abstract biological ideas as indicated by his journal entries below.

Charlie (j): I would like to know more about cancer in plant cells - do they get cancer? If so, do they get it as frequently as in humans? Do all carcinogens have the same sort of affect on plant cells as they do on humans? Doesn't this cancer information go against our natural selection theory? i.e. wouldn't mutations become cancerous and die?

These are very thoughtful and searching questions. Charlie's statement indicates that he wanted to find out more information and that he had an intention to extend and apply his new understandings about cancer to ideas that had been covered in previous units of work in biology (plant structure and function and evolution).

He also indicated in his essay that he understood (Section 8.5.3) that telomeres were like timekeepers in a cell and that their formation limits a cell's life span.

Charlie (e): Biological conflicts arise in all facets of the disease. For instance, some biologists believe that cancer is a natural aspect of all animals and that finding a cure is futile. Other biologists believe that resourcing cancer research could lead to the key to immortality. Cancer could ironically be the key to immortality!

Charlie was one of the students who had the greatest positive changes in the overall number of categories between pre and post-unit questionnaires on the issues associated with cancer (Table 6.6).

8.5.6 Motivation

Charlie had a younger brother who had kidney cancer. He already knew a lot about the personal, family and social traumas associated with cancer. Even so, he chose not to reveal these during class sessions and I suspect that this was a self-protective mechanism. Although the teacher knew that his brother was being treated for cancer, at no stage did he try to get Charlie to contribute his personal feelings. As far as Charlie was concerned, his brother was having treatment and would be all right. However the influence this had on Charlie's motivation was probably quite strong.

Charlie also wanted to get a good mark in the exam and knew that time well spent in the classroom would be beneficial. He gained the highest essay mark in the class, which was equivalent to Liz's. This was due to his confidence in working independently during class research sessions and his keen sense of inquiry. He describes how he did this to enable greater understanding.

Charlie (iv1): Usually, I find if I cannot understand something, I will try and find it out by myself, because if someone tells me, I do not think I will really understand. So I try and really research it and try and understand.

This indicates that Charlie usually had an intention to understand from his own volition which no doubt influenced his inquiry approach. This is also confirmed by his statement in the post-unit interview.

Charlie (iv2): It made me think about the things because it had all the things to think about questions and it made me think about cancer more as a whole and I wanted to find out more information and I found out more information.

Rather than just finding out information for the sake of writing the essay, he was genuinely curious, intended to find out more information and thought of wider applications.

He described his distractions as "my job, problems you have (*but he did not elaborate*), noise, and other work to do". His determination to work efficiently in class was due to his intention to do well considering his limited capacity to research and write his essay in his own time. Avoiding distractions in class was a good strategy for working independently. He was employed 3 afternoons a week and therefore did not have much spare time, apart from classroom sessions, to work on his essay.

8.5.7 *Summary of Charlie's Characteristics*

There was no doubt that Charlie could articulate his knowledge and specific use of strategies. This is in contrast to Daniel and Mitchel's more generalised or broader perceptions of what they did well and needed help with. Among the students, Charlie probably had the most sophisticated knowledge of the ways he went about his learning; he knew that using the strategies actually helped him. This knowledge was linked to his success in tasks where he had consciously been aware of using them previously. His success was not due to luck as he suggested. It was due to his calculated choice of learning procedures. Through practise, some of the learning strategies he used had become automatic.

For Charlie, the focus of his planning and monitoring was to maximize the efficiency of his time. He always worked consistently well in class, and separated himself from others when he wanted to work independently. This was another example of how he applied his awareness, knowledge and use of learning strategies effectively.

Charlie integrated and extended both his content and procedural knowledge through conscious self-monitoring and self-regulation. His use of journal writing and peer-checking no doubt helped with this. He had the most separate entries in his journal, had the most positive changes between the pre and post unit questionnaires (number of categories identified, Table 6.6) and shared the highest essay mark.

8.6 Liz

8.6.1 *Background Information*

Liz was a relatively able student who was accustomed to success in general. She contributed well during class discussions due to her confidence and outgoing personality. She would occasionally "chip in" with comments about people that she knew or about television programmes she had seen to illustrate what the group or class were discussing. This showed application and use of information other than what was gained in the classroom. Occasionally her behaviour could be considered loud and attention-seeking.

She was also prepared to take risks by asking questions of the teacher and her peers, to increase her understanding. Despite her tendency to distract other students sitting next to her by making comments, laughing or idle chatter, her awareness and control of her own learning were relatively high compared with other students in this research project.

Liz was chosen as a case study because although she thought some of the activities in the unit were not very useful, in some instances (for example the use of journals) she used them more than other students and applied them when writing her essay.

8.6.2 *Learning Awareness*

Liz considered she was good at listening and learned when teachers told her information.

Liz (iv1): I'm probably better at listening and taking stuff in than reading stuff and then regurgitating it. But I am better at regurgitation than thinking for myself. Maybe it is just that it is interesting and I remember a lot when he [the teacher] tells me stuff. I know it is the same in Chemistry. I remember it heaps better than if I just have to learn it myself. Maybe it is just lack of motivation. I don't know.

She discussed that understanding the essay question and organising the structure of the essay was important.

Liz (iv2): I am not good at writing essays but I've got better as I have had to write essays in the last few weeks. [Previously] I have just written, not with any formula. I need help with the formula [structure] of essays. And I have to unpack the question, which I find hard usually unless I'm told exactly what to unpack.

This last comment indicates that Liz knew she needed help with interpreting the question and structuring her writing. She also recognised that she had trouble linking ideas and connecting the introduction to the main body of the essay.

Liz often talked to her peers during work sessions in class (co). She enjoyed class discussions.

Liz (iv1): I work well with discussions because I work well with bouncing ideas off other people.

8.6.3 *Use of strategies*

Liz had used key words and key questions when writing essays in history. Although she said they did not help, she considered that she needed them.

Liz (iv2): I have been doing it [using key words] for a while. I usually need a bit more than just a few key words. I need key sentences.

During researching and note making she was aware that you should sift information as had been instructed by the teacher previously. The "Trash and Treasure" idea was not new to her.

Liz (iv2): I was kind of already aware of that. Sometimes I blindly copy. Sometimes it's better when people dictate notes but when you have them on an overhead, you tend to copy everything. He's told us during the year not to write down everything, and gives us a choice.

Her comment is important in that it indicates that despite the teacher's general instruction that the students should be discriminatory about what they copied from the overhead, Liz still tended to copy word for word. She chose not to evaluate the information.

Liz started a plan for her essay but abandoned it.

Liz (iv2): Kind of. I started to plan it but then I ended up just writing it. I thought it was a lot easier.

Her essays show that she was able to keep one main idea per paragraph, her sequence of ideas flowed logically with links between the introduction main body of the essay and the conclusions. Her first essay scored 10/10 for structure and her second 7/10. Clearly, these results show that she had worked on structuring her essays since she had identified this was an area that she needed "help with" (Table 7.1). Liz considered that this was the first year that she had had real help with how to write an essay (Appendix 10E).

8.6.4 Monitoring Progress

Despite Liz's comments about the journal not being useful (Section 6.6.3), she wrote the most questions of all the students in her journal.

Liz (iv2): I think I'm a bit too reliant on my own brain. I think oh, I'll remember that, so I don't write it down. It would be better for me to write things down.

Liz answered some of her own questions in her journal. She also clarified some of the questions in her journal with the teacher. For example, she had written in her journal "What do cancer cells look like?" When the teacher was explaining about the changes in cell structure of cancerous cells to the class, she checked that cancer could occur in all cells.

Of all the students, Liz also had the most entries (4) in response to the prompt on the bookmark "Something I learned today was....". For example

- Liz (j): Tumours of non-cancer cells can become cancerous and so should be removed.
- Liz (j): They told us about 5 plus a day [servings of fruits or vegetables] but they never told us the consequences [of not eating 5 a day].
- Liz (j): Today I learnt that lifestyle is a major factor in cancer prevention. Of course it's not fool [full?] proof but it has been linked to preventing certain cancers. Exercise, type of food, job, where you live are all things that can affect your health.

Liz checked her essays to make sure the content was relevant to the essay question.

- Liz (iv2): I just read it and picked out bits that went for one of the headings of the questions. You know what your essay lacked and what to put in next time. I didn't have time to do more than one essay, but I had lots of other things to do at this time of the year. It might've been better at a different time of year.

She produced her second essay after this comment, perhaps after realizing that there might be a benefit in writing more than one essay.

When asked what she would do differently she replied:

- Liz (iv2): I'd get everything done a lot quicker.
- Researcher: What do you think we could do to help with that?
- Liz: I've got to organize my time better. If it [the essay] was part of internal assessment it would be more motivating.

In this last comment, Liz was referring to the fact that she spent a lot of time in class talking, and not being "on task". She was also inferring that had the essay been part of the internal assessment component of the course, the external motivation for finishing the essay would have been more immediate. As it was, students finished school in mid November, sat the exam in late November and did not get their grades back until January.

8.6.5 *Integrating and Extending Knowledge*

Liz's comments about some of the activities in the unit of work indicate how she thought they helped her to consider the bioethical issues.

- Liz (iv2): Brainstorming was useful because other people thought of things you didn't think of. It made you think. Because it was at the beginning it made you think about the issues at the beginning. All the things [activities] in this unit made you think.

Many of the questions Liz asked in her journal were answered as statements in one of her essays. For example she asked in her journal about where cancer could form in the body.

Liz (j): Can you get cancer anywhere, or just anywhere you have fat or muscle or blood?

Then an answer to this question appeared in one of her essays.

Liz (e): Because cells are everywhere in the body, cancers can form anywhere.

This implies that prior to her inquiry, she was not aware that cancer formed in any type of cell, but was aware of this when she wrote her essay.

Another example was the sequence of questions about treatments in her journal.

Liz (j): What methods do people seem to prefer to use when they've found out they have cancer? Treatment, chemical, radiation, positive thinking, god, nature, surgery?

In her essay she mentioned gene therapy, radiation therapy, chemotherapy, surgery and genetic screening for hereditary types of cancer. She extended her ideas about choices of treatments to include consideration of the side effects of the treatments and conditional aspects of treatments for when they could be used as shown in the quotation below.

Liz (e): ...and some treatments are only viable and effective during the latent stage, when the cancer is slowly dividing and before metastasis sets in.... Better treatments are, however, being looked at since scientists now understand cancer and its' causes better.

Liz was one of the few students who responded to a prompt at the back of the journal. In response to "I had to think of my own values when..."

Liz (j): ... questioned on which treatment I'd take.

She was referring to the activity where students had to decide which treatment they would choose if they had lung cancer (Section 5.3.10). This was obviously an issue for her because she wrote strong ethical statements in her essay.

Liz (e): As individuals must decide on his or her own code of ethics in dealing with this disease, so must the collective body of society. In this the rights of every person must be considered. However it is rarely cut and dried and the ethics involved in

cancer cases are still being debated. Human dignity, equality, protection, privacy and freedom are among each person's rights.

The above essay extract also acknowledges the ambiguity and that there is no right or wrong answer for decisions related to cancer issues.

8.6.6 *Motivation*

Interest was a key factor that motivated Liz, as indicated by the personal questions she wrote in her journal (Section 6.6.3). She was interested in biology in general and considered that this interest factor would help her to get higher marks in biology than chemistry.

Liz (iv2): I'm more interested in biology, so I know I'm going to get a better mark than in chemistry. In biology I can read stuff and take it in, but in chemistry, I can read something and it doesn't go in. I don't know why. I wish someone could work out why.

She was obviously contemplating why she could understand biology better than chemistry. Although she had not found a reason, this shows that she was considering her own learning tendencies.

Although Liz stated in her interview that she was not a marks oriented person, she wanted to do well in the University Bursaries exam, even though she was not sure what she would do after leaving school (co). She also admitted that previously, she had not put much effort into her work.

Liz (iv2): I've had to get better because I have to get those marks in Bursary [the national exam]. Before this year I hadn't really tried.

This last statement is a reflection that Liz knew she had a lot of natural ability and had not needed to consciously think of strategies or ways of going about her learning more effectively until now. She also acknowledged that effort would make a difference.

Researcher: What will make the difference between 50% and 60% [in the exam]?

Liz (iv2): Study. Interest.

Her keen enthusiasm and confidence was reflected in the way she volunteered her opinions in small group and whole class discussions. She was prepared to take risks by

putting her ideas and comments forward. For example, the teacher discussed some issues about smoking with the class, particularly its addictive nature and therefore how difficult it is to give up, even though people know it is affecting their health. Liz commented that she had a friend who was a smoker for years and who was able to give up smoking really quickly. Lung cancer was one of the cancers Liz discussed in her essay.

8.6.7 Summary of Liz's Characteristics

Liz was aware that she needed help with structuring essays and that this was what made essay writing difficult for her. Her final marks for essay structure (Table 7.2) indicate that she developed these skills.

Using reflective and critical thinking processes to make decisions about what she would include in her essay helped her greatly. As noted, she asked more questions than other students in her journal (14, Table 7.5), used the questions to help her research information and incorporated some of the ideas from them into her essay (Section 8.6.5). She actively and intentionally sought information. The way she used monitoring strategies allowed her to identify what information she needed and what strategies she needed to improve her essay structure and its quality.

Her motivation was related to her interest in the topic and the fact that she wanted to get good marks. She chose lung and breast cancer as her two examples. These choices can be related to her statement about friends who smoked and that she considered the high incidence of breast cancer in New Zealand was an issue in her essay.

As mentioned in Section 8.6.1 she had a tendency to distract other students sitting next to her but her awareness and control of her own learning were relatively high compared with other students in this research project. She knew and used many learning strategies and took reasonable responsibility for her own learning. She was conscious that she had to get the marks. Therefore she knew that it was up to her to put some effort into her work.

8.7 How Do These Cases Inform The Research Questions?

8.7.1 What kind of relationship, if any is there between students' prior knowledge of learning strategies and their use in researching and essay writing?

Students already had some prior knowledge and use of learning strategies before taking part in this unit of work. These cases illustrate that there appears to be a link between the prior knowledge these students had and their use of strategies. There is also a link between their prior knowledge and their final essay outcome (Table 7.6).

Daniel's prior content knowledge was poor. He admitted that he did not know what cancer was or what affects it had prior to the unit of work. Daniel did not articulate that he knew or used specific learning strategies. He had little background to work with. This was exacerbated through not paying attention during class instruction, and distracting others. No doubt his absences also prevented him from maintaining a sense of continuity with the classroom activities.

Mitchel could not articulate specific learning strategies. His awareness of his own learning was in a broad rather than a specific sense. Considering his assessment of his ability to write essays at the beginning of the unit, Mitchel made huge gains in learning as a result of the unit. For him, identifying that he needed to improve was a motivator to seek help from others. This worked in his favour.

Ann had a clearer understanding about her learning needs. She knew that she needed to analyse the essay question and put ideas into logical sequences with connections so that her essay flowed better. Her prior knowledge and use of strategies was greater than those of Daniel or Mitchel (Table 7.6).

Charlie and Liz both had considerable prior procedural knowledge as a result of taking history and geography where similar inquiry approaches, followed by writing an essay had been used. They were able to transfer this knowledge and use it effectively for managing the structuring of their essays. The degree of sophistication of their knowledge and awareness of their own learning was greater than that of the other case students.

The application of learning strategies is very important for effective learning. Reminding students about what they already knew, or prompting them in some way, was,

for most students, necessary to put the strategies into action. Several students commented that they knew of discriminating strategies previously but would not have used them spontaneously (Section 7.5). Although they had not used the strategy named "Trash and Treasure" before, some students knew that you could use key words or key questions to sort information. They had learned this from history or geography. The demonstration of the specific example of "Trash and Treasure" by the teacher (Section 5.3.9), reminded some students what they should do.

As students such as Charlie and Liz became more confident in their skills in both researching and writing, they were more able to concentrate on monitoring and evaluation strategies. They were also more enabled through having background knowledge, to check their essays and evaluate how it could be improved. It would be difficult for anyone to monitor or self-check aspects of essay structure if they did not know how an essay should be structured in the first place.

8.7.2 What evidence is there that the intervention helped the students to be self-monitoring and self-regulating in their learning?

As mentioned in the previous section, prior knowledge and its transfer to a new context was important in this unit of work, since if students did not know what to do, they could hardly be expected to work independently. By identifying what strategies students reported using prior to the unit, and by evaluating their perceptions of their roles as learners, it was possible to gain some indication of their self-monitoring and self-directedness prior to the unit.

In general, reminding students what they already knew helped them to use their prior procedural knowledge. It must be remembered that these were students in their final year of high school and therefore all of them had some self-directed capabilities. The intervention improved their use of self-monitoring and self-regulation to varying degrees, rather than instigating it.

There were many ways that self-monitoring and self-direction were implicitly part of this unit of work, as described in Section 5.2.4. Certainly for those students who used them, the prompter bookmarks accompanying the learning journals were useful (Sections 5.3.2 and 6.6.3). The teacher also commented that this made a difference in the way students researched information.

The extremes were shown in these case studies. For Daniel, his self-directed capabilities were not developed as a result of this unit of work, probably due to a combination of lack of both declarative and procedural knowledge, motivation to get started and actually participate in the inquiry process. He had no intentions of producing an essay.

Mitchel was not very self-directed. He knew that he needed help and therefore sought it both from the teacher and other students. Although he used some learning strategies to assist his researching and essay writing, he did not necessarily accept responsibility for monitoring and controlling his own evaluation. Instead he relied on the evaluation of others.

Ann was quite self-directed which was mirrored by her preference for working by herself. Her clear intentions to write a good essay impelled her to write two essays, showing a degree of perseverance and ability to work to deadlines. Because she had identified that understanding the question and essay structure was important, she consciously tried to address these aspects in her essay.

Charlie was probably the most self-directed student in the class. He actively monitored what he needed to do and looked for efficient ways of completing his work individually. He was confident in his ability to work independently.

Liz had a lot of natural ability, but did not demonstrate self-directedness very often in class. Instead she enjoyed socialising with her friends and chatting about other things during some individual class work sessions. She would have had to work on her essays independently out of class time to get two essays completed. A similar situation could be described for Terri and Marianne. All three students worked independently out of school hours to complete their multiple essays.

