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ABSTRACT

This research reports on interpretive and cognitive approaches that were used in a unit of work with a final year high school biology class. The aim of the intervention was to promote students' awareness and communication of the biological, social, and ethical issues associated with cancer. Students were encouraged to use an inquiry approach. They were also provided with opportunities to engage in open and critical discourses and develop independent learning skills through metacognitive behaviors. The students', teachers', and researcher's perspectives on aspects of the unit of work and learning were used to evaluate the approaches used. Small group discussions and peer checking of essay drafts, as well as reflective journal writing, were perceived by students to have developed their thinking about cancer issues. Some students reported that making the skills explicit for researching and writing their essays was very useful in the inquiry process. This investigation indicates that students must have procedural knowledge and be motivated to use it in order to enable more effective learning. Bioethical contexts explore the ethical issues and decision-making associated with the use of living organisms and medicine (Macer, 1994). In countries such as New Zealand, where there is strong economic reliance on biotechnologies, science curricula now include biotechnology. The associated ethics and social responsibilities linked with the use of new technologies are being seriously questioned by society (Van Rooy, 1994). This is reflected in "Biology in the New Zealand Curriculum" (Ministry of Education, 1994) where the aim of including bioethical issues is to provide opportunities for students to be prepared to respond to issues in adult life by giving them experience in discussing personal, social, and ethical aspects (Conner, in press). In a democratic society, where citizens are expected to be able to make autonomous decisions, the impacts of technology on society need to be explored and elaborated, so that a culture of informed citizenry develops (Solomon, 1993). (Contains 26 references.) (Author/ASK)

Inquiry, Discourse and Metacognition: Promoting students' learning in a bioethical context

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Abstract

This research reports on interpretive and cognitive approaches that were used in a unit of work with a final year high school biology class. The aim of the intervention was to promote students' awareness and communication of the biological, social and ethical issues associated with cancer. Students were encouraged to use an inquiry approach. They were also provided with opportunities to engage in open and critical discourses and develop independent learning skills through metacognitive behaviours. The students', teachers' and the researcher's perspectives on aspects of the unit of work and learning are used to evaluate the approaches used. Small group discussions and peer checking of essay drafts, as well as reflective journal writing, were perceived by students to have developed their thinking about cancer issues. Some students reported that making the skills explicit for researching and writing their essays was very useful in the inquiry process. This investigation indicates that students must have procedural knowledge and be motivated to use it in order to enable more effective learning.

Bioethical contexts explore the ethical issues and decision-making associated with the use of living organisms and medicine (Macer, 1994). In countries such as New Zealand, where there is strong economic reliance on biotechnologies, science curricula now include biotechnology. The associated ethics and social responsibilities linked with the use of new technologies are being seriously questioned by society (Van Rooy, 1994). This is reflected in *Biology in the New Zealand Curriculum* (Ministry of Education, 1994) where the aim of including bioethical issues is to provide opportunities for students to be prepared to respond to issues in adult life by giving them experience in discussing personal, social and ethical aspects (Conner, *in press*). In a democratic society, where citizens are expected to be able to make autonomous decisions, the impacts of technology on society need to be explored and elaborated, so that a culture of informed citizenry develops (Solomon, 1993).

The role of inquiry, discourse and metacognition when learning in bioethical contexts.

Students will already have some background knowledge of the use of the technologies they may be studying. More importantly, they will also have notions about what we ought to do socially or ethically to deal with issues that arise from the use of these technologies. In a constructivist approach to teaching and learning, these ideas need to be clarified for students as well as their teachers (Osborne & Freyberg, 1985). Establishing what students already know can be done through the use of brainstorms, discussions or other written methods. Students can develop their ideas through an inquiry approach which encourages them to investigate/research the relevant content material, including notes provided by the teacher (Blakey & Spence, 1990; Evans & McCann, 1993, Jarvis *et al.*, 1998). Exploring students' beliefs or feelings can be done through the approaches of values clarification and values analysis (Conner, 1999). For example the use of video accounts of what it is like to have

cancer or a relative with cancer, case studies or requiring students to make a decision or judgement as part of a learning activity, creates opportunities for students to consider issues from multiple perspectives.