The teacher considered that the students took more responsibility for their learning in this year (of the research study) than other students had in previous classes. He indicated that perhaps this was due to his insistence that students had to find out content information for themselves (Section 5.4). His perception was linked to the role he played in his teaching of the unit this year. Although he was available to help students during individual working sessions, he tried to reduce the amount of help he gave them, compared with similar classes

he had taught previously, to allow them to develop independence. Some students could have benefited from more teacher input to get them started or assist them with procedures that could have helped them to be more efficient in their learning.

8.7.3 What other factors, regarding the teaching and learning environment in this context, might influence the way in which students learn about social and ethical issues?

There was no doubt that affective aspects influenced student motivation. These were linked to emotional connections with people who had cancer (11 of the 16 students had a direct relative or friend who had experienced some form of cancer), students realising that their personal lifestyle choices (particularly smoking and sunbathing) could influence their chances of getting cancer and the broader implications for society as a whole (Sections 6.6 and 6.7). These personal connections influenced their need to know and their natural curiosity about what cancer is and how it progresses. Whereas Daniel had no connections with anyone who had cancer, Mitchel, Ann and Charlie all had relatives who had experienced cancer.

My observations indicate that the teacher treated all of the students similarly. He responded to their ideas with respect and did not appear to spend an unusual amount of time with any one student. He was always willing to answer all students' questions. However, due to his experiences in teaching these students throughout the year, the teacher had developed his own set of expectations for each student. (For example see Sections 8.2.6 and 8.3.6). The influence of his expectations no doubt had an effect on each student but the extent of this influence is difficult to determine.

As mentioned in Section 7.6.2 other pressures at this time of year, particularly the completion and revision of work in other curriculum areas, was important for students. The unit of work was at the end of the year when students were preparing for their national exams. Daniel was not anxious about the exams since he was not really concerned about passing them. Mitchel wanted to pass the exam but was realistic about the marks he might obtain. The pressure to do well in the exams was more significant for Ann, Charlie and Liz.

All of these students were able to identify personal "distracters" that diverted their thinking or took up time, which could otherwise have been spent on writing or improving their essays. The class as a whole was interrupted every day by the role monitor, people

bringing information to the teacher or notices to individual students. External events such as special meetings and sports photographs also disrupted individual members of this class.

8.8 Aligning the Case Studies with the Notion of Evaluative Constructivism

In chapter 3 I mentioned how the degrees of intention and extent of knowing choices could determine the extent of engagement in evaluative constructivism. In this section I discuss how the case studies in this chapter can be mapped onto figure 3.2.

If the relative degrees of intention and choice are used to help determine the level of engagement in evaluative constructivism, then the characteristics of the five students illustrated in this chapter can be shown relative to each other (figure 8.1).

Daniel had very low intentions but he knew of some strategies. Because he negotiated tasks downwards, he has been placed in the right hand quadrant. Mitchel on the other hand had relatively high intentions but did not have sufficient knowledge to realise that he could choose how to tackle tasks. He was often frustrated by his inability to get started. Therefore he has been placed in the left-hand quadrant, but at a higher level of engagement than Daniel because he participated more than Daniel. Ann, Liz and Charlie can be placed in the top quadrant because they had high intentions and knew multiple ways to approach tasks. The differences between Ann and the other two students though, is that Ann did not have as much experience in inquiry learning. That is, Charlie and Liz were able to use their prior knowledge and experience of using inquiry to help them reflect and evaluate their work more extensively than Ann.

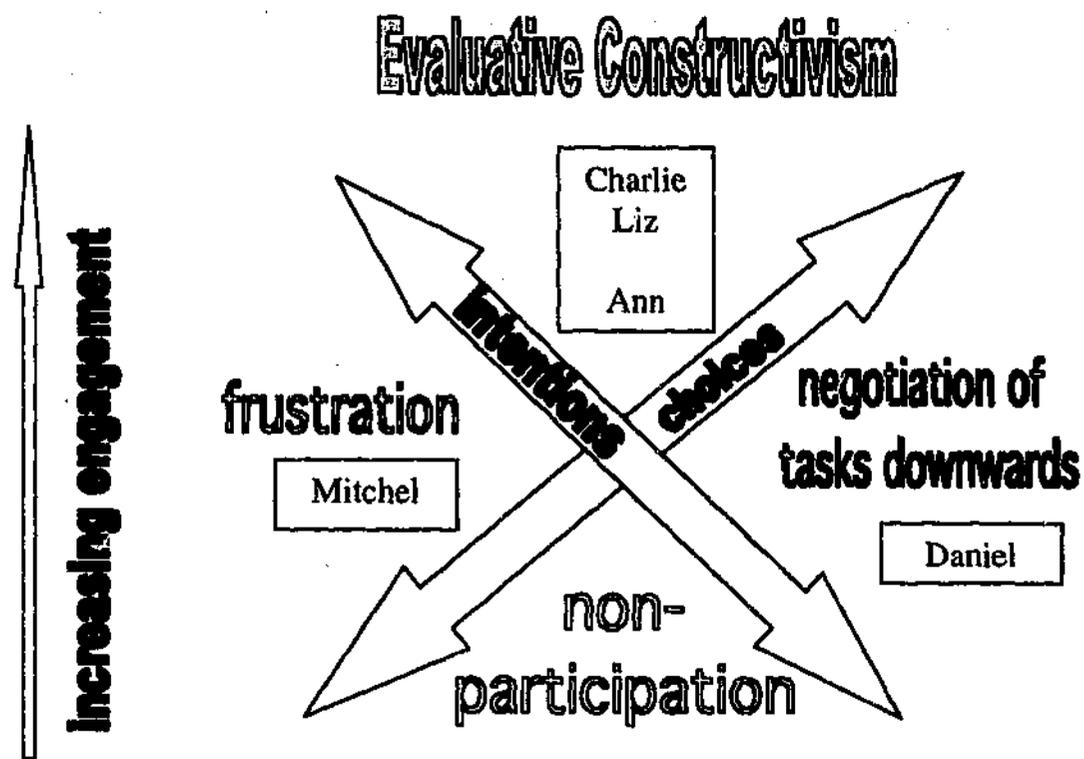


Fig. 8.1 Mapping the influences of intentions and choices for 5 student cases

8.9 Summary

These 5 cases have provided a glimpse of the characteristics of their learning in the context under investigation. The categories of learning awareness, use of strategies, monitoring progress, integrating and extending knowledge and motivation were used as these are considered important for enhancing self-directed learning (Wang & Peverley, 1986). The degree of sophistication regarding knowledge and awareness of personal learning characteristics paralleled the degree of knowledge and use of learning strategies. Knowledge of both content and processes is necessary before evaluation can take place. The extent of declarative and conditional knowledge is likely to influence learning procedures, that is, what students actually do when learning. The degree of self-directedness or self-regulation not only depends on this knowledge (declarative, procedural and conditional), but it also depends on the willingness of students to choose to use evaluative procedures.

There are many other influences that determine whether students respond to their ability (take responsibility) and decide to act on their intentions to improve their own

learning. When they act on their intentions and use appropriate strategies, there is enhanced achievement.

Chapter 9 Discussion

9.1 Introduction

The purpose of this chapter is to discuss the findings. A summary of conclusions is given in Chapter 10.

The aims of the research were to investigate ways to increase students' awareness of bioethical issues (in the context of issues associated with cancer) and to promote more effective ways of learning, especially in relation to researching information, essay-writing and to enhance self-directedness. This involved encouraging students to be more reflective on their prior knowledge/experiences of both the bioethical issues and learning procedures, and to incorporate learning strategies.

In this chapter I consider each of the research questions. Then, I outline the important factors that are relevant to the overall findings and the implications for teaching and learning in this bioethical context. These are grouped into themes. Finally I discuss how the findings relate to *evaluative constructivism*.

9.2 How Do the Findings Relate to the Research Questions?

9.2.1 Can Students' Views About Social and Ethical Issues be Broadened?

A comparison of the pre and post unit questionnaires indicated that, overall, students' ideas increased in terms of the number of categories for the social and ethical implications related to cancer. This was substantiated by interview comments by some students and the teacher.

The breadth and depth of students' thinking about specific issues was indicated in Section 6.5. The students identified a wide range of issues. Many students identified euthanasia as being controversial. Some of the issues were personally relevant because 11 of the 16 students had personal experiences of friends or relatives with cancer. Investigating the issues also instigated a reconsideration of some lifestyle choices such as diet, smoking and sunbathing, as illustrated in Section 6.6. A requirement of the essay was to link the

issues with their social relevance. Examples of how students made these links are given in Section 6.7. Overall, students' views about bioethical issues associated with cancer were extended.

9.2.2 Which classroom activities influenced student thinking about bioethical issues associated with cancer?

Activities that were identified as being important for helping students to think about the bioethical issues were brainstorming, small and whole class discussions, journal writing, videos and essay writing. These activities have been discussed in Section 6.8.

Group activities allowed students to articulate and hear a range of viewpoints. A variety of activities enabled social interaction similar to a community of inquiry approach. Group activities which relied on students to give their opinions or make decisions were the continuum on the preventability of types of cancers (see Section 5.3.3), videos (Section 5.3.6), choices of treatments scenario (Section 5.3.10), euthanasia scenario (Section 5.3.11), and ethical considerations from the instruments on human rights (Section 5.3.12). In all of these activities, students were prompted to evaluate their prior knowledge and to question what was important.

9.2.3 What Kind of Relationship is there Between Students' Prior Knowledge of Bioethical Issues and the Content of their Essays?

Students already had some prior knowledge about the bioethical issues associated with cancer. Their comments suggest that the unit of work helped to clarify and expand on these ideas. Obviously this research question cannot be addressed for the 5 students who did not complete essays.

The number of bioethical issues mentioned in essays was not as great as the number of issues identified in the pre-unit questionnaires (Table 6.7). This could be due partly to students expanding their explanations about particular issues in their essays rather than including a wide range of. It is likely though, that students still considered biological facts to be more important and therefore did not always emphasise issues in their essays. This is disappointing considering their exposure to such a wide range of issues in class and their

participation in discussions about the issues. Students' perceptions of what was required in the essay are likely to have influenced what they included.

The case studies show little correspondence between students' prior knowledge of bioethical issues and what they wrote in their essays (Section 8.7.1). Mitchel had very little prior knowledge of the issues and did not include any in his essay. Ann did not identify any social implications in her pre-unit questionnaire. Also she did not mention the ethical implications indicated in her pre-unit questionnaire, in her essays. However she did include the issues of the needs of society to be more aware of preventative measures, human rights and the cost of treatments as issues in her essays. Both Charlie and Liz extended their ideas about social and ethical issues in their essays. They both included a discussion about euthanasia and other issues not indicated in their pre-unit questionnaires. More importantly, Charlie and Liz also referred to the controversial nature of some of the issues and how conditional aspects make them debatable.

9.2.4 Which Activities in the Intervention Helped in Developing Learning Processes?

The information processing activities were designed to help students be more efficient and effective in the ways they researched and compiled their essays. Although some students found the "Trash and Treasure" and "Notes on Notes" procedures useful, there was resistance from most students to use them. Students may have made more use of these procedures if the resource material had been presented with a margin or at least spaces for students to allow the annotation of the resources directly.

The pre-writing of a paragraph activity was included to help students focus on an overview of their essays to help with advance organising and planning. It is a good procedure but one that requires knowing what you intend to include in your essay. Students probably had not considered or chosen what content they would include prior to this activity. There was also little motivation to complete it since the essay could be written at a later time.

The teacher explicitly prompted students to use key words, key questions and planning procedures for writing essays (Section 5.3.14) by questioning, illustrating planning with an example of an essay about a dog and the explanation of an essay checklist.

He also reminded the class to use these procedures when he made comments about the essays he had marked.

The knowledge and use of declarative and procedural strategies have been discussed in Chapter 7. The activities in the unit of work that students considered were most useful for developing learning processes were writing the essay and the peer checking of essays.

Students' perceptions of using the learning journals varied (Sections 5.3.2 and 6.8.3). Some students used them to record their own questions. The students' use of self-questioning in this way made the content real and relevant (see Sections 8.5.5 and 8.6.5 for examples). Students also recorded comments about what had surprised them or what they had found interesting. The journals then, provided an instrument for making student thinking more available to the researcher. More importantly, the journals were a catalyst for students' to evaluate what they knew and what they needed to do.

Some students did not use the journal effectively which was probably linked to their perceptions that the purpose of the journal was for evaluation by the researcher. The aim of the learning journals was to help students to reflect and write up their thoughts, identify what they knew or what they needed to know or do and aspects of bioethical issues that they were wondering about. It was anticipated that their use would encourage students to think more carefully about what they were doing during a lesson as they were largely responsible for researching, constructing their own notes and writing their essays. Some students' and the teacher's comments about the use of the journals indicate that they were indeed a useful way to help students to be more self-directed. Even though some students knew the value of using the learning journals, they still considered that the time required to write in them was not worth the effort (for example, Marianne and Terri).

9.2.5 What Kind of Relationship, if any, is there between Students' Prior Knowledge of Learning Strategies and their use of these in Researching and Essay Writing?

Students who had previously used key words, key questions and mnemonics for structuring paragraph writing, such as G.E.E., used them more consistently to search for information and structure their essays than students who were unaware of them prior to the unit of work. This was especially so for students who previously had taken either history or

geography, where it is likely they had positive experiences in their use. They transferred this knowledge for use in the inquiry process.

Many students already knew about using other declarative strategies such as underlining or highlighting important words, using flow charts to organise text, explaining, self-questioning, summarising or paraphrasing text (Table 7.6). Some students considered the procedural strategies of generalisation and discrimination to be useful prior to the unit of work. Checking was identified as the main monitoring strategy prior to the unit of work (Table 7.6). Although many students reported that they checked their essays as a monitoring strategy during the unit of work (Table 7.5), the extent and effectiveness of checking is difficult to determine.

The case studies provide examples of how prior knowledge was instrumental in students' use of learning strategies (Section 8.7.1). There was also a strong link between students' prior knowledge of learning strategies and the quality of essays. Daniel and Mitchel could not specifically explain how they went about their learning. Their descriptions of their learning were broad rather than specific. In contrast, Ann, Charlie and Liz could clearly articulate some of their learning strategies prior to the unit of work. Ann's essays were of satisfactory quality. Although Ann knew what she should do to write more effective essays, she may have had less experience in using some of the strategies. Unlike Charlie and Liz, she had not taken history or geography where keywords, key questions and an inquiry process similar to the one used in this unit of work had been used. Charlie and Liz had more experience and prior knowledge of procedural and metacognitive strategies which contributed to their production of quality essays.

The key points about prior knowledge and the link with the use of strategies is that firstly, students cannot use strategies unless they have knowledge of them. This does not preclude the development of their own strategies, but in terms of the research, students would not be able to report on them unless they consciously knew how they learned. If they used strategies unconsciously, it is less likely that they would report them. Secondly, even if students knew about potential strategies they could use, they did not necessarily use them. There is some evidence from this study (and from the literature) that use of strategies is associated with a belief in the value of the task and students' belief in their own ability (Stipeck & Weisz, 1981; Thomas, 1999; Thomas & McRobbie, 2001). Previous success

with using the strategies is likely to influence their perceptions of the fruitfulness of using them (Siegler, 1990). Further, students' motivations to succeed in general and openness to try new methods are likely to influence their willingness to take risks in using new strategies. This in turn influences what they actually do. Students need to see the fruitfulness in investing the effort required in the use of these strategies (Gunstone, 1994).

9.2.6 What Evidence is there that the Intervention Helped the Students to be More Self-monitoring and Self-regulating in their Learning?

It is quite difficult to assess the effect the unit of work had on students' self-directness. Students showed very promising signs of knowing about learning strategies and using them (Chapter 7). Self-monitoring and self-regulating strategies were employed differentially by students both as a result of their prior knowledge and experience with them and because of cueing from the teacher and the prompts on the artefacts. Therefore it is difficult to make generalisations.

There were many ways that self-monitoring and self-direction were implicitly part of this unit of work, as described in Section 5.2.4. Students needed to question what they should do. Evaluative processes were necessary for deciding:

- where to find information;
- what information either from research or personal opinions was important or relevant;
- how much detail should be included in the essays;
- what words and essay structure should be used to describe their ideas and
- what could be changed to improve their initial drafts.

Certainly for those students who used them, the prompter bookmarks accompanying the learning journals were helpful (Sections 5.3.2 and 6.8.3). Self-questioning was instigated as a result of the prompter statements on the bookmarks. As previously mentioned, some students also made use of mnemonics to allow them to evaluate the structure of paragraphs.

By identifying what strategies students reported using prior to the unit (Table 7.6), it was possible to gain some indication of their previous self-monitoring and self-directedness. This data is somewhat inferential however, since not mentioning strategies in the pre-unit interview did not necessarily mean a lack of knowledge or use of strategies. Daniel, Mitchel, Vincy and Liz did not indicate that they knew of strategies for planning, monitoring or evaluating prior to this unit of work (Table 7.6).

In general, reminding students what they already knew, helped them to use their prior declarative and procedural knowledge. It must be remembered that these were students in their final year of high school and therefore all of them had some self-directed capabilities. I had assumed that all students would be introspective and develop some self-directed capabilities. Although this was true, the degree of self-direction varied considerably.

Even when students reported using strategies, it was difficult to determine the extent and effectiveness of this use. Triangulation of the students' self-reports by using two interviews, evidence from their journals, class work and essays allowed a greater understanding of their use of these strategies.

I have indicated in Chapter 8 how individual students showed a range of self-monitoring and self-regulation of their learning. Although Daniel showed examples of self-reflection, he did not use this capability to accomplish what he knew he ought to do. Daniel's lack of knowledge and unwillingness to participate, together with his absences, contributed to his lack of self-regulation. Of all the students, Mitchel probably moved the most in terms of his own self-regulating capabilities. He considered that because his prior knowledge of strategies was low at the beginning of the unit, any help he had gained benefited his essay writing (Section 8.3.2). Mitchel had assessed that he needed help with structuring his work but relied on others to monitor his work. In contrast, Ann was quite self-directed. She indicated that she preferred to work individually and showed some self-monitoring and self-regulating characteristics. Charlie and Liz were more self-regulating than the other 3 cases. They had many of these characteristics prior to the unit of work. As with many of the other students, I suspect that the activities reminded them to be proactive in deciding what they needed to do, rather than self-regulation being a new framework for working.

The teacher considered that the students took more responsibility for their learning this year than previous classes had. This was probably true for 11 students. He indicated that perhaps it was due to his attitude and insistence that they had to find out content information for themselves, being stronger than in his previous teaching of this unit (Section 5. 4).

9.2.7 What other Teaching and Learning Factors, Might Influence the Way in Which Students Learn about Social and Ethical Issues?

As mentioned in Section 7.6 the decisions learners make regarding their learning are likely to be influenced by a number of factors that will interact with each other. Those considered important in influencing learning in this context are now considered in three groups: student factors, features of the learning context and the mediation of effective learning by the teacher.

Student Factors

Student factors include motivation and an ability to concentrate on what is required, time management and their beliefs about their own roles in their learning. Students learn more effectively only when they have an intention to do so (or want to learn) and perceive that they have the ability (Ames, 1992).

General motivation varied for these students (Section 7.6.1). The students in the "Invisible Product" group were not very motivated. They were easily distracted and needed to develop ways to organise their time more effectively. They had low expectations of their level of success, probably as a cumulative result of all their previous years of learning. The students in this group would have preferred the teacher to take a more direct role in delivering specific information about cancer. Some of them were resistant to an independent mode of inquiry.

In the "Satisfactory Product" group, students were motivated by personal interests in cancer but their assessments of their potential marks in the Bursary exam were low (Table 7.1) which paralleled their lack of success in biology during this year of study. Their effort and persistence was inconsistent and may have been due to their moderate level of success in the past.

The students in the "Quality Product" group were motivated by the need to achieve well in the end of year exam. Many of them also had personal experiences or thought cancer was personally relevant. The students in the "Quality Product" group also perceived that they had the ability to succeed. In general these students were more organised, used their own time (not necessarily class time) to research, write and evaluate their essays. The latter was related to their perception that they were ultimately responsible for the quality of their own essays, even though Liz, Marianne and Terri commented that they wanted the teacher to give them more content information. They were looking for short cuts and ways to get the information more efficiently.

As mentioned in Chapter 3, providing choice helps with motivation (Brophy, 1983) and self-regulation of learning (Zimmerman, 1994). In this unit of work, allowing students to choose content and decide how they conducted their own inquiries were ways to initiate intrinsic motivation. Students often chose types of cancer to investigate that interested them personally, either because they knew someone with that form of cancer or it had relevance to their own lifestyles (Section 6.6). This utilization of subject matter relevant to the present day lives of students was a way to incorporate existing experience to meet the desired educational goals. Allowing student choice is a "double-edged sword" though. If students do not have sufficient knowledge of how to attack tasks, or have not internalised learning processes (such as discriminating between relevant and irrelevant information or summarising, paraphrasing etc.) they find it difficult even to get started. Consequently for students who had these difficulties, their use of time to work independently was less efficient. They were unaware of the choices they had (lower left portion of Fig. 3.2).

In an independent inquiry approach, students may be required to make decisions about their learning that they are unaccustomed to making. Daniel is an example of a student who tried to negotiate the tasks downwards so that he did not have to make decisions about content or comply with what was expected. He also used avoidance tactics and distracted others as a way to delay what he should be doing. His goal was to minimise effort rather than to learn.

Features of the Learning Context

The learning context is an important consideration because it describes the influences on the content and processes of thinking. The timing of the unit is discussed

first. Then I consider the influences of task factors such as variety, challenge and meaningfulness on student motivation since these have been highlighted as being potentially important by Blumenfeld (1992). Other factors of the learning environment that are likely to influence motivation include the influences of students' perceptions of authority and evaluation (Ames, 1992). The role of the teacher in establishing student perceptions is discussed in the following section. Assessment and its link with evaluation is considered as a theme in Section 9.3.2.

In Section 7.6 I discussed how the amount of time students were prepared to put into planning, monitoring and evaluating their work through checking was limited because this unit was conducted at the end of the biology course. Many students were revising other subjects for the exams, had outside of school activities or other work that needed to be completed.

I will now briefly discuss the task factors in relation to the unit of work investigated in this study.

Task factors can be expanded to include the effects of task variety, challenge and meaningfulness (Blumenfeld, 1992). There was variety in the classroom activities in the unit of work as outlined in Chapter 5. These did add interest. Students commented that the group discussions were engaging and required active cognitive participation. The range of activities was useful either for helping students to think about the bioethical issues or about their learning. Variety in this instance did not seem to be at the expense of cognitive engagement as cautioned by Blumenfeld (1992).

Naturally different students viewed the degree of challenge of tasks differently. Goal theory indicates that tasks that are challenging but can be achieved with reasonable effort promote a mastery orientation (Ames, 1992). However, students' perceptions of what constitutes reasonable effort is linked to the source of the challenge (level of difficulty, type of activity or assessment, or social organization) (Blumenfeld, 1992). In this project, the pre-unit interview asked students to identify what they were "good at" and what they "needed help with". To a certain extent asking these questions helped students to identify what they found challenging in general terms. Their comments about the activities also gave an indication of some of the difficulties and challenges that were either inherent or created by the activities (Sections 5.3, 6.8 and 7.7). In general, students identified that

organization of their time and the content material (gaining enough information and structuring their essays) was the overriding challenge. Writing an essay was a major challenge for students who had "invisible product". Redefining the parameters of tasks or placing more emphasis on carrying out parts of tasks may have helped these students. The teacher commented that he would consider making the deadlines and the requirements more explicit for the pre-write paragraph and planning exercises. This may have made the smaller chunks of the writing task potentially more manageable.

Blumenfeld (1992) indicates that even when there is variety in tasks and a degree of challenge and self-regulation built into tasks, students may still not expend effort on tasks if they do not see the value or meaningfulness of them. Tasks may be meaningful because they make cognitive sense (logic or connections with prior knowledge) or because they have intrinsic value. In designing the activities in this unit of work, an effort was made to access students' prior knowledge to help them make links with what they knew or thought was useful in terms of declarative and procedural knowledge. The students in this present study not only had different prior knowledge and understandings about their own learning (Table 7. 6) but also were likely to have different ways of applying the relevancy of this knowledge and therefore the meaningfulness they assigned to tasks. There is wide scope for investigating how classroom environments might influence the value and meaningfulness students attach to their learning processes.

Other aspects of the learning environment are connected with how the teacher set up and maintained situations conducive to investigating bioethical issues and for developing more reflective and self-regulated learning. These are outlined in the next section.

The Role of the Teacher

Students' perceptions of authority can influence how they view the part they play in their own learning. If the teacher gives them all the information, they have no need to be self-starting or evaluate what they need to do. How the teacher portrays what is expected of students then becomes very important.

In the class in the present study, the teacher promoted an awareness of bioethical issues and an awareness of metacognitive learning strategies for more effective learning through a process of mediation or facilitation. He considered that his role was to support students rather than to direct them. He allowed some negotiation of outcomes. In some ways the teacher was accustomed to acting in this role. For example he indicated to students that they should choose what notes they wanted to copy from his overhead transparencies. The students reported that this was what he usually did. In other words he had already established an environment where students knew they had a choice in what they wrote for themselves.

The teacher's role in developing many of the activities in this unit of work indicated that he had taken on the responsibility to establish the learning framework and incorporate activities conducive to allowing students to think critically about the issues and about their own learning (see Chapter 5).

The teacher tried as best he could to explain the activities. Although this often encouraged the students to use learning strategies, it did not necessarily stress the importance of those strategies for achieving the desired learning outcomes (the fruitfulness). In general, students were left to make these links for themselves. Devoting more time to giving examples, reminding or cueing pupils to use different learning strategies could have been beneficial. Students needed opportunities to practise the strategies and to exchange ideas about what they had learned and how they accomplished the learning, as recommended by Fairbrother (2000).

The teacher concentrated on an independent learning approach for the research and essay writing activities. He tried to avoid telling the students "how to" as much as possible. He suggested ways of organising information, note making and essay writing. His interaction with students and use of questions on a one-to-one basis during class research sessions appeared to help some students to develop self-directive processes. The teacher considered that the students worked more independently than in previous years. Some students were uncomfortable with this approach and wanted to be told "the facts". These students preferred a more teacher-directed approach. Nevertheless, eleven students worked well using the independent learning approach.

The teaching procedures used to help students vocalize and think about their ideas regarding bioethical issues, were generally successful. The discussions required active participation, represented real situations, and involved some degree of tension (moral disequilibrium). Emotions, context, reason and relationships were key elements in the discussions. The group/class discussions were a "way in" to promote students' thinking about and reflection on their ideas.

It was not the purpose of this investigation to analyse discursive behaviour during the unit of work. Even so, the discussions and other small group activities required students to actively participate and work collaboratively. These activities assumed that the students would work together. In the main they did. However, some students were not as vocal as others or were more hesitant about contributing their ideas. Also, the dominance of certain individuals has been noted as problematic in student behaviour during discussions (Rudduck, 1986). The teacher considered that it was his role to help students to participate in the discussions.

It is the teacher's role to initiate such opportunities and to ensure that open and supportive discussions allow a range of points of view to be shared (Dawson & Taylor, 1998). This teacher cared for his students, tried to foster active engagement and had the respect of the students. These qualities have been identified as teacher attributes that help to build bridges to engagement (Cothran & Ennis, 2000).

9.3 Emergent Themes

In this section I outline the important factors that are relevant to the overall findings. These are grouped into the themes of knowledge and use of learning strategies, critical thinking and the ambiguity of content, assessment issues, limitations in promoting cognitive and metacognitive strategies, and limitations in promoting self-directed and self-regulated learning.

9.3.1 Knowledge and Use of Learning Strategies

Many students already had prior knowledge and used learning strategies before taking part in this unit of work. The way these strategies were applied was important in

how effective they were in relation to the learning context. Reminding students what they already knew, or cueing them through questioning or written prompts seemed to be necessary. For example, two students (Marianne and Mary) commented that they knew of discriminating strategies previously but would not have used them spontaneously. Although the students had not used the strategy named "Trash and Treasure" before, some knew from history or geography that you could use key words or key questions to sort information. The demonstration of the specific example of "Trash and Treasure" by the teacher (Section 5.3.9) reminded some students what they should do.

Although most students could articulate what might be done for more effective learning, some were not sufficiently motivated to use these strategies. This may have been because they had not experienced the benefit of using them previously. It may also be linked to a view that learning is about finding the "right" answers. The tentative response by some students is not surprising since, for some of them, it was the first time they had experienced such strategies. However, journal writing, key words, key questions and the essay checklist were perceived to be useful by most students and the teacher. Opportunities for practicing essay writing and obtaining feedback on progress from both the teacher and peers were also identified as being very useful.

In general, there was a positive correspondence between students who used learning strategies and the quality of their essays. In particular students who used strategies such as planning, monitoring by checking on progress, using checklists or checking their work and asking questions, were more self-regulated in their learning and produced quality essays.

Some students had a more integrated knowledge base of both declarative and procedural strategies. For these students there was less need to invoke strategic processes for transfer since integration may have resulted in the development of skills that had become somewhat automatic. Information (content/declarative knowledge) itself may have driven the transfer/integration process, as suggested by Alexander and Schwanenflugel (1994). In contrast less well-integrated knowledge bases (of declarative and procedural knowledge) may have acted as a cue for the need to engage in strategic processes (Perkins & Salomon, 1989; Alexander & Schwanenflugel, 1994). As I have mentioned previously though, it is likely that students need to know some basic information, either declarative or procedural, before they can evaluate what they need to improve on. It may be more difficult

for students to develop initiative, perseverance or adaptive skills if they do not know where to start or what their choices are.

Some students had perceptions that their essays should have gained higher marks than they did (Mitchel and Vincy). These "illusions of knowing" (Hacker, 1998) or perceptions that they know content or processes may prohibit students from finding out more effective ways of learning. They may not see the need to evaluate their work because they think it is good enough already. When they receive lower grades than expected, their self-esteem may be dented because their evaluation of their work was inconsistent with that of the teacher's or the mark allocated by a peer.

9.3.2 Assessment Issues

Students were assessed by the essays they wrote at the end of the unit of work. Five students did not complete essays. Since the ultimate assessment was the external exam rather than the essay produced as part of this unit of work, there were no immediate consequences for poor performance during class time. Some students needed more immediate incentives to get started. The essay students were required to write in the external exam was worth 20% of the exam mark. There was a perception by some students that the essay produced in class did not really count.

It is interesting that as a result of a recent review of assessment in New Zealand, this section of work will be examined as an internally assessed achievement standard, marked by teachers, in 2004. This means Achievement Objective 8.3a of the curriculum can be assessed by multiple modes, rather than being restricted to an essay. This will also mean there will be immediate consequences for non-completion.

The essay format enabled students to have choices about what types of cancer they considered and how they structured their writing. However, this mode not only assessed students' ability to identify, analyse and evaluate bioethical issues, but also their ability to transform this knowledge meaningfully into an essay structure. Their success depended on how well they conducted the inquiry process and on their knowledge about writing essays and the application of this knowledge.

Some students gained low marks because of their inability to write logically and coherently. They still needed more assistance, perhaps just more practice at structuring written text. The advantages of planning or of handing work in so that students could gain feedback on their progress could have been emphasised more. The pre-write activity could have provided a valuable opportunity for more students to get feedback. Since only 7 students handed in a pre-write paragraph, it seems that the usefulness of this for monitoring progress was not immediately obvious to many students.

Peer assessment and feedback was deemed to be very useful by the students who used it and the teacher. Through evaluation of another essay, some students gained insights into content and possible structure for improving their own essays. There was some concern about a perceived lack of fairness in the peer assessment. Mitchel commented that he did not have sufficient knowledge about what could be included in the essays to be able to assess someone else's essay and that "you would not want to be mean to your friends."

Many students only included a limited range of issues in their essays. This is disappointing considering the apparent exposure to the issues in classroom discussions and other activities. As Aikenhead (2000) has noted, students' and teachers' perceptions of the importance of the social and ethical aspects of issues are linked to the degree to which they are given real importance in the assessment. In the essay, a discussion of the issues was worth 10 marks out of a possible 40. Perhaps some students considered the issues they mentioned were sufficient to gain some marks. More emphasis could have been placed on the importance of discussing a range of issues in the essays.

In the context of bioethical issues, it is unlikely that individuals will be able to make decisions about what should be included in an essay if they have not reflected on their own ideas and beliefs. They need to analyse (evaluate) their ideas in some way, based on comparisons with other ideas. This is why social interactions and other means of sharing ideas, like peer assessment, are important. Similarly, enhancing metacognitive processes and developing self-regulated learning requires an evaluation of what is important regarding content and processes for the construction of knowledge. Students could have been reminded to use the essay-marking schedule as a guide and for checking their essays more often to help them evaluate what was important.

9.3.3 *Critical Thinking and the Ambiguity of Content*

Investigating bioethical issues and developing self-directed learning requires critical thinking processes. Self-questioning or evaluation processes are required for values clarification, values analysis, inquiry and for learning to be self-monitoring and self-regulating. The ways in which these were promoted as part of the unit of work were explained in Section 5.2.4.

Critical thinking was modelled through examples and cued through written artefacts and questioning. It was not until the students became aware that there were gaps in their knowledge, or that aspects of knowledge were uncertain that they saw the need to use learning strategies to question, analyse and interpret their experiences. The uncertainty of the issues was important, for without a "right" answer or a sense of doubt, there would be no need for evaluation. The uncertainty and ambiguity inherent in clarifying and analysing the issues associated with cancer, was precisely why learning strategies that invoked evaluation were useful for learning in this bioethical context.

The skills of elaboration and going beyond the given to construct new formulations of the issues were required. New constructions, particularly in this bioethical context, involved weighing multiple alternatives and sometimes accepting uncertainty. As such, learning required some social risk; of disagreeing with others perceived to be more powerful (peers, the teacher or other authorities), of not arriving at the expected answers and of not always responding instantly. The degree of comfort students have in self-questioning and risk-taking has personal dimensions linked to personality and self-confidence. It is important that the teacher provides suitable conditions (through modelling and acknowledging conditional/tentative aspects), so that students can consider alternatives and feel comfortable enough to take risks.

Discussions were used because they have been identified as a way to develop critical thinking competencies (Oser, 1986) and have been used for this purpose in other studies investigating the teaching and learning of bioethics (Dawson, 1996; Dawson & Taylor, 1998; Van Rooy, 2000). The issues were discussed and considered as having a range of dimensions rather than the objective being a consensus or correct view. As Snook (2000) has mentioned, treating issues as being multi-dimensional is more likely to describe

the breadth of issues so that students can see the inherent conflicts and ambiguities which may enable them to handle other people's views in more tolerant ways.

Critical thinking has been linked to metacognitive approaches to learning (Kuhn, 1999). When students are given opportunities to choose ways to go about their learning, it presupposes that they have a purpose or intention and have enough knowledge to make their goals come to fruition. If they do not have this knowledge, they cannot be expected to choose what strategy to use. It follows that general learning skills such as "chunking" the task or checking for main ideas may be impossible to apply if there is little prior knowledge about similar tasks or if not enough is known about the topic to be able to recognise its' central ideas (Resnick, 1987). The idea of not knowing enough content was expressed by several students regarding marking (evaluating) other students' essays.

The extent and depth of content required for students to analyse issues is an important content issue. Without sufficient background knowledge of content, students may not be confident enough to feel comfortable with communicating about the issues. Inherent interest in the content may be necessary to get students to participate willingly, to share their personal views and experiences as well as actively self-monitor and self-regulate their progress during the inquiry process. On the other hand, extreme personal connection with the issues may inhibit students discussing personal and family dimensions (for example Charlie, Section 8.5.6). Emotional aspects may prevent active participation in critical discussions about personal factors.

9.3.4 Limitations in Promoting Cognitive and Metacognitive Strategies

Some students used learning strategies intuitively. For example, they did not write essay plans because they considered writing plans was too time consuming. Marianne, Terri and Charlie claimed to plan "in their heads". They could orally describe how they planned. There was some degree of automaticity in the way they used planning as a learning strategy. These non-conscious or automatic processes have been identified as unintended, effortless and very fast. Once in gear, automatic processes may guide the learner with "one third less effort than regular thinking" (Gilbert, 1989, p. 193, cited in Bargh & Chartrand, 1999). Automatic learning processes may in fact surpass the need to be consciously monitoring and controlling in experts. Students who use strategies automatically may have

some inherent self-regulation that predisposes them to behave more consistently. Marianne, Terri and Charlie chose not to write essay plans because they recognised it took time.