Discussion of the personal, social and ethical issues is important for enabling students to clarify their views and scaffold their ideas about controversial issues (Geddis, 1991). In order to delve into the underlying issues in depth, Dawson & Taylor (1998) and Van Rooy (1993) advocate that the classroom environment should allow open discourse in which students' beliefs can be articulated, disclosed and examined non-judgementally. Lipman's comments about an effective community of inquiry illustrate how discourse can promote reasoning.

> It is of equal importance that children learn to reason together with their peers, for the only way to deal effectively with peer pressure is not to engage in futile efforts to eliminate it, but to endeavour to make it rational, and this can be done by converting the classroom into a reasoning community (Lipman, 1987, p141).

Students not only need a "sounding board" for their ideas to clarify them, but also need to hear and critically consider what their peers think so that they become aware of alternative ideas. Discussion can also reveal that mostly there are no "clearly correct" answers when it comes to ethical thinking. Discussion methods build on the principles of participatory, active learning.

The role of the teacher in facilitating the classroom environment which will allow open, non-judgemental discussions is vital. The ideas of 'objectivity, balance, and neutrality', often employed in discussing controversial issues in biology are linked to the role of the teacher being a facilitator rather than having an authority role and are consistent with the pre-requisites for reflective and self-regulated learning to occur (Conner, 1999). The ability to listen and discuss respectively with those who hold views different from our own is a valuable skill. Discussions using issues provide students with opportunities to develop respectful disagreement. In order to establish this culture, teachers need to model mutual respect, otherwise discussions may reflect closed mindedness, power structures or egomanical grandstanding.

It has been stated that ethical contexts can be used for stimulating

> 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, p146).

The analysis of issues in bioethical contexts is controversial and is related to an individual's feelings and beliefs. Each student is required to clarify and evaluate 'What do I think'? Bioethical contexts therefore provide dilemmas which tap into students' reflection on their thinking. Because of this, bioethical contexts could also provide a "way in" for students to reflect on and enhance their own learning skills.

Enhancement of learning can occur if students use metacognitive processes ie. they know, monitor and control their own learning (White & Gunstone, 1989).
Good learners have been shown to be metacognitively adept and poor ones metacognitively deficient in how they tackle learning tasks in most subjects (Gunstone, 1994; Shuell, 1988; Wang & Peverly, 1986). Baird & White (1982) have shown that if students are aware of the nature and processes of their own learning, they are more likely to be successful. In theory, using metacognitive approaches to learning should encourage students to develop their abilities as self-regulated learners (Winne, 1996).

Purpose of the investigation

The purpose of this study was to investigate the students' and teacher's perceptions of the learning activities used in a unit of work in a New Zealand co-educational year 13 biology classroom (final year of secondary school). In particular, the areas of inquiry, discourse and metacognition were targeted in both the unit and the research for reasons set out in the introductory section.

Biology in the New Zealand Curriculum (Ministry of Education, 1994) requires year 13 students to *investigate contemporary biological issues and make informed judgements on any social, ethical, or environmental implications* (Achievement Objective 8.3a). This learning is formally assessed in the end of year University Bursary Examination where students are required to write an essay (worth 20%) of about 500 words on a contemporary biological issue. 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 school selected for investigation chose cancer issues as its context because it is an area of personal relevance to the students and is well supported by 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 genetic screening, the choices of who to treat and how to treat cancer patients, the financial costs involved and the resultant preventative treatments (including surgery), euthanasia and the personal, family and social implications of all of these.