Non-conscious/ automatic use of strategies poses a difficulty for researching and assessing levels of metacognitive processing. For the purposes of documenting metacognition, the processes need to be conscious so that they are potentially reportable by students. Also, if learning processes are conscious and deliberate, they are likely to be more controllable by the learner themselves. Students who use learning strategies automatically may use processes spontaneously, without conscious effort. Therefore there is a dilemma as a researcher in monitoring an intervention designed to promote metacognitive processes when the processes may have become automatic and unconscious.

Many interventions have emphasised how long it takes to develop strategies that consciously and wilfully regulate behaviour, including making evaluations and decisions about learning (for example, Bargh & Chartrand, 1999; Gunstone & Mitchell, 1998; White, 1998). It is assumed that interventions used to enhance metacognition need to be long term, and require a considerable energy input from both teachers and students. This is true if students do not use metacognitive processes already. However, we know that some students arrive in classrooms with not only prior content and procedural knowledge, but also with knowledge through experience, of executive processes linked with metacognition (Gunstone & Mitchell, 1998). They have often developed these on their own, without formal instruction and are naturally efficient learners.

The unit of work reported here took four and a half weeks to complete. However, it was designed to tap into students' prior knowledge of learning strategies so that they could use and build on this prior knowledge to develop more independent and self-regulating learning processes. The students in this study varied in the degree to which they used metacognitive processes. Variableness of individuals' knowledge and use of metacognitive processing was also observed by Thomas and McRobbie (2001) in a study of senior high school students. As noted in this present study, some students, particularly by the end of their schooling, may already use many metacognitive processes on their own accord. For example Charlie strategically choose not to invest further effort in monitoring and checking his work because he had assessed that he had performed sufficiently to succeed. Charlie spoke about not changing what he had written after the teacher had given feedback on his

essay (Section 8.5.4). It is likely the "fruitfulness" of investing more effort was perceived as insufficient to justify the required effort. Other students do not use such skills and need more support from teachers even to get started. Loughran and Derry (1997) also observed resistance to self-evaluation or monitoring in a group of year 9 science students.

There is no doubt that learning and consequent academic achievement can be enhanced through promoting cognitive and metacognitive processes (Adey and Shayer, 1994; Baird and Northfield, 1992; Mayer & Wittrock, 1996; White & Fredericksen, 1998). This study is consistent with previous studies that have shown there are limitations in getting students to use learning strategies to enhance their self-regulation. Even though many students used metacognitive strategies for planning, monitoring and checking their work, there are still difficulties for students as listed below.

Students often ask questions that require little effort to answer, and that may only require factual answers. They may also ask questions related to personal interest, which is motivating and essential in considering bioethical issues, but which may obviate a focus on the scientific ideas.

Students often have trouble finding relevant information and/or discriminating between relevant and irrelevant information. A lack of monitoring, or not knowing the depth of what is required, accentuates this, especially if students are not accustomed to using an inquiry mode.

It is also possible that students may judge their understanding of text as complete, consistent and compatible with their prior knowledge when in fact it is imprecise or inaccurate.

Similarly students may judge their own writing as being adequate, even though it is judged by the teacher to lack sufficient content or not to be substantiated with reason or sufficient examples.

A lack of initiative to monitor work or a reliance on the teacher, rather than being self-starting, may be a consequence of previous learning experiences and reflect the level of confidence students have in their own abilities.

Students may also have an intention to complete work or to achieve well in the examination rather than to understand the meaning. This is not surprising in such a high stakes assessment context.

Even when students know through experience that more metacognitive approaches help their learning, they may still be unwilling to use these strategies due to the perceived amount of time and effort required.

All of these factors limit the extent to which cognitive and metacognitive strategies are used for more effective learning.

9.3.5 Limitations in Promoting Self-directed and Self-regulated Learning

When trying to foster self-directed learning, many teachers see a dilemma in deciding on the appropriate balance between teacher-directed instruction to provide content and procedural knowledge and allowing students to develop their own learning strategies (Shuell, 1988). In particular, providing too much direction to the learner may undermine the need for cognitive engagement and the development of autonomous learning processes. For this reason, in order to engender a responsibility by students for their own learning, in this study a minimum amount of teacher guidance was combined with tasks which enhanced metacognitive behaviours. Although some procedural strategies were made explicit, those designed to enhance metacognition were embedded in the tasks and were more implicit as recommended by Resnick (1987). This may have resulted in the purpose of strategies being treated too cursorily. The skills may have been perceived by students to be more useful if the purpose of them and their possible benefits had been clarified as part of the teaching. One of the dilemmas for the teacher was to decide on the balance between how much to remind or cue students in their learning processes and how much to let them be self-starting.

Knowledge of content, knowledge of procedural strategies and knowing how to reflect on and monitor progress all influence self-regulated learning (Winne, 1996). I consider that in this intervention, the students' beliefs about what learning involved needed to be challenged more. For more students to take more responsibility for their learning decisions, more attention could have been given to explicitly discussing what was expected,

especially to move students away from thinking that there was a "right" answer or "correct" set of information. Students' perceptions of themselves as learners and their consequent use of regulatory processes are thought to be critical factors in determining the level of academic achievement (Zimmerman, 2001).

Giving students the opportunity to choose content and negotiate tasks tends to engender a greater sense of empowerment, control and responsibility for learning (Brown & Campione, 1994; Ramsey, et al., 1990; Zimmerman, 1994). A pre-requisite for this though is that they know what choices they have. There are also restraints such as ensuring students cover adequate content. In an ideal situation, we would be able to allow sufficient time for supporting students to choose strategies, guiding how they are to be accomplished, and assisting students to be metacognitive in establishing intentions and evaluating their strategy use. In reality, time constraints and external assessment schedules tend to obviate this. Time restrictions clearly influenced students' willingness to use strategies for greater self-regulation.

Some students did value their ability to think and work independently (for example, Ann, Charlie and Liz). Other students spoke of their frustration associated with a more student-centred approach (Vincy, Mary). Perhaps they had not gained enough confidence or maybe had not had enough positive experiences/ feedback about their learning processes to know that they were able to work well independently. Providing these students with structured experiences including examples and specific feedback on their success may have improved their perceptions of the value in working independently, as suggested by Loughran & Northfield (1996).

In planning teaching, we need to be optimistic that each learner can be introspective and take an active role in controlling his/her own learning. Students need to realise that their learning is potentially controllable and take charge so that they have some control over it. Teachers may need to provide a framework to allow students to develop personal initiative, perseverance and adaptive skills for what they are doing.

9.4 The Connections Between the Findings and Evaluative Constructivism

In this section, I relate the overall findings to the notion of *evaluative constructivism*.

The experiences that students have in any learning situation and their interpretations of these experiences are likely to influence what and how meaning is constructed. Multiple aspects affect how students construct meaning from their experiences.

The discussion in this chapter considered ways to support constructivism. These include recognising the importance of content, identifying and analysing prior knowledge, and promoting knowledge and use of declarative, procedural and metacognitive strategies.

The analysis of bioethical issues seems to be enhanced through students' active engagement in cognitive inquiry and reflection on their ideas and beliefs. Questioning and self-questioning were fundamental to both analysing bioethical issues, and evaluating learning processes. Students were required to ask themselves "What do I think? What do I need to know? and How will I find out?" as part of many of the classroom activities. Questioning was fundamental to the metacognitive strategies. It was also fundamental in clarifying and analysing the issues.

As mentioned in Chapter 3, evaluation could encompass the processes of searching for information, identifying and planning what is needed, weighing up choices, reflecting on what is known, monitoring work in progress and appraising and checking completed work. Learning strategies were used to execute these processes, as documented in Chapter 7.

For the construction of declarative, procedural or conditional aspects of knowledge, students firstly need to identify their learning strengths and weaknesses. Those students who could identify their learning strengths and weaknesses more specifically rather than broadly, were more likely to develop and use strategies for addressing their needs (compare Mitchel and Charlie's knowledge and use of strategies). All students probably need guidance in identifying what they need to know. If students lack knowledge of their own learning or lack an understanding of how they come to know, they can hardly be expected to be reflective on utilising this knowledge to their own advantage by choosing or developing learning strategies (National Research Council, 1999).

The element of choice is important for students to decide for themselves about the implications of bioethical issues (Van Rooy, 1994). This is why activities that explore values clarification and values analysis are important. Through collaborative, group activities, students can experience a range of points of view. Using scenarios (Section 5.3.10 and 5.3.11) draws students into specific case examples where they are required to make decisions about the situations. This requires them to critically choose options and make decisions based on the options available.

Choice is also important for developing self-monitoring and self-regulation (Ramsey, et al., 1990; Zimmerman, 1994). Decisions about learning cannot be made unless students know what choices they have. Students' perceptions of the degree of choice may be important, that is, whether they are aware that they have a choice about how they think (McCombs, 2001). Teachers can assist by explaining steps in learning processes or by indicating that there are multiple ways of processing information. Once students know the options, they still may need to be cued or prompted to use them. Through use or experience with the strategies, students' own evaluation of the effectiveness of the strategies may become more apparent. Then the fruitfulness of participating in self-regulation may be more understandable.

This study indicates that students who used learning strategies produced better quality essays and broadened their thinking about the bioethical issues associated with cancer. Although using learning strategies may enable more effective learning, it does not follow that teaching these strategies or making them more accessible through examples, cueing or prompting, means that students will use them effectively. Students must also be clear about the purpose of what they are doing or have an intention or goal and reflect on the efficiency of these strategies. If their intention is to construct knowledge more effectively, then they also need to be flexible in their choice of strategies so that they fit or adapt them to the demands of the tasks. This latter point is strongly connected with evaluating and the consequent re-construction of procedural knowledge.

Elements of the learning environment need to foster support and mutual respect, so that students feel that they are being given the responsibility to take charge of their own learning. Students in turn have to invest in an element of trust in the teacher; trust that teachers can provide the "tools" for learning more effectively. Motivational factors and

other contextual factors such as timing, perceived importance of assessment and students' self perceptions, influence students' intentions and the choices students make which in turn influence the effectiveness of their learning.

There is wide scope to investigate ways to provide choice and autonomy while providing adequate support for students to derive intentions. The challenge is to help students to evaluate what they know, what they need to know, what pathways to take or how effective pathways might be to achieve what learners want. Evaluative constructivism as a process could then allow students to construct various types of knowledge and the processes for improving learning.

This chapter has discussed the findings in terms of the research questions. It has also outlined the important factors relevant to the overall findings under five themes. I have indicated that an active view of learning on the part of the learner is essential for using self-regulation and has profound implications for the ways teachers plan learning activities and manage learning environments. The focus is to get students to personally construct ways to improve their own learning rather than the idea that students' abilities are fixed and that learning environments are not malleable.

Chapter 10 provides a more concise summary of the findings of this study.

Chapter 10 Conclusions

10.1 Conclusions

This chapter presents a summary of the findings of this study and the inferences for the pedagogy of bioethical issues.

1. Overall the students' thinking about the bioethical issues associated with cancer was broadened.
2. Students who produced quality essays also broadened their thinking about the issues to a greater extent than did students who produced essays of lesser quality or no essay at all.
3. The limited expression (range) of students' ideas about bioethical issues in their essays may have been a result of their perceptions that biological facts were more important than the issues in the essay.
4. The pedagogical issues associated with teaching bioethical issues are complex. They can be addressed to some extent by using a combination of teacher-directed and student-centred approaches which incorporate evaluative processes.
5. An inquiry approach to learning which incorporated social interaction promoted evaluative thinking about the bioethical issues.
6. Students reported that specific activities influenced their thinking about bioethics. In particular those activities that involved social interaction such as small group and whole class discussions, videos and specific decision-making activities (scenarios and case studies) were perceived as important.
7. There was no relationship between students' prior knowledge of bioethical issues and the content in their essays.
8. Many activities were identified as being useful for "learning". Students considered that writing the essay and peer checking of essays were the most useful.
9. Students' perceptions of the tasks/strategies are linked to their previous use and success with them. Their perceptions of the strategies

(particularly usefulness or perceived effort relative to benefit), influenced strategy use (particularly self-questioning in journals and re-editing drafts of essays).

10. Highlighting learning strategies helped students to access their prior content and procedural knowledge. Cueing prior knowledge of strategies seems to be important. Some students reported that otherwise they would not have used them of their own accord.
11. The amount of guidance/prompting is a dilemma that can only be gauged on an individual basis. Too much guidance may undermine students' self-evaluation of their needs, since it externalises what students need to do. Conversely without some guidance, some students may not know how to get started.
12. The prompter bookmarks for use with journals, the essay checklist and the essay assessment schedule provided written prompts for students. These could have been used more extensively.
13. There was a positive relationship between students' prior knowledge of learning strategies and transfer for use in this learning context.
14. Students' prior content knowledge and the subsequent development of knowledge may influence the students' ability to participate in and make decisions about self/ peer-review processes. Evaluation is difficult if students do not have a basis on which to make evaluations.
15. There was a positive correspondence between the knowledge and use of declarative, procedural and metacognitive strategies and the quality of students' essays.
16. Those students who reflected more specifically on their learning needs and consciously used a range of learning strategies were more self-directed in their learning than students who had broad conceptions of their needs.
17. The use of strategies by individuals is also linked to their motivations and personal relevance of the context.
18. Giving examples or oral cueing of evaluative strategies as part of the teaching and learning procedures did not necessarily mean students used

these strategies. Many students may know strategies for making their learning more effective but do not use them or do not use them appropriately or effectively. Modifications to resources may need to be considered for more effective implementation of some procedures.

19. Getting students to use the strategies may involve helping them to develop their intentions for proceeding and increasing their awareness and knowledge of ways to proceed, so they know what choices they have.
20. Negotiated tasks where there is inherent student choice may be important for acting as a cue for evaluative construction of knowledge.
21. Students need to ask; "what do I need to know?" "what do I need to do?" and "how will I achieve this?" (develop intentions) to direct an evaluative construction of declarative, procedural and metacognitive knowledge.
22. The learning environment and how that is established/maintained by the teacher may be crucial. Trust and mutual respect is fundamental when requiring students to share their personal views about issues. Support for students to identify their knowledge and establish their intentions is valuable. Students also need to trust that being introspective about learning will enhance their learning.

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Appendices

Appendix 1 Letter to Participants

M O N A S H U N I V E R S I T Y



AUSTRALIA

Dear student,

My name is Lindsey Conner and I am studying for a PhD at Monash University. A research project is an important component of the course and I am undertaking mine under the supervision of Dr Richard Gunstone a professor in the Department of Education.

Project Title: Reflective learning: a bioethical context

The aim of this project is to **find out what activities/ strategies you found useful for helping you to learn and why they were useful**, during the unit on Contemporary Issues in Biology. This may indicate how others should approach this topic in the future.

If you agree to take part you will be asked to:

1. Answer a questionnaire before the unit of work, and after the unit of work. Any data reported from this questionnaire will not be traceable to any student, nor to the school.
2. Answer interview questions about what you know about your own learning. I will also be observing how you approach tasks during class time using a tape recorder and written notes. You may be asked to take part in a second interview to find out what you found useful and what was difficult.
3. Keep a log book in which you note any thoughts about what you did in class and which activities you thought were useful and why.

Access to data is restricted to my supervisor and to me. Coded data are stored for five years, as prescribed by University regulations.

Participation in this research is entirely voluntary, and if you agree to participate, you may withdraw your consent at any time by not returning the questionnaires or indicating to me that you do not wish conversations to be recorded etc.

If you have any queries or would like to be informed of the research finding, please contact me telephone 343 7780 ext 8643 fax 3437784

Thank you.

Lindsey Conner (ph 343 7780 Ext 8463)

Should you have any complaint concerning the manner in which this research is conducted, please do not hesitate to contact The Standing Committee on Ethics in Research on Humans at the following address:

The Secretary
The Standing Committee on Ethics in Research on
Humans
Monash University
Wellington Road
Clayton Victoria 3168
Telephone (03) 9905 2052 Fax (03) 9905 1420

Appendix 2 Consent Forms

M O N A S H U N I V E R S I T Y



AUSTRALIA

Informed Consent Form

Project Title: Reflective learning: a bioethical context

I agree to take part in the above Monash University research project. I have had the project explained to me, and I have read and understood the Explanatory Statement, which I retain for my records.

I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party.

I also understand that my participation is voluntary, that I can choose not to participate, and that I can withdraw my participation at any stage of the project.

Name:.....(please print)

Signature:.....Date:

Independent witness to participant's voluntary and informed consent:

Name:
.....(please print)

Signature: Date:

Address:.....

Informed Consent Form for Parents/Guardians of Project Participants

I agree that(full name of participant) may take part in the above Monash University research project. The project has been explained to and to me, and I have read and understood the Explanatory Statement, which I retain for my records.

I understand that any information provided by is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party.

I also understand that’s participation in the project is voluntary, that s/he can refuse to participate, and that s/he can withdraw her/his participation at any stage.

Participant’s Name: (please print)

Participant’s Age:.....

Parent’s/Guardian’s Name:.....

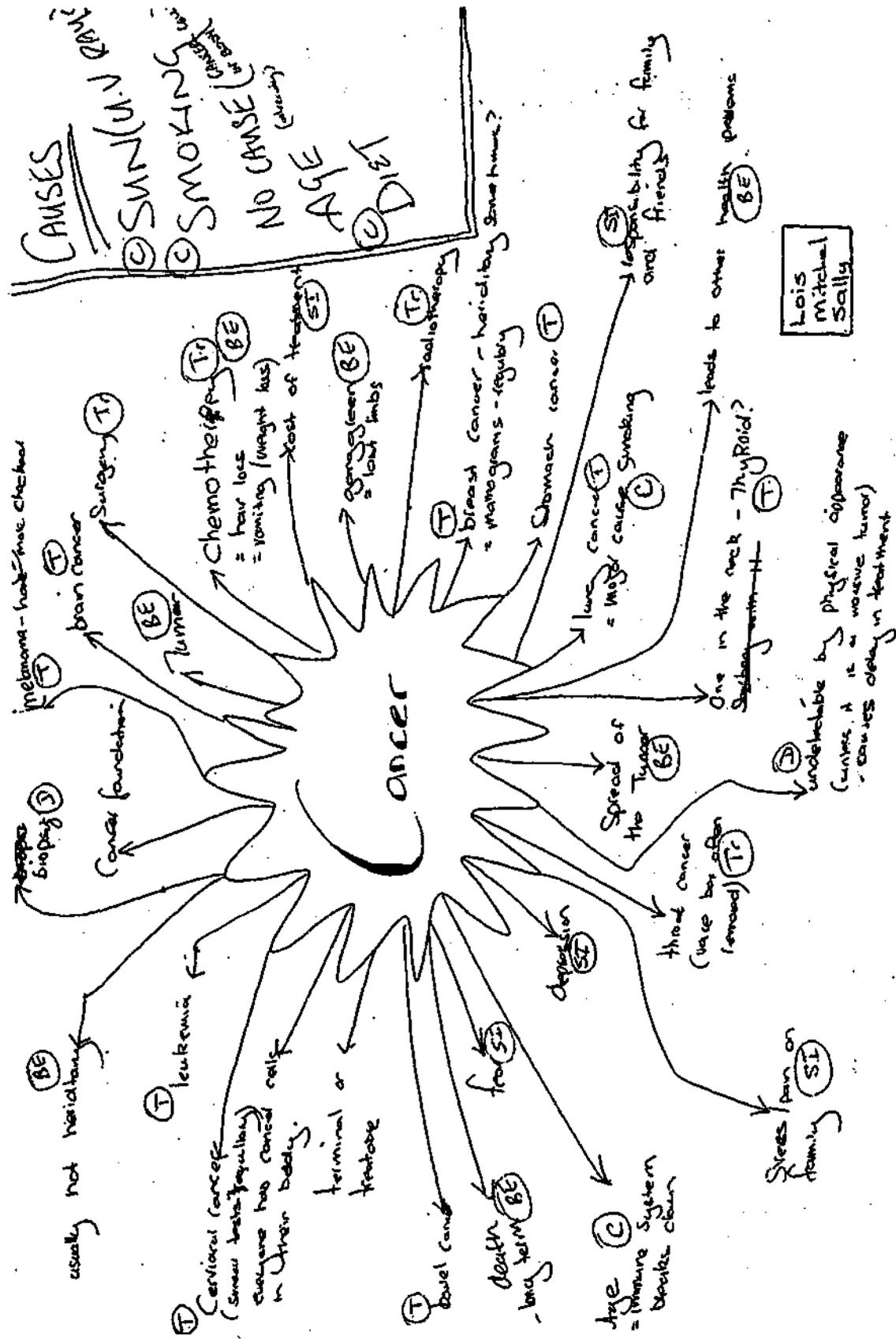
Your relationship to participant:.....

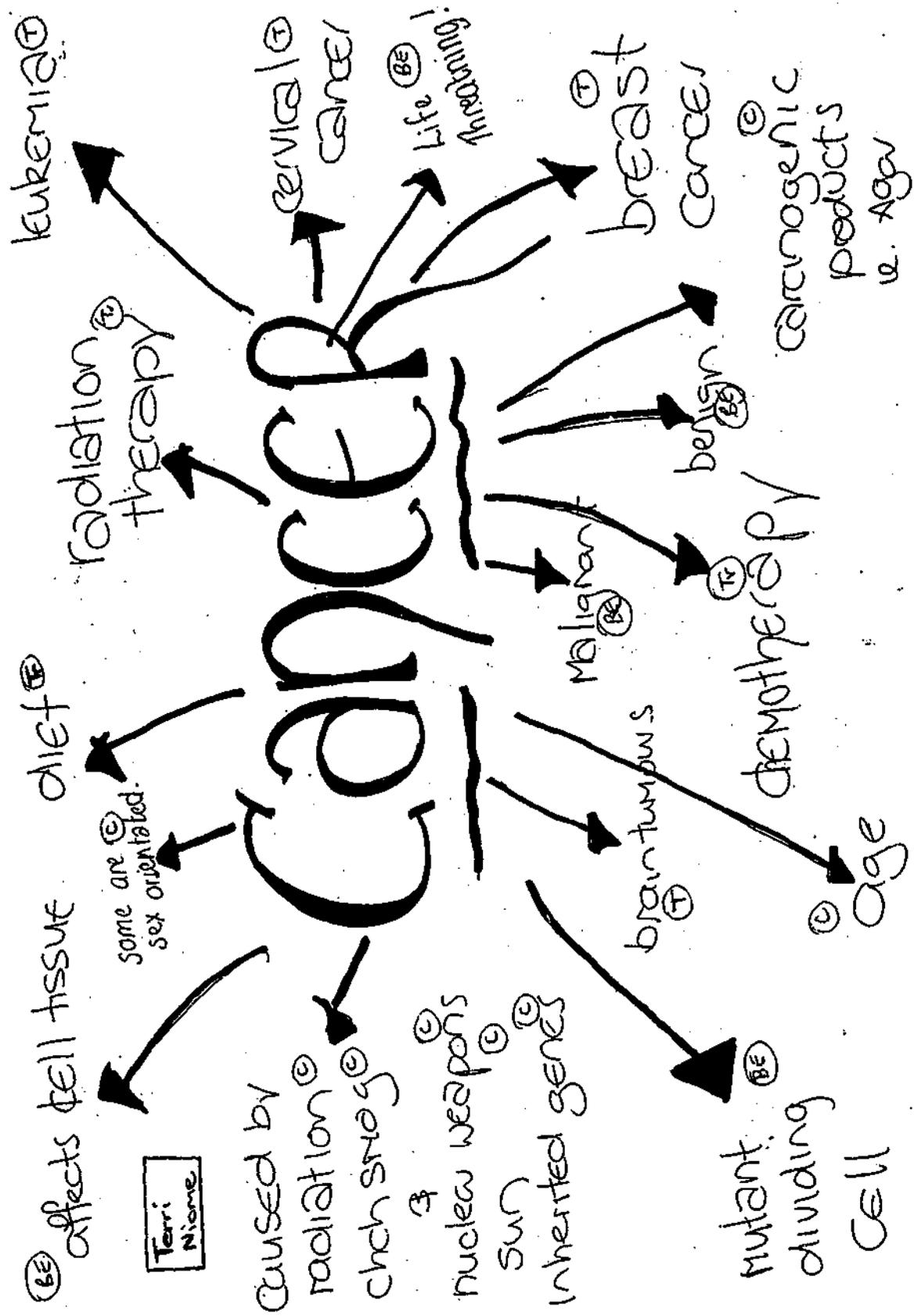
If appropriate, reason(s) why s/he cannot give written consent:

.....
.....
.....
.....

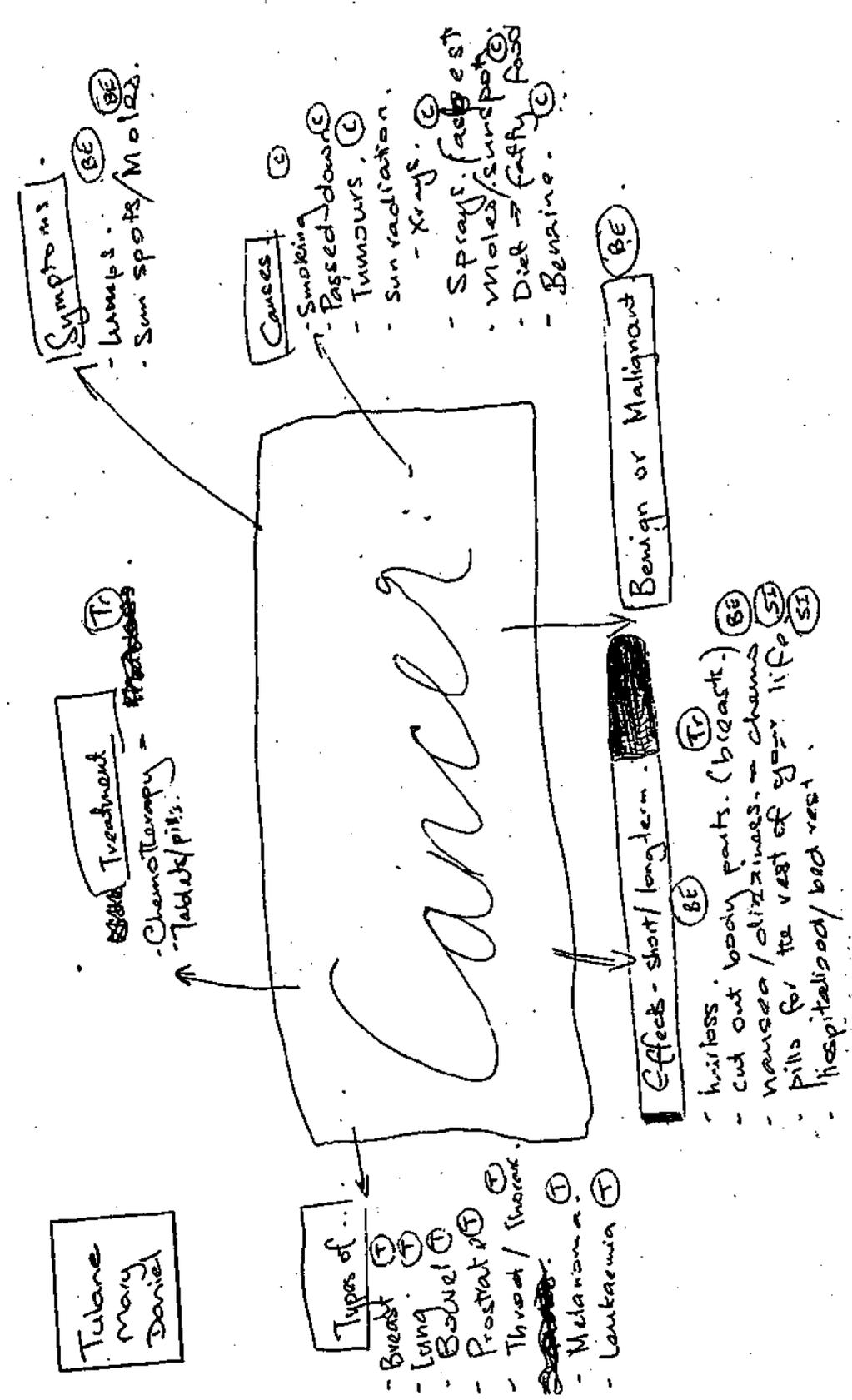
Signature: Date:

Appendix 3 Sample Brainstorm Sheets



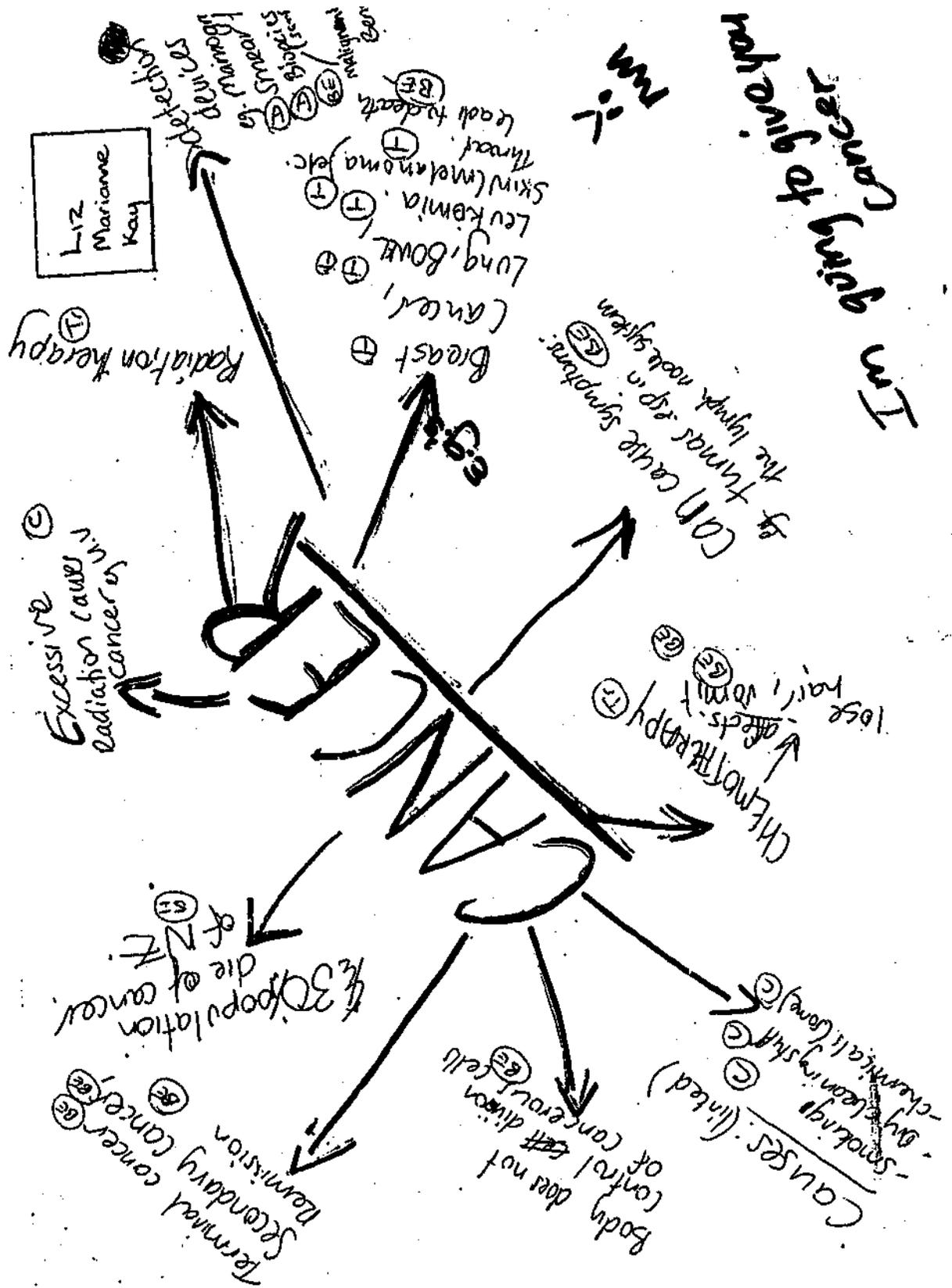


What is cancer - A disease which causes a mutation.



In genes that give you
cancer

mm-i



Liz
Marianne
Kay

Lung, Breast, Leukemia, Skin (melanoma), etc.

Appendix 4 Questionnaire

**Bioethics Questionnaire
Year 13**

The following questions are part of a larger study on what students think and how they learn about bioethical issues.

This survey is designed to find out what you know about your contemporary issue already.

You should have read the explanatory statement about the study and signed the consent forms for the study.

Please take time to think about the questions and answer them as best you can.

Thank you for taking part.

Lindsey Conner

Your name _____ Class _____

Your teacher's name _____

School _____

The topics for Contemporary Biological issues for 1998 and 1999 are:

Either **Incidence and control of a human disease**

Choose either cancer or heart disease

or **Biological Control**

Choose either an organism that is a pest in New Zealand or an organism that is a weed in New Zealand

or **Conservation of a New Zealand Coastal Aquatic Environment**

You will be required to write an essay of approximately 500 words that outlines

- the **biological concepts** involved in the issue
- the **social, ethical and biological implications** of the issue

1. Which topic have you chosen for your investigation?

.....

2. In general, what is meant by '**biological concepts**'?

3. What are the '**biological concepts**' of the topic you have chosen for your investigation?

4. In general, what is meant by "**social implications**" ?

5. What are the '**social implications**' of the topic you have chosen for your investigation?

6. What is meant by the word **"ethical"**?

7. What do you think people who are responsible for making decisions about treatment for diseases base their ethical reasons or decisions on?

8. What are the **ethical implications** of the topic you have chosen for your investigation?

9. What are the **biological implications** of the topic you have chosen for your investigation?

In your essay you are expected to present a **"reasoned"** personal viewpoint. What do you think **"reasoned"** means in this context?

Appendix 5 Pre-Unit Interview

1. In terms of thinking about how you learn, what are you good at?
2. What types of activities do you do best at?
3. Do you know why you are better at?
4. What tasks do you need the most help with?
5. Do you know why you need more help with?
6. Why are you studying biology?
7. What do you hope to achieve in biology at the end of the year?
8. Have you done any research where you had to write an essay?
9. Thinking about background reading and research on a topic, can you tell me what you do?
10. What do you do when you make a summary of an article or piece of writing?
11. Do you use concept maps or mind maps for summarising?
12. What do you do when you need to write an essay on a science topic?
13. Do you find writing essays easy or difficult?
14. What makes writing essays easy or difficult for you?
15. How do you sort relevant information from irrelevant information?
16. How do you know if you've done a good job on an essay?
17. Do you prefer to work individually or with others?
18. In general, do you ask for help when you don't understand what to do?
19. Do you usually complete work with minimal assistance from your teacher?
20. Do you help others when they ask for it?
21. I'd like you to think of times when you weren't working well. What distracted you from working?

Appendix 6 Post Unit Interview

Students were shown a list of activities in the unit of work as a reminder of what had been covered.

1. Which activities in the unit did you like best?
2. Why did you like....?
3. What did you expect to learn from the unit on contemporary biological issues?
4. Can you tell me about any activities or parts of activities that helped you learn something?
5. Can you tell me about a task where you asked yourself questions?
6. Can you remember a task where you asked for help?
7. What did you do when you took notes from articles or books?
8. Thinking about your essay now, how did you organise your information before you wrote it?
9. Can you tell me about any information that you thought was biased in any way?
10. What did you do to plan the layout or format of your essay?
11. How did you choose the relevant information to include in your essay?
12. What examples did you use in your essay and why did you use them?
13. Did you use several points of view in your essay?
14. What did you do with your draft version before writing the final copy of your essay?
15. How has studying this topic helped you in getting better at essay writing?
16. Do you think that making the learning skills explicit /obvious helped you?

Appendix 7 Journal

Students were given notebooks in which to record their thinking, feelings and plans or anything that they wanted to include. The heading page below was stuck into the inside cover of the notebooks.

Contemporary Issues Learning Journal

Name.....

Purpose:

Please use this journal to write a personal record of your thoughts, ideas, feelings and goals during each session in the Contemporary Issues topic in Biology.

The journal is to help you focus on your own learning. It will not be used for assessment. Please use the bookmarks to help you write in your notebooks.

I hope you will allow me access to this journal to assist me to determine the teaching and learning approaches which helped you.

Goals for the Contemporary Issues Topic

-
-
-

Prompts on journal bookmarks

Something I learned today

What does what I've found out today mean?