From my own observations of classes that I have taught at year 13, and through consultation with other teachers of senior biology, I was aware that the students in this class being studied would not only need help with researching and writing skills, but they would also need more than just encouragement to enable them to articulate their ideas about bioethics. Fortunately for teachers, there are many useful ideas for helping students to think about bioethics provided by the models of values clarification and values analysis (Conner, 1999). It has also been suggested that pedagogy in socio-scientific issues needs to allow students to integrate a knowledge of the physical world and a knowledge of the social world (social regulation and social organisation) (Flemming, 1986). Clearly in this unit, ways were needed to encourage students to articulate their opinions and be reflective on their own and others' beliefs. So one aspect of this research was centered in the question,

"What methods and techniques would allow students to be more open to others' ideas (listening, cooperating) and be more reflective on their ideas and on their learning?"

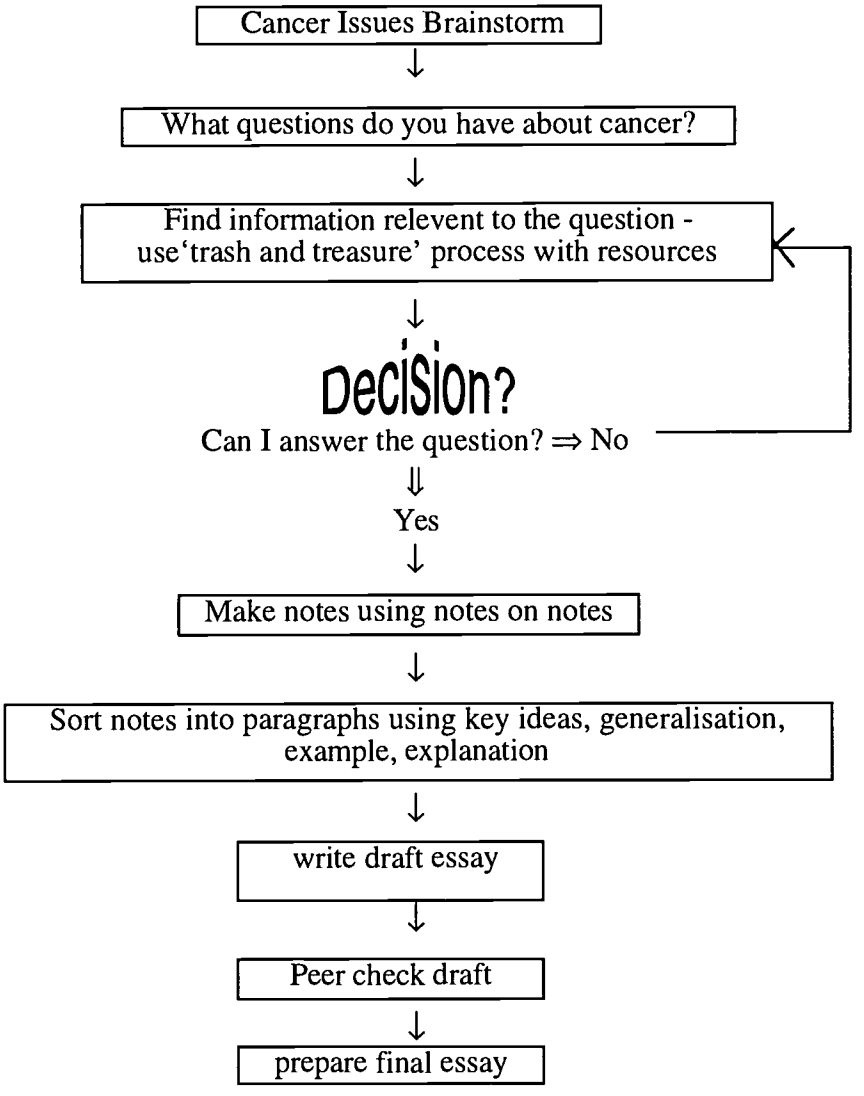
The teaching approaches and strategies used in the unit of work to address these issues were planned by the classroom teacher and researcher together. They are based on a social constructivist model of learning which incorporated activities to promote students' metacognition. In order for effective implementation of these approaches, the teacher is required to act as a facilitator by encouraging students to plan their own agendas and choose what and how they learn. This requires the maintenance of a classroom environment where the relationships between the teacher and students and among students are open and egalitarian.