It seems important to note

I want to...

A question I have is....

I'm lost with....

I disagree with..... because

What I need to do now is.....

A question I have is.....

I can't decide if...

I'm stuck on....

I wonder...

What I need to do now is...

I'm wondering why.....

One point of view is....

How...

What I need to do now is.....

Questions in the back of journals

In general, what do people base their decisions on when deciding about cancer treatment?

What do I take into account to make a decision about Cancer treatment?

I'm not sure about.....

The best activity we did in this unit was.....
because.....

I also thought that was useful
because....

I had to think about my own values when

-
-
-

Appendix 8 Sample Essays

Describe the causes, effects and treatments of two types of cancers, including a hereditary type.

Mitchel

In today's society, cancer is well known around the world. Everybody has the genes present in their bodies that can produce this deadly disease. With the world aware of this there are treatments available to those who detect they have cancer before it spreads. Two types of cancer of main concern are Breast cancer, which has a hereditary link, and skin cancer also known as melanoma.

The genes responsible for inducing cancer are oncogenes (cause cell division) and tumor suppressor genes (regulate cell growth). However there is still much undiscovered about the way cancer is inherited.

Treatments of cancer vary. Tumors may be surgically removed, and with the vast array of new technology this procedure is more viable, with the high success rate ^{giving} a great deal of security ~~to~~ as patients feel content with the area of treatment. Chemotherapy is also often used. Certain drugs can be used to kill the cancerous cells. Radiotherapy is another standard way of treating cancer. Radiation aimed directly at the cancer/tumor will prevent the cells dividing further and having a chance to spread throughout the body. This however is very expensive as the machines cost millions and only very few cancer treatment units have access to them.

One of the most common hereditary linked cancers, is cancer of the breast, Breast Cancer. Breast cancer can be distinguished by a lump found in the breast tissue. ~~to get a~~ ^{mammograms} should be taken regularly to, particularly get a definite ~~diagnosis~~ ^{diagnosis} for this type cancer. People are well aware of ~~the~~ ^{the} effects ~~could~~ ^{could} due to breast cancer and are using the mammograms to keep a regular check on their bodies to detect anything early.

Skin cancer is ~~also~~ ^{one} of the highest ~~death~~ ^{concerns} in N.Z. With the ozone depletion that has occurred over the past decade or two, the increased strength of the U.V. rays has made ~~the~~ ^{the} skin ~~more~~ ^{more} susceptible to these

Issue
SP
SP
Bio
BAC
figures, charts
Treat

Effect
Social

Bio
SP
cause

94

Discuss why the incidence and control of cancer is a current issue. Include comments on the biological and ethical issues involved.

Cont. issue
 bit confused?
 conf. fits

The increasing occurrence of cancer over the last decade has caused cancer to be a current issue. The fact that it is the major cause of death in New Zealand and the lack of cures is a real concern worldwide. It is at present a controversial issue for New Zealanders as 6 people have died waiting for radiation treatments and 100 people are still waiting. Also with the many New Zealanders lifestyles promoting many factors like smoking, UV rays and a fatty diet; that include carcinogens.

It's a scary thought that most causes of cancer are unknown and that there is no one single cause. It is encouraging to know that many cancer causing carcinogens have been identified. The knowledge of the 3 development stages has made society more aware of the disease. The first stage known as the mutation stage is when the carcinogen acts on the cell causing a DNA change. The second stage is the latent stage where cancer slowly divide but may not become visible for years, and the final stage is the progression stage where the growth is promoted by some factor (carcinogen). following these stages cancer cells which have pushed through their tissue can reach a blood vessel, where cancer cells can break off and circulate this is known as metastasis.

Bio 1
 Bio 2
 Bio 3
 cause 1
 bio 1
 bio 1

There are many ethical issues involved with cancer, especially due to every cancer patient being an

individual case. Everyone has the right to have the
eth 1 highest attainable physical and mental health with
eth 1 limited funds who should receive medical treatment
and who shouldn't, as there is not in N.Z. enough
funds to treat all those who suffer from cancer.
/ Soc. 1 Should someone old not get it due to a younger
person on a waiting list. There are so many
ethical issues involved with the treatment of
eth 2 cancer as everyone should theoretically have the
same right human rights, no matter on their age,
family, beliefs and occupation.
Soc The increasing cancer numbers are not going to
decrease, especially with New Zealand's aging
population. Cancer research needs to continue to
find more preventative action that should be
taken so less incidents will occur in a future,
and in the hope the disease can be understood
and cures found.

95

Discuss some of the causes and treatments of Cancer.

Include a reasoned opinion on whether it is better to invest in research research to improve preventive medicine or to invest in the search for an improved treatment.

There are many contributing factors that cause cancer, many of these will be familiar to the average New Zealander which is important because preventative action can be taken reducing the need for treatments. Some of these causes of cancer are known and totally avoidable. Some of the best examples of carcinogens are likely factors, a person who consumes a fatty diet is more likely to fall victim to cancer. Possible the main cause of cancer is smoking, two thirds of all cancer is smoking related, and accounts for $\frac{1}{3}$ of all cancer deaths. Other carcinogens include ultra violet lights radiation from x rays and nuclear power, as well as many viruses. There are three main treatments of cancer which treatment used depends on the type of cancer and how far it has advanced. These treatments are surgery - the removal of growth, Radiotherapy - using high energy rays to kill cancer cells and chemotherapy - using drugs to kill cancer. Chemotherapy & Radiotherapy are generally used first & surgery as a last resort. I believe it is more important to invest money into research than to invest in the search for an improved treatment. I think by spending money on education on the causes and by advertising the already known carcinogens is going to be a better investment than in search for treatment. By doing this those that do not have cancer know how they can avoid getting the disease. therefore hence less people will get the disease in the future saving lives and trauma.

However money in research should not be completely forgotten as there are still millions of people world wide that have the disease and they as humans have the right to the highest attainable physical & mental health.

and diet.

The way I see the money allocation is clearly seen as I'm sure many cancers and even death has already been prevented, and with New Zealand's aging population by telling people the facts they are likely to be more responsible and think about how they are exposing their body to carcinogens by lighting that cigarette, working with asbestos and exposing themselves to UV rays by sitting in the sun. I know by what I've learned through the already known carcinogens may just be enough to save my life.

2 = A Good first essay. - Good structure
2 = Paragraphing!

* The Q did ask you to include the usual 'contemporary issue', 'biology', social, ethical issues too.

You could have referred to particular examples of cancer to illustrate points.

* Considering your 'other' essay - it provides the info for this Q.

Terms to be included - oncogenes, etc.

Probably about 2/40

Charlie

include a discussion of the social, ethical, and biological conflicts arising.
B- Describe the cause, effects, and treatments of two types of cancer including one hereditary type.

Cancer is a disease that claims the lives of one in every four New Zealanders. It is a disease that is very complex, with many social, ethical and biological issues encompassed in it. Cancer is a current issue because at present, very little is known about its processes, a cure is far from being discovered, and the incidence of cancer is on the rise.

Bio
cause
Bio
Effect
Issue
Cancer is caused by carcinogens which fall into two types of categories. Genes damaging carcinogens (ie causing mutations) occur from exposure to certain types of chemicals. For instance lung cancer is caused by individually cancer producing chemical substances found in tobacco smoke, air pollution and industrial hazards. Prolonged exposure to these carcinogens affect the genetic material of cells producing a series of genetic modifications ie, tumors in the lungs. Lung cancers arise in the epithelial lining of the bronchi. The cancer spreads early directly to the lymph nodes and bloodstream. A cough blood stained phlegm, hoarse voice, shortness of breath, chest pain, weight loss, and tiredness are some of the effects the cancer has on the patient. Sufferers of lung cancer usually die within five years of diagnosis, this type of cancer causes over one million deaths worldwide annually.

cause
Bio
Bio
Effect
The second category of carcinogens are those which induce cell growth (ie increase mitosis). This type of carcinogen includes some telomeres, oncogenic and hereditary factors. An example of a cancer that has a hereditary link is Bowel Cancer (which NZ has the highest incidence rate in the world). Certain genes have been found to induce some types of Bowel Cancer. Tumour suppressor genes, which instigate cancer, are located on chromosomes 5, 7, and 18. These genes are linked to Bowel Cancer, but little is known about the way this cancer is inherited because the expression of the tumour suppressor gene is recessive. Bowel Cancer effects the sufferer by giving them rectal bleeding, abdominal pain and vomiting. As with other cancers, the

end result could be the death of the patient.

Treatments
With cancer research being an advancing subject, there are now a range of treatments available. Surgery to remove cancerous tumours, is carried out when the cancer has not metastasized i.e. the tumour has spread, or the patient is not well enough to have surgery other options need to be considered. Chemotherapy is when high doses of cancer-killing drugs are used to kill cancer cells as they divide (this, however has the negative side-effect of also killing normal body cells). Radiotherapy is another way of treating cancer. Ionised radiation is targeted at the tumour to prevent the cells from dividing further. New forms of cancer treatments include immunotherapy and gene therapy.

ETH
Conflicts arise from the incidence and control of cancer. These conflicts arise because of differing viewpoints of the individuals involved. Perhaps the best example of an ethical issue which surrounds cancer is euthanasia. Should terminal patients have the right to end their lives if they are suffering too much? Social and biological conflicts are also connected to cancer. Social issues arise when society makes decisions about cancer. For instance, people have to decide whether we should spend our money on cancer prevention or treatment.

Social
differs via
points
Bio
Biological conflicts arise in all facets of the disease. For instance some biologists believe that cancer is a natural aspect of all animals and that finding a cure is futile. Other biologists believe that researching cancer research could lead to the key to immortality. Telomeres, the fuse for cancer are the cap on the end of a chromosome - much like the plastic tips at the ends of shoelaces that prevent them from getting frayed. In normal cells, the telomere fuse gradually becomes shorter and shorter until the fuse disappears (the cell then dies). However, cancer cells have the ability to keep the telomere fuse perpetually long. This means,

ironically be the key to immortality!

Moreover, there are many reasons why cancer is a current issue in biology. A range of social, ethical and biological conflicts surround this disease. More needs to be found out about cancer to prevent the great toll it already has on human lives...

* S's mark 33/40

Good opening paragraph, altho we do know a bit nowadays.

2nd paragraph is detailed, well structured, good facts to support.

Is it P53? & breast cancer? Elaborate on hereditary link.

Relate treatments to the 2 cancers you have mentioned.

A good essay - use key words to remind examiner of your logical path through the topics.

S's mark is probably about right - perhaps 30/40?

①

Liz Essay 1 1994

PART A Discuss why the incidence and control of cancer is a current issue in Biology. Include a discussion of the social, ethical and biological conflicts arising from this issue.

Correct in introduction!
Correct issue & goal

Today Cancer is an issue of importance, and has been becoming increasingly worrisome over the last 20 years. It is currently the second most common cause of death in NZ. Each year approximately 7,000 people die from cancer, with an average of approximately 10,000 new cases diagnosed per year. That means 1 in 3 New Zealanders will deal with cancer in their lifetime. With Lung cancer and breast cancer being the two most deadly. Cancer is known as the disease of age, 65% of all males ^{who have} cancer are over 65 and in 53% of women ^{age} and because ~~3~~ human are now living longer, ~~due to~~ due to advances in health and education, this combined with our growing population and ^{ability to} recognise cancer as a separate disease means cancer is ^{fast} becoming our deadliest killer. Perhaps it should be known not as the disease of age. But as the disease of our age.

Scientists are are fast becoming aware of factors which can combat this disease. ~~The~~ Just like your mother always said "Prevention is the best cure." However some preventable

effective

3

3

measures are cause of social unrest in New Zealand. Take lung cancer for example. Perhaps the most preventable cancer of all. 85% of lung cancers are a result of smoking. Therefore it is logical that not smoking gives ~~one~~ a higher chance of not getting lung cancer. However banning smoking for the good of public health creates problems; black markets for cigarettes for those who are addicted, not to mention the political implications and ~~basic~~ arguments about basic personal liberties. Freedom to choose; Do we want to live in a society which controls those basic freedoms.

In the end the responsibility of prevention lies with the individual. This is where conflict arises. Some people feel that any risk of cancer is enough reason to impose restrictions on those who use ~~these~~ carcinogenic chemicals or ~~products~~ ^{products}. But others believe these chemicals or products necessary for higher quality of life and economic benefit.

As the individual must decide on ~~his~~ ^{his or} her own code of ethics in dealing with this disease, so must the collective body of society. In this the rights of every person must be considered. However it is rarely ~~the~~ ^{cut and dried} an ~~abstract~~ ^{concrete} ~~principle~~. And the ethics involved in cancer cases are still being debated.

Human dignity, equality, protection, privacy, and freedom are among each persons rights. ~~But what about euthanasia~~ But what about euthanasia?

③

Cancer is a longterm disease and in most respects. ~~Most~~ people experience debilitating pain. And a few of these people would rather die in what they consider to be a dignified and practically painless measure. ^{which they consider to be the ultimate cure.} However euthanasia is seen under the ~~law~~ ^{former act} as assisting suicide, and is punishable by law. Euthanasia in most places in the world is illegal. ~~Whatsoever In.~~ This ~~case~~ personal choice is overruled ~~to~~ ^{is still considered} to take a life ~~is~~ ^{is} the ~~most~~ ^{most} immoral act there is.

Conduct
concerns

Soon, scientists (and in fact the entire human race) hope these issues as pertaining to cancer will no longer be relevant as advancements ~~and~~ in treatments and possible cures progress rapidly.

Treats

Gene therapy is a new additive to the list of radiation therapy, chemotherapy ^{and} surgery with promising results particularly to hereditary genes which have been linked to cancer. e.g. BRCA1 linked to breast cancer and HNPCC linked to bowel cancer.

To
Effects

Radiation therapy, where a ray of alpha radiation is beamed onto the patient's from various angles to try and breakdown the cancer cell.

Rec
Treats

Chemotherapy, using ~~the~~ medicines to try and combat the disease. And surgery to remove the cancer infected area.

Effects

But all of these treatments have side effects ~~and~~ vomiting, infection, rejection, hair loss among many, and some treatments are only viable and effective

6:12 during the latent stage, when the cancer is slowly dividing, and before metastasis sets in. (metastasis = cancer cells begin to spread around the body via the bloodstream or lymph system)
Better treatments are, however, being looked at since scientists now understand cancer and its cause better.

6:11 Cells become cancerous because of ~~the~~ mutations in cell division controlling genes. By cancerous it is meant they inherit faulty genes. These cancer causing genes are known as Oncogenes. ~~When~~ Cell division controlling genes ~~are~~ are cancerous, they are in a permanent cell division state and cells divide uncontrollably causing useless cells to be formed, and do not respond to any of the body's chemical signals.

6:11 Because cells are everywhere in the body cancers can form anywhere. ~~Cancer is a disease which can be caused by any~~

Cancer's aggressive nature and frequency in today's society plus the fact that it is ~~multifactorial~~ has many contributing factors makes it a contemporary issue of importance in every person's life. Its occurrence is unpredictable which makes cancer the most dangerous ~~and~~ ^{most} disease known.

Word Conclusions

32/40

May be a bit generous!

(2)

bronchi

~~They~~ And are covered with cilia, tiny hairs which keep dust and bacteria away from the lungs by carrying it ^{back} up into the throat. Goblet cells which secrete mucus, keeping lining moist trapping dust and bacteria. And Basal cells which divide to make replacements for epithelial cells.

Biol 2 In the case of smokers. The tobacco smoke makes goblet cells in the bronchi secrete too much mucus, this paralyzes and destroys the cilia, and instead of flowing up the bronchioles and sometimes become infected, air gets trapped in the alveoli causing them to burst, ~~along with~~ ^{the result of} this damage are smokers cough or emphysema and people experiencing either/both of these has very high chances of developing cancer.

Tar in cigarettes cause the basal cells of the bronchi to divide too quickly and too much. These form into lumps of unspecialised cells. The cancer can block the bronchioles or even the bronchi preventing air from reaching the alveoli. This is usually followed by infection. At this 'progression' stage lung cancer is virtually untreatable, and sufferers usually don't have long to live.

scat 2 However some other types of cancer are highly treatable. Breast cancer if detected early is easily treated by radiation, minor surgery, for more advanced cancers a mastectomy (removal of ~~the~~ breasts) is also an option. And ~~the~~ ^{cosmetic} surgery ~~can reduce the breasts with skin and implants~~

③

Women are able to return to a fairly normal life.

causal Cause of breast cancer are not as obvious as those of lung cancer or other smoking, carcinogen related cancers, although smoking has been linked to breast cancer. But scientists do ~~believe~~ believe that 5% of ~~women~~ ~~with~~ ~~breast~~ ~~cancer~~ ~~sufferers~~ have a ^{hereditary} mutant gene known as BRAC1 which is also linked to ovarian cancer.

causal BRAC1 is a tumor suppressor gene, and a mutated BRAC1 gene means that it does not give effect the dividing cells the signal to stop. Lumps of unspecialised cancer cells form in the breast.

Treatth ~~Although~~ 5% of all breast cancer sufferers is not a large ~~number~~ ^{number}, ~~but~~ ~~but~~ but scientists feel that very soon gene therapy (replacing mutant genes with healthy ones) is a viable option for future treatment of this type of cancer.

15% ^{of} Breast cancer is the leading cancer death among females, 20% of all ^{female} cancer sufferers.

soc¹ And although breast cancer is treatable, ~~many~~ people still die from it. But ~~cancer~~ cancer education is becoming common. It is necessary for everyone to be aware of the ~~causes~~ ^{causes} causes and effects of cancer if this disease is to be combated sufficiently.

Appendix 9 Cancer Essay Marking Schedule

(This marking schedule was negotiated by the teacher with the students and used for peer marking, teacher marking and my assessment)

1994 University Bursary question:

Discuss why the incidence and control of cancer is a current issue. Include comments on the biological, social and ethical issues involved.

Student: _____	Marks allocated	Mark for your essay
Why is it a contemporary ?	2	
Why is it an issue?	2	
Biological aspects	4	
Social aspects	3	
Ethical aspects	3	
Examples of cancer		
Causes	4 for each eg	
Effects	2 for each eg.	
Treatments	2 for each eg.	
Ability to write an essay		
Logical	2	
Clear	2	
Appropriate terms	1	
Spelling	1	
Script readable	1	
Paragraphs	1	
All parts addressed	1	
Overall impact	1	
Comments:		

Appendix 10 Metamatrices for Case Study Students

The metamatrices for the 5 case study students are given below. These were constructed so that I could visually collate the multiple data sources (Miles & Huberman, 1984). This enabled me to categorise quotations, extracts, observational notes and outcomes into themes related to learning. It also allowed me to more visually collate individual's learning tendencies. The data represented in the metamatrices allowed me to cross reference my sources. Quotations are referenced in the tables. Where lengthy, they are expanded beneath the tables to maintain the integrity of the data. The results for all 16 students were used to determine if students knew of learning strategies and whether they used them as reported in Chapters 7 and 8. I also established whether students had prior knowledge of the strategies for research question 5, by analysing the pre and post interview comments.

A. Metamatrix for Daniel

Source	Ability Perception			Perception of Essay Writing	
	"good at"	"help with"	mark prediction	easy	difficult
Interview 1	remembering learning orally PE	decisions making notes writing organization quit english	I'd like to pass		needs help with writing "The actual style. Styles and ways of writing." "Difficult, because I get bad luck. Not bad enough. Compared to the other marks they seem to drip out."
Interview 2		can do if put the effort in			
Journal					
Class obs	kinaesthetic activities	finds it difficult to start			no intention to write essay obvious

① Daniel (iv1): Yes. Because when I write things down I just write them down without thinking. I do not actually learnt it. It just comes by talking and interesting. If it is interesting I learn. I am not very good at sight reading.

Daniel (iv2): It is probably because it seems simple, that I am memorizing for a purpose. Learning things for the sake of it - doesn't seem attractive to me. I really, have it in my mind but I don't actually bring it up to the end of the exam or something and then once I have memorized it, I can hold on to that thought better. Until when I need it, then I sort of chuck it out the window again.

② Researcher: No I meant the actual study part. What will you need to do?

Daniel(iv2): Determination I reckon. If I go back I will want to be there and putting the work in. I know I can pass anything if I study. It is easy for me if I study, if I don't it is just like everyone else.

Researcher: So you have to put the effort in?

Daniel: Yes. I just feel that if I want to do well at something I can do it, do well in anything. But it is my choice if I want to put the work in. But I think I will find it easy to pass because I am starting to put the work in.

	Planning		Researching		
	plans use of strategies	planning structure for essay	uses key words or questions	summarises (own words)	multiple sources of information
Interview 1	Deciding selecting③	doesn't plan④ knows generalisation	knows should use key words/questions	writes facts for studying doesn't summarise while reading⑤	
Interview 2		thinks it would help it depends time available		Did you summarise? "Not really, I copied. I just put down everything"	only used teacher notes due to absences
Journal	no journal entries				
Class obs		no written evidence	distracted		
Essay	no essay				

③ Daniel (iv1): It is sort of, deciding aspect of.... selecting the right words to say that

④ Daniel (iv1): Because I don't have a clue about what to do, you know. I don't structure right and sort of, that is probably why English is quite hard, because there is a lot of essays and that and I wanted to get good marks and I was not getting what I was thinking I was getting. It wasn't enough to pass.

⑤ Researcher: I was actually thinking like constructing an essay, so how do you get the information, background information that you need? Summarize it from a book?

Daniel (iv1): I have never done that.

Researcher: All the projects and stuff that you have done, so you would read something and compile it all in your head and just download it onto paper?

Daniel (iv1): I would download when writing. I will be thinking and writing. Then maybe do a second copy, but most times it is the first copy and I just write in my best sentence and I will just. I know these things then I will probably look over the book and change a few words, sometimes.

	Essay Writing			Seeks Help
	Structure (It flows)	Content coverage	Marks	
Interview 1		content important⑥		recognises that needs help would not ask others to check essay Usually has help from the teacher⑦
Interview 2		learns from others		recognises usefulness of peer check⑧
Journal	no journal entries			
Class obs.	no essay			"chips in" with comments, distracters, not afraid to clarify impulsive behaviour/ outbursts
Essay	no essay			

- ⑥ Daniel (iv1): Because it has got a lot of information which is required for the essay, it's how I based... I know I have done right. I know what I am talking about. I can write a lot of garbage you know. It will be on the same lines, not entirely. You just know you have done, you are on right track because you have all the information you needed for what you think. It may be not be compiled right but...
- ⑦ Researcher: So in general would you be able to complete things without help from the teacher.
Daniel (iv1): No, I usually have help. I complete things with heaps of help, help from teachers. It all stems from English you know. It does help.
- ⑧ Researcher: Did you read someone else's essay?
Daniel (iv2): Yes. It helps just reading what you should be doing, it is good to know what you should be writing about and how you should be writing, what style. Some people have different styles. Some people go straight into it and other just wing around it, but overall it is about the same. You learn that by watching other people do their work and it is good.

Reflective Processes			
	Monitoring Progress	Self Questioning	Other Evidence of Reflection
Interview 1	memorising by visualisation ^① thinks as he writes ^② knows procedures but doesn't use them ^③		"If I did my work it would be a lot better. I could achieve harder than what I am."
Interview 2		implied by realisation that there might be other ideas from group discussions	discussions good because of interest and multiple viewpoints ^④ "I would be there, and try to get as much information as possible from everything. Just not being there was a real disadvantage because I didn't know the basic facts about cancer because I wasn't there." "I probably could've taken more understanding of the notes Mr S gave us like read them carefully and tried to understand them. Collected more information."
Journal	no entries		
Class obs	no evidence		
Essay	no essay		

① Researcher (iv1): There are specific ways of memorizing things. Do you use special techniques or do you just revise and revise?

Daniel (iv1): I just look at the things and like I visualize and it comes back to me, I visualize what it was like reading a book, what I have read. It's word visualization.

② Researcher: What do you do, when you have to do some research on something and write an essay? What are the steps you go through?

Daniel (iv1): Just write it down. I think about it as I write, as I think I better write that down.

Researcher: In terms of getting information, how do you do that?

Daniel: Really just off my head. I just make up a lot of grudge really. I study a bit for it, I never study anything for just information. I try and compile it in my head when I write it.

③ Researcher: So it is the key words to the question idea? That you have been taught that. But you do not use it?

Daniel: Not to the extent as I should be.

④ Daniel (iv2) : You see another person's perspective and it is pretty good. You think yours is right and then you hear other people's ideas and it makes you think different. It gives you more knowledge. Stuff that interests you, like that sort of stuff gets into your head easier like when you talk about it and try and make your point clear, it seems to stick in your head more rather than people telling you or when you are not interested. You're just writing words down [when taking notes]. You get a different point of view [from discussions] talking to them and try and make a comeback. You sort of take it in as well.

B Metamatrix for Mitchel

	Ability Perception			Perception of Essay Writing	
	"good at"	"help with"	mark prediction	easy	difficult
Interview 1	plotting ideas PE working as a team ❶	"the basic terms, just trying to remember it all." sorting	pass ❷		structure and formatting has difficulty discriminating relevant from irrelevant information ❸
Interview 2		essay structure			
Journal	"I have a better knowledge of and understanding of ethical issues"				
Class obs	working with others, (Lois)				to Lois 9/11 (co): "I don't know where to start."

- ❶ Researcher: Just in terms of, are you good at problem solving, are you good at maths or anything.
Mitchel (iv1): Physical education is my subject. Anything, working as a team, I feel. You have more than one [person], you get more ideas, talk it out and get the best answers.
- ❷ Mitchel (iv1): I am not sure. I want to get a pass, that is the main thing. I do not care if it is just over or whatever. I do not want to really fail.
- ❸ Researcher: How do you know if you have done a good essay?
Mitchel (iv1): I always think I have. When I am finished I am really impressed with it, I get the marks back and I am not really pleased. I always think I have done a really good essay.
- Researcher: So you would like to do better?
Mitchel: Yes, definitely
- Mitchel (iv2): I got myself in a bit deep, but I will try to get out of it [work to achieve].
(referring to not taking biology in year 12)

	Planning		Researching		
	plans use of strategies	planning structure for essay	uses key words or questions	summarises (own words)	multiple sources of information
Interview 1			"lot of points"		internet, books, "wherever I can get it from."
Interview 2		put into sections no written plan④	"a few questions"		newspapers, parents
Journal			identifies treatments, causes, effects		identifies need to get more information
Class obs	didn't have a strategy until checklist used				several articles
Essay		paragraphs >1 main idea	some	yes	yes but not enough facts and figures

④ Mitchel (iv2): I did that just jotting down everything that is relevant and working out what I needed and what I didn't and putting into sections.

Researcher: So you organised it into sections. How did you decide what sections to have?

Mitchel (iv2): Sort of what went with what, just depending. Like I did the breast cancer with mammograms and that comes into sort of treatment and causes.

Researcher: So how did you plan your essay, or did you plan it?

Mitchel (iv2): I just wrote it.

	Essay Writing			Seeks Help
	Structure (It flows)	Content coverage	Marks	
Interview 1				depends on subject. Yes for biology
Interview 2				asked questions of researcher in journal checklist ⑤
Journal	problems with wording and making it flow	"need more info on specific types of cancer"		
Class obs.				27/10 asked Lois to check essay without prompting asked teacher to check essay several times.
Essay	introduction, general information conclusion	2 biological 1 social 0 ethical 1 cause 1 effects 1 treatments	peer 19/40 researcher 13/40	

⑤ Researcher: You had the checklist for the essay, did you use that?

Mitchel (iv2): Once he put it up on the board and we went over what had to be in there and I worked out what I didn't have in there, which helped.

Reflective Processes			
	Monitoring Progress	Self Questioning	Other Evidence of Reflection
Interview 1	research ⑥		
Interview 2	essay writing ⑦	videos prompted questioning ⑧	"I just think because I've always had a problem writing essays that I feel that I could write quite a good essay now, in that end of year exam, this has definitely helped me."
Journal	need more info on specific types of cancer, treatments, causes, effects	2 for terminology clarification	"Still having problems with wording and making it flow." "Still amazed at the effects of asbestos". "Feeling good about the study!"
Class obs		27/10 asked Mr S for clarification ⑨	willing to rectify errors ⑩
Essay	sections		

- ⑥ Researcher: What sort of steps do you go through when you are researching a topic?
 Mitchel(iv1): Knowing what I have to do, what I have to research. Getting down a lot of points and just proofing it and putting it together.
- Researcher (j): Does using the essay checklist help you and if so how?
 Mitchel (j): Yes it does, knowing what is needed makes it easier to write, keep to the topic.
- Researcher (j): What else helped you to write the essay?
 Mitchel (j): Learning the correct layout. What is needed in each paragraph.
- ⑦ Mitchel (iv2): I did that just jotting down everything that is relevant and working out what I needed and what I didn't and putting it into sections.
- ⑧ Researcher: Fine. You have asked questions in your journal writing. Can you think of any of these things here that helped you with asking your questions or was it just things you were just thinking of?
 Mitchel (iv2): It was just things as they came up, like the effects of asbestos, the video we watched on that.
- Researcher: So the videos in fact helped you ask questions?
 Mitchel : Yes, and euthanasia. I have really learnt a lot about that, I really didn't know what it meant before this.

③27/10 (co) Mitchel asked the teacher to check whether he was “on the right track” with what he’d written.

⑩9/11 Researcher (co): Will you change what you’ve written?

Mitchel: I’ll need to link my ideas more.

Researcher: So how will you do that?

Mitchel: Read it through and sort of work out what ideas should go where.

C Metamatrix for Ann

	Ability Perception			Perception of Essay Writing	
	"good at"	"help with"	mark prediction	easy	difficult
Interview 1	recall, "finding out things for yourself"	remembering	C		remembering the main points and connecting them up, making it flow.
Interview 2				When the teacher explained the question	essay checklist helped understand the question ①
Journal		understanding the question		when question understood and having the research to back you up	"I have trouble understanding what the question is actually asking."
Class obs	confident in answering teacher questions			worked independently	

① Ann (iv2): Well with having a checklist you can just go through and you make sure you know what you have got and it helps with understanding the questions.

	Planning		Researching		
	plans use of strategies	planning structure for essay	uses key words or questions	summarises (own words)	multiple sources of information
Interview 1		links main points	uses both key words and key questions main points		
Interview 2	Intention to act on teachers feedback	flow chart would be a good idea pre-write useful	named key words	used "notes on notes"	used brainstorm, peer essay, videos
Journal		wrote headings for sections			"I have read most of the resources"
Class obs				worked independently	used multiple written resources
Essay		good logical order	key words obvious		

- Researcher: Now, what will you do to help you when you get your essay back from Mr. S, obviously he will put comments on it, what will you do with them?
- Ann (iv2): Well I will read through and see what he said and then see how I can improve it, probably write another one, because I wrote two instead of one, I did that in all my subjects. It is just good practice.
- Ann (iv2) : Well I tried key words. I tried to make sure that I had words like say metastasis and like the later stage and I things like that I made sure that the biological things were in there. So the person marking will know that I know stuff.
- Ann (iv2) : Learning to take notes on notes because usually I just write everything down.... but if you've just got a little bit [of notes] you tend to memorize it a bit better, so that was good.

	Essay Writing			Seeks Help
	Structure (It flows)	Content coverage	Marks	
Interview 1	main points should link			from friends
Interview 2	summarises question, orders ideas⑤	used prior knowledge⑥ included <i>human rights</i>	marking schedule helped⑦	peer check ⑤
Journal		need to learn more facts		doing practice essay and marked the way examiners mark
Class obs.	listens to instructions carefully	logical, able to reason		
Essay	follows instructions on checklist	2 essays biological 3 social 1 ethical 2 causes 2 effects 0 treatments 0	18/40 first essay	

- ⑤ Ann (iv2): Well I read through the question first and then I summarized the question again at the beginning of the paragraph, sort of like my introduction, because if I summarize it, then re-word it then I can definitely make sure that I can understand it, then from there I go back and see the order it is in or how it flows. I just put them flowing onto each other, like the biological, I had that going after the causes and then for the social and ethical, they kind of go together.
- ⑥ Ann (iv2): I would write what I already knew in that bit there, so when we got the final question I had half of it rewritten.
- ⑦ Ann (iv2): It helped to realize what you have to be, how many marks are allocated to that, so how much you should go into depth and write about it.

- ⑤ Ann (iv2): Well you can see where other people go wrong and you can make sure that you don't do the same things, and you get a few ideas on how it is structured, because I read Marianne's and hers is really good. Hers was structured really well and she had good key words and stuff like that. From reading that you could see that she actually knew quite a lot.

Reflective Processes			
	Monitoring Progress	Self Questioning	Other Evidence of Reflection
Interview 1			
Interview 2	used essay checklist used brainstorm ^①	prompted by ethical issues ^②	discussions helped gain information and clarify opinion ^③
Journal	checklist ^④ marking schedule ^⑤ linked to intention to "cover everything"	3 clarification of content statements	"I've now started to do some research, which I find incredible interesting and useful" marking to schedule "then you know exactly where you have gone wrong".
Class obs	checks essay with checklist		
Essay	Key words evident		

- ① Ann (iv2): It was really good to have a brainstorm to see what we already knew and then see what we can pick up from it and its good because we have still got the brainstorm and I can see what I have already learnt.
- ② Ann (iv2): Mainly just the ethical issues really. What it would be like for you and your family and things like that. You realize that you shouldn't really judge. I find it really hard to write about, so I just put my opinion down for it.
- ③ Ann (iv2): Yes they gave you more information and just helped with the general background and stuff. Helped to make my own conclusions about it, my own opinions and stuff.
- ④ Ann (j): The essay checklist helps as I want to know all the possible things in the essay which we may get. I want to cover everything.
- ⑤ Ann (j): Having a marking schedule is the best help with writing an essay. You then know how much depth to go into each attribute and the importance of it in relation to the rest of the essay.

D Metamatrix for Charlie

	Ability Perception			Perception of Essay Writing	
	"good at"	"help with"	mark prediction	easy	difficult
Interview 1	memorising ❶ problem solving essays		not sure luck	✓	
Interview 2	memorising essays		good mark if plan ❷	✓	
Journal	"learat lots about what cancer is- know about metastasis, oncogenes and carcinogens"	finding statistics more content on biological issues			"overload on things that cause cancer! Should be kept to the basics."
Class obs				"Yep, I found it really easy"	

- ❶ Charlie (iv1): Instead of trying to memorise words and stuff, I a'ways memorise bits, even if it's just,.... it is really strange,.. like if I have my book and I write in it and if there is a picture I can always remember the picture and if I can remember the picture and I can usually remember the words about it.
- ❷ Charlie (iv2): You can have a plan and do exactly what you have been asked you will definitely get high marks.

	Planning		Researching		
	plans use of strategies	planning structure for essay	uses key words or questions ③	summarises (own words)	multiple sources of information
Interview 1	no	Prior knowledge from geography ④	no	no, just memorises it	own knowledge books
Interview 2	not written, perception of lack of time	Plans in his head ④		yes	
Journal			yes		
Class obs	writes in journal frequently		yes		yes
Essay	by paragraph (causes/treatments)		yes definitions included	in logical order	collated reasoned explanations

- ③ Charlie (iv1): I don't know. Being drilled in my mind, since the third form. I think geography was the place I learnt to do essays.
- ④ Charlie (iv2): I can show you, like in my essay, this is just the way it works out in my head. You have a flow chart, the opening and in that you introduce the question and then you have main point number one and I think on my one it was about carcinogens, you talk about cancer and then there are two types of carcinogens and I put for example the first type of carcinogens and then I talked about lung cancer, that was my example.... and then the other question was talking about the social/ethical, I just stuffed them all in one paragraph I think, and then conclusion. So that is why I don't I plan it, I just remember it.
- ⑤ Researcher (iv1): What did they teach you?
- Charlie (iv1): They had these little sayings [mnemonics], you had to remember sex, that meant summary, explanation, example and there was another one g or something - generalisation as an example, sort of things like that. And then in english you learn to do an introduction, lead up by three or four main points and then you summarise and conclude. That sort of thing.

	Essay Writing			Seeks Help
	Structure	Content coverage	Marks	
Interview 1	"no waffle"			no
Interview 2	paragraphs GEE	checked with question	know what you missed	peer check helped
Journal	"need to learn more figures (stats) "	identifies what he knows and doesn't know	"It was good to practice essays"	responds to feedback
Class obs.		often works independently		independent, focussed on task statistics from teacher source keen for feedback on journal Read comments straight away
Essay	Divided causes and effects GEE	4 biological 1 social 1 ethical 4 causes 4 effects 4 treatment interprets and explains meaning	peer 33/40 teacher 30/40 researcher 32/40	

⑥ Charie (iv1): Usually I find if I cannot understand something, I will try and find it out by myself because if someone tells me I do not think I will really understand so I try and really research it and try and understand.