Description of the unit

The usual class teacher continued to teach the class. The curriculum followed was that prescribed by the official national curriculum document. The stages of the classroom inquiry process outlined by Lane Clark (Keown and Crocker, 1996, p14) were followed and the steps involved in this unit of work are outlined in Fig 1. In this unit, students were provided with structured opportunities to develop skills useful for inquiry : using key words, key questions, how to sort relevant from irrelevant information and note making ('Trash and Treasure'). These strategies, along with those mentioned in the metacognition section below were viewed as tools to help students be more self-regulated in their learning.

Inquiry

Fig. 1 Steps in investigating cancer issues



On previous occasions, students had been instructed to make notes only on important points, but many admitted that this meant they still copied a source word for word. This was the first

time these students had been shown an activity using a common source of information, that illustrated how you could use some key questions, sift through some text information sentence by sentence, discard most of it ('trash'), and simply write down the answers to the question ('treasure').

Students were provided with background research materials from the NZ Cancer Society, texts and scientific journals. They were expected to use 'Trash and Treasure' as well as identifying key words, key questions and using prompter statements issued with their journals (see below) to help them make notes from which they could construct their essays.

There were three more 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 details about the incidence, treatment and prevention of two types of cancer individually from the resource materials provided.

Discourse

Since discourse is an integral part of enabling students to clarify their views and scaffold their ideas about controversial issues (Geddis, 1991) opportunities were created for informal small group and whole class discussions during the unit of work. Spontaneous discussions were prompted via teacher and student questioning. The ideas of values clarification and values analysis were incorporated into activities such as a card continuum exercise where students had to work together in groups to rank types of cancer according to their preventability. Other discussions were on the issues of genetic screening, cancer treatment, euthanasia and human rights. Three videos were shown at different stages of the unit and discussed afterwards. They were "Cancer: Beating the odds" - 4 case studies of New Zealanders with cancer, "Cancer: the facts" - Royal Prince Albert Hospital and "Genetics: a popular guide to the principles of human heredity" - Westmead Neurological Society, Australia. The first video prompted the most discussion due to it's personal nature. All of the discussions provided forums for students to voice their opinions and hear the opinions of others.

Strategies used to enhance metacognition

The teacher acted as a facilitator by assisting students in their planning, monitoring and evaluation. Written guidelines for planning research and for writing essays were given. 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 given notebooks to use as personal journals with prompter statements on bookmarks, to record their thinking. The prompts 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 also emphasised several times during the unit, that their journals were to be viewed as thinking records ie. a place where they could create a record of their ideas. The teacher and the researcher encouraged the students to write questions into their notebooks as a guide for their research. The teacher also went through a specific checklist of features of an essay. Completed draft essays were checked by peers to allow the sharing of ideas about what could be written and how ideas could be organised and presented.

Data Sources and Analysis

An interpretive case study of 16 students was used as part of a broader study of the year 13 biology class. I acted as a participant observer (Gold, 1958) and was well known to the students, since I had been a teacher in the recent past at the school chosen for investigation. I had also taught 13 of the 16 students who were willing to take part in the study in previous years, so it was natural to act as a support person by answering questions and prompting students during class work sessions.

Data to assess the learning and thinking were gathered throughout the unit and were collected in a number of ways. The brainstorm sheets produced at the beginning of the unit were photocopied and given back to students. Class discussions and some small group discussions were tape recorded. A record of who took part in the oral discussion parts of most sessions was kept. I collected in journals at the end of most lessons and wrote comments or questions in them. The idea of giving students feedback in this way was to encourage and promote greater usage and indicate the importance of the journals. Statements, or questions in the journals which suggested learning were recorded.The learning of each student was assessed during the unit using observations of classroom work and more formally by analysis of summary paragraphs and draft essays. The essays were marked both by peers and the teacher according to a marking schedule that had been negotiated between the students and the teacher.