Reflective Processes			
	Monitoring Progress	Self-questioning	Other Evidence of Reflection
Interview 1	relates to question		equates achievement with effort ⑥
Interview 2	practised writing check against marking schedule ⑥	I had so many questions about cancer. I found them out as well Prompters useful for thinking of questions and about cancer	more peer checks, more practice, check it against the marking schedule
Journal	9/11 need more info on biological issues	3 content 2 extension	28/10 Evaluates lesson usefulness ⑥ Evaluates that he has heaps on social and ethical ideas, needs more on biological
Class obs	self checking against marking schedule and other people's essays during writing process		Not prepared to make changes after peer check. Consideration about effort for relative gain. ⑦
Essay	addresses part of essay question	answered question about telemere question about rights euthanasia ⑦ recognised ambiguity	Linked telemere fuse length and immortality. "Cancer could ironically be the key to immortality!"

- ⑥ Charlie (iv2) : [pre- writing paragraphs] That was good because I found the first paragraph I wrote was really bad, I think the more practice I did the better I got. I think practicing was the best thing to do with this cancer essay and the more practice I do the better I get.
- ⑦ Researcher: Just thinking too about the whole thing to do with cancer and ethics and social stuff, can you think of things that made you ask yourself some questions about it? Things that you haven't thought of before?
- Charlie (iv2): Yes it did. I had so many questions about cancer. I found them out as well. I found out about telemeres. I thought they were really interesting and I learnt one of my questions that I wanted to know was, if plant cells get cancer as well and I found out that they do, that it doesn't usually kill plants and I think insects can induce cancer in a plant, I though that was quite strange.

- Charlie (j): I would like to know more about cancer in plant cells - do they get cancer? If so, do they get it as frequently as in humans? Doesn't this cancer information go against our natural selection theory? Wouldn't mutations become cancerous and die? Do all carcinogens have the same sort of affect on plant cells as they do on humans? Doesn't this cancer information go against our natural selection theory? i.e. wouldn't mutations become cancerous and die?
- Charlie (e): Biological conflicts arise in all facets of the disease. For instance, some biologists believe that cancer is a natural aspect of all animals and that finding a cure is futile. Other biologists believe that resourcing cancer research could lead to the key to immortality. Cancer could ironically be the key to immortality.
- ⑧ Charlie (iv2): It is probably because I was, like in the fifth form, I sort of, I was good in maths up to the fourth form, then I was told I wouldn't pass School Certificate english because I was really bad. I took some of that knowledge in maths and sort of spent more time on english, so then my maths went down and I sort of enjoyed my english more. I just put more effort into that. Probably the main reason.
- ⑨28/10 Charlie (j): [Feedback on paragraphs was] Not very successful period- cor'd have been better utilised. Common sense stuff.
- ⑩ 9/11 Researcher (co): So have you written down any comments [from the peer check] ?
- Charlie (co): Oh we just talked to each other. I can remember them.
- Researcher: So what will you change before you hand it in to Mr. S?
- Charlie: Nothing, I don't think I'll change anything.
- Researcher: What about including some other ideas?
- Charlie: Maybe, I can't be bothered. It's too much effort, I've already written this.

E Metamatrix for Liz

	Ability Perception			Perception of Essay Writing	
	"good at"	"help with"	mark prediction	easy	difficult
Interview 1	listening discussions ^① dictation	the formula for writing essays ^②	60		trouble linking ideas and connecting the introduction to the main body of the essay.
Interview 2	links mark with effort		motivated by marks ^③		unpacking the question "I've done them but I haven't done them properly. This is the first year I've had real help"
Journal		identifies gaps in information			
Class obs	confident in classroom discussions (gives examples)				

- ① Researcher: So in terms of thinking about how you learn, what are you good at?
Liz (iv1): Not essays. I'm probably better at listening and taking stuff in than reading stuff and then regurgitating it. But I am better at regurgitation than thinking for myself.
- Liz (iv1): I work well with discussions because I work well with bouncing ideas off other people. Dictation, that works well because I can take my own notes.
- ② Liz (iv1): I am not any good at writing essays but I've got better as I have had to write essays in the last few weeks. But I think it is probably because I have never really written essays [the way] that you are supposed to. I have just written, not with any formula, I need help with the formula of essays. And I have to unpack the question, which I find hard usually unless I'm told exactly what to unpack.
- ③ Liz (iv2): I've had to get better because I have to get those marks in bursary. Before this year, I hadn't really tried. From 6th to 7th form was a huge jump. Like last year we didn't have to write an essay in 6th form Biology.

	Planning		Researching		
	plans use of strategies	planning structure for essay	uses key words or questions	summarises (own words)	multiple sources of information
Interview 1			key points	key sentences ^⑤ aware of T & T ^⑥	
Interview 2		kind of ^④	No, it doesn't help		
Journal	Identifies content needs		14 questions		
Class obs					
Essay		good structure	Questions answered in essay	Summary statements followed by examples	Used own opinions

④ Researcher: What about planning your essay overall, how did you do that or did you do that?

Liz (iv2): Kind of. I started to plan it but then I ended up just writing it. I thought it was a lot easier.

⑤ Liz (iv2): I have been doing it for a while. I usually need a bit more than just a few key words. I need key sentences.

⑥ Researcher: What about the Trash and Treasure activity?

Liz (iv2): I was kind of already aware of that. Sometimes I blindly copy. Sometimes it's better when people dictate notes but when you have them on an overhead, you tend to copy everything. He's told us during the year not to write down everything, and gives us a choice.

	Essay Writing			Seeks Help
	Structure (It flows)	Content coverage	M arks	
Interview 1	trouble linking ideas			yes
Interview 2	"I've done a lot better this year because they've (teachers) explained it better			"Mr. S. said you have to do this and this"
Journal		Recorded new information from discussions		
Class obs.				21/10 seeks clarification of cell structure pictures (linked to journal question "what do cancer cells look like?") 27/10 Willing to take risks to clarify understanding. contributes to teachers questions
Essay	essay 1:10/10 essay 2: 7/10	essay 1:22/30 essay 2: 15/30	essay 1: 32/40 essay 2: 22/40	

Reflective Processes			
	Monitoring Progress	Self Questioning	Other Evidence of Reflection
Interview 1	Choice of using strategy, see summarising		hypothesises that motivation may be an issue ^⑦ Independence: I am better at figuring stuff out for myself.
Interview 2	links what's needed with question ^⑧ I know when I know it ^⑨ Teacher feedback ^⑩	checks for relevancy in essay ^⑪ thinks about what to include in essay "Nothing specifically, not enlightened on something. When some information came up, it made me think in terms of the essay."	"It gets easier the more you write." "I kind of found it hard to write in my own journal. The things I asked weren't really important. I didn't really care about the answers. The prompters weren't useful." "I think I'm a bit too reliant on my own brain. I think oh, I'll remember that, so I don't write it down. It would be better for me to write things down. I've got to organize my time better. If it was part of internal assessment it would be more motivating."
Journal	4 separate entries of things learnt today	14 questions answered 2 in journal	"I believe the most effective way to prevent cancers is to educate people especially against smoking. Encourage exercise, use of sunscreen etc. raise awareness especially in young children & make the problem seem more urgent."
Class obs	Never used a journal before	asked teacher content questions she was wondering about	
Essay		recognised ambiguity answered questions about where cancer can form and about range of treatments	

⑦ Researcher: But you said you take things in by listening?
Liz (iv1) : Listening as well because I can remember heaps of what Mr S said about bumble bees and stuff, irrelevant stuff. Maybe it is just that it is interesting. And I remember a lot when he tells me stuff, I know it is the same in chemistry. I remember it heaps better than if I just have to learn it myself. Maybe it is just lack of motivation. I don't know.

⑧ Liz (iv1) : I just read it and picked out bits that went for one of the headings of the questions.

⑨ Liz (iv1): I'm not really a marks orientated person. I know when I know it and that's good enough for me.

⑩ Researcher: How do you know if you've written a good essay?

Liz (iv1): I've done it! [completed it]...it used to be... now I check over it.

Researcher: What sort of things [do you check for]?

Liz : Just that I keep it relevant, don't go off on a tangent.

Appendix 11 Student Research Guide

Guidelines for Contemporary Biological Issues Essay

You are to investigate a contemporary biological issue and make informed judgements on any social, ethical, or environmental implications.

The issue we will consider is the bioethics of cancer management. Your assessment task will be write an essay in the UB examination.

The skills you would find useful to study this section include:

Reading skills (eg. SQ3R)
Note taking skills
Researching skills
Writing skills
Essay writing skills

Strategies you can use include:

Planning
Monitoring
Asking questions
Checking and revising

Self-directed learning will require you to be able to identify your own particular learning needs select and use learning resources that work for you and evaluate your own learning.

In other words you must **think critically and think independently.**
This does not preclude working collaboratively and cooperating in groups.

As a starting point we need to find out (a) what we need to know
(b) what we already know (eg. brainstorm session).

Researching involves about 5 steps:

1. Analyse
2. Find
3. Use
4. Take notes
5. Organise

[AFUTO = A Funny Unicorn Took Opium!]

- 1. Analyse** Be sure what you are required to do. Don't wander off the topic.
Examine the question carefully - what is being asked? What is not clear to you?

What approach is required? There is a difference between "discuss", "compare", "describe".

Now apply this information you've had so far and start your study of this section of work. Af you have completed your analysis you should have a 'shopping list' of items you will need to research information on. (Also put a brief comment in your log).

2. Find - Information can be sourced from a variety of places. 6 potential sources are:

3. Use - Consider others when using resources - you are not competing with your class members, you can all pass the exam! Sharing and booking of resources may be necessary.

4. Take notes - First you will have to read the information.

Note taking

- * Wait! Don't rush into writing things down. Have a clear purpose. Write down only what you understand.
 - * Identify sources by jotting down the book name and the page number.
 - * Space your notes out so you can poke bits in later. The column system works well.
 - * Start mind maps in the middle of the page.
 - * Key points only - keep notes brief - most students take too many notes with irrelevant information. Always refer back to the required topic or task.
 - * Depending on what type of mind you have, you may prefer lists, mind maps or spider-grams.
 - * Interact or personalise your notes with colour, doodles or diagrams. Any triggers that help you to recognise a page will help. Write in your own opinions.
- 5. Organise** your notes in a file. You will collect various pieces of information that will need to be collated. Be quite strict on this! Many students spend time and effort on extracting good material but then lose it.

Slow and repetitive reading is necessary to understand and critically evaluate the information. What is the writer's viewpoint?

The SQ3R method

- * **Survey:** You first gain a general impression of the book by looking at the contents page, preface and introduction.
- * **Question:** Before reading the section, ask yourself why you are reading it - what is the purpose?
- * **Read:** Don't make notes or underline as you read. Do this only after you have understood a passage.
- * **Recall:** Go over what you have read by either orally summarising what you read or by taking notes. Recall immediately after reading greatly assists memory. Recalling checks information is going in, being stored, and can be retrieved. Don't stop to recall after each paragraph - it interrupts your reading flow.
- * **Review:** Go over your reading material soon after first learning - it helps to ensure memory traces are deepened into long term memory. Review within 24 hours.

Appendix 12 Trash and Treasure - note taking strategy

**From Big Six lesson Plans- <http://ericir.syr.edu/big6/bigsix.html>
Jansen, B bjansen@tenet.edu**

A researcher must dig to find words to help answer the questions (treasure) and toss aside unnecessary sentences, phrases, words, ideas as trash because they do not answer the questions and therefore are unimportant in this context.

Teacher Instructions

1. Demonstrate the method using an OHP and transparency of a paragraph of information on the topic. Give the students a copy of the article.
2. Show a prepared question, including the underlined keywords and list of related words.
3. Scan the article until the appropriate heading is located.
4. Place a slash at the end of the first sentence and read it. Ask "Does this sentence answer the question?"
5. If the answer is no, tell the students that that sentence is trash to them. Go on to the next sentence placing a slash at the end of it.
6. If the answer is yes, underline the first phrase and ask if that phrase answers the question. If the answer is no, underline the next phrase and repeat the question.
7. If the answer is yes, read that phrase word by word, asking which words are needed to answer the question. They are treasure words and are written as notes
8. Carry on until the text is finished. Students are impressed when they see how little they have to write.

Example of "Trash and Treasure"

Questions on Genetic Screening for Cancer genes

Focussing questions

1. What are the **advantages** of being screened for the breast cancer gene BRCA1?
2. **Why** do women who are tested need **counselling**?
3. What are the **implications** for a person who is **tested** to be **positive** for the gene?
4. What are the **implications** if the test is **negative**?

Read through the following information and decide what information to "trash" and what to "treasure". Keep the treasure by writing it down.

Alterations to the gene BRAC1 have been linked with breast and ovarian cancer. BRAC1 is a tumour suppressor gene. Tumour suppressors are genes that control cell growth. When enough cells in a particular area have grown, the tumour suppressors tell the cells to stop growing. When these genes don't work properly, as in the case of mutated BRAC1 genes, the signal to stop growing is not always given, and growth continues out of control, and tumours result.

To test for a BRAC1 mutation, a blood sample is taken, and a specific alteration on chromosome 17q21 is sought. 5% of women with breast cancer are thought to have this particular mutation.

Genetic testing is a great advancement as early detection could ultimately prolong and save lives, however it could also risk havoc if the information is misused or misunderstood. When a women discovers that she carries the gene, her potions are not great. She has to make a choice. Should she simply monitor her health? In the case of ovarian cancer this may not be enough as often times symptoms do not appear until it is too late. Some women choose to have a preventative mastectomy or hysterectomy as they feel there is no other alternative after learning of their possible fate.

People deal with stress in different ways. Some people become devastated. This may lead to anxiety attacks, depression or even heart disease. Some people, even in the absence of being able to alter outcomes find information of this sort beneficial... the more they know, the more their anxiety level goes down. But there are others who cope by avoiding, who would rather stay hopeful and optimistic and not have the unanswered answered. Some people feel they would have more control over their health if they knew they inherited a defective gene. Some women might choose to have their children early in life and then proceed with a hysterectomy. And others feel they simply could not adjust to a positive test result.

Consider the scenario that your sister tests positive for the gene, would you recommend to her that she have her breasts removed? This is a difficult dilemma for a family to face.

This type of testing can have enormous implications on future employment or health and life insurance eligibility. Suppose a person learns that they have a predisposition to cancer, would they be forced to inform their employers and insurers about the test results? Potential employers may hold this information against you and not offer you the job. If insurance companies were given this information premiums would increase for those at risk and life insurance may be denied.

There are also implications should a person test negative as this result may lead to complacency. A women might decide not to monitor her health carefully, neglecting the early detection practices such as self- exam and mammography feeling that she is safe from this cancer. Complacency would be especially harmful if the test results are actually a false negative.

Euthanasia



Euthanasia is not a new topic. Discussions about intentionally ending the lives of patients can be traced back to at least ancient Greece and Rome. But the intensity of the debate in many countries has increased in recent years.

It is not the intention of this resource to promote any one view, but to assist people to clarify what they think and to be aware of the different understandings and arguments that are used. Our hope is that this resource will contribute to a more informed public debate, one which will involve people from many different groups in New Zealand.

Euthanasia can be an act of caring.

Some people argue that, in some situations, doctors causing the death of a patient, is not harming them but caring for them. Some people spend their final days in delirium and agony. Linger in such a state can be extremely harmful to the patient and family and friends. Some people firmly believe that

5. CURRENT PRACTICES AND TRENDS IN NZ

I/we will begin this section by talking about what is possible under New Zealand law.

1. Right to refuse treatment

Everyone in New Zealand has the right to refuse any medical treatment under section 11 of the Bill of Rights Act, 1990. This section states that "everyone has the right to refuse to undergo any medical treatment".

There are certain acts which have the power to limit this right. For example, people can be forcibly treated under the Mental Health Act, 1992 and the Infectious Diseases Act. Furthermore, in some cases children are made wards of the court if their parent/s refuse to give proxy consent for the child to undergo certain medical procedures.

However, in most situations, section 11 of the Bill of Rights Act applies without restriction.

4. Advance directives (living wills)

The report also suggests that new laws be introduced that allow people, while in good health, to make advance decisions about their treatment if they were to ever be in such a situation. For example, if a person was to go into a persistent vegetative state, an advance directive would assist health professionals to be aware of the wishes of the patient. The suggestions regarding living wills, contained in the report, do not include provision for active euthanasia.

VI. RELIGIOUS AND SPIRITUAL ARGUMENTS

Some of the strongest objections to euthanasia are based on religious and spiritual grounds.

ARGUMENTS:

1. Life is a gift:

Some people believe that life is given by "God". As humans, we are not permitted to take that away. God gave life and he shall also take it away. Life is similar to a gift which God has given every living human being. We should accept it with gratitude. Gratitude does not include destroying that which we have been given.

Appendix 14 Ethical considerations from Instruments on Human Rights

Prevention regulations

Industry resource consent - disposing of chemicals/ health requirements

Guardianship Act: State enforces treatment/ consent?

Confidentiality: Medical practitioners Act

(patients best interests/ confidentiality)

Euthanasia: Crimes Act (1961) Assisting suicide

(permanent vegetative state)

(withdrawal of fluids, large doses of morphine)

User pays: cigarette tax, alcohol tax, industry tariffs

Transplant issues - Human Tissues Act: use of remains of the dead / consent

donors- lack of

cloning organs/ xenotransplantation

gene therapy

Abortion : as a result of foetal screening

Profit v's health care issues (who decides?)

Alternative medicines (who's values?)

Animal Testing for new drugs/ treatments

International Instruments on Human Rights

1. Human dignity and worth must be respected
2. Equality before the law
3. Protection of rights of vulnerable individuals
4. Free consent before subjected to medical or scientific experimentation
5. The right to have the highest attainable physical and mental health
6. Protection against interference with privacy
7. The right to enjoy the benefits of scientific progress.
8. Freedom for scientific research

Experimental subjects need both full and fair explanation of the procedures, and honest information about the relative balance between research interest and therapeutic prospects.