At the end of the unit the teacher and 15 students were interviewed to survey their views on what had been gained from the unit and what they thought about the approach to the unit. A summary list of activities in the unit was used to stimulate recall. The interviews were semi-structured but open in that an integral part of these interviews was the elaboration of responses prompted by probing questions. The probing was used to help determine the underlying reasoning used by subjects. The interviews were recorded and transcribed. Students' and the teacher's comments were grouped according to specific activities and general comments about the approach. Sample comments about critical aspects of the approach presented below, exemplify the range of responses. Where appropriate, contextual clues for these comments are given in italics. It should be noted that not all students commented on every activity.

Utilising Guba and Lincoln's (1989) credibility criterion for judging the quality of the research, the extent to which the students' and the teacher's accounts during the post unit interviews honestly portrayed their experiences was gauged through classroom observations of approximately three quarters of the lessons. I took detailed field notes of the information provided and observations made. The teacher was given the opportunity to modify the transcript of his interview. I also discussed issues with the teacher frequently, as was natural from our previous relationship as colleagues and co-teachers of similar classes in the past.

How did the activities enhance learning?

A summary of the activities which were most influential on learning is reported here using the entries in journals (j) and post unit interview comments (iv). Although the examples of data given below have been grouped into the processes of inquiry, discourse and metacognition, their influence on learning processes cannot be easily separated in reality. They interact with each other.

Inquiry

There were many aspects to the inquiry approach (see Fig. 1). One was to give students a basis on which to start their research. At each stage of the inquiry process, students were encouraged to ask themselves questions. Some students wrote these questions into their journals.
The brainstorming activity showed that collectively, students had significant prior knowledge about types of cancer, treatments, alternative therapies and some of the social and ethical issues associated with cancer.

The second aspect was for the teacher to present some detailed background information

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

The students were accustomed to teachers presenting the information rather than them having to decide what they needed to find out. Some students would have preferred more teacher-directed instruction. These students considered they were better at regurgitation than thinking for themselves. The teacher considered that for some students, teacher -provided information was seen to save time, whereas for others it was linked to not knowing what to do or just simply being lazy.

The third aspect was to show the students strategies that could be used to make notes more effectively ('Trash and Treasure' and 'notes on notes'). The 'Trash and Treasure' activity which illustrated a way to sort relevant from irrelevant information, was considered to be a powerful technique by most students. These students found that they made notes in a much shorter time compared with using previous methods; some students considered that they had learnt as much if not more than they would have done by taking notes as previously.

Charlie (iv): 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.

Sally (iv): 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 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.

These comments also suggest that some students regarded note taking and recall of specific facts, rather than note making and understanding, as what was expected of them for learning in biology.
Daniel's comments about 'Trash and Treasure' indicate that he thought learning in biology was about finding the right answer. His confusion was linked to the idea that misinformation had been included and you had to sort what was correct in the activity. My observation notes record that he was not paying attention during the instructions for this activity.

Daniel (iv): I thought that 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 the learner, herself to make decisions 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.

'Notes on notes' is a way of annotating notes. 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 (iv): 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.

The fourth strategy was to help students 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.

Charlie (iv): 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 a 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 eg. the first type of carcinogens and then I talked about lung cancer, that was my example....and I talked about bowel cancer, and then the other question was talking about the social/ ethical. I just stuffed them all in one paragraph I think, and then conclusion.

The ability to work independently on research varied widely and was linked to the students' prior experiences of researching and writing essays. Learning how to organise information and structure their essays were seen as beneficial outcomes of the unit of work.

Researcher (j): What else helped you to write the essay?
Mitchel (j): Learning the correct layout, what's needed in each paragraph.

Liz (iv): 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.

However, 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. 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.

Prewrite (paragraph)
Only seven students handed in their paragraphs. This was partly because students were going in and out of class for sports and cultural photographs during this lesson. This activity was designed to get students to write down some preliminary ideas. Many students considered it as being unimportant because there was no assessment mark attached to it. One student suggested that they should have been given tighter deadlines to hand in work. In general, the comments about pre-write paragraphs were very positive and show that writing helped to clarify the students' ideas.

Liz (iv): Pre-writes were good. You kind of know what you're already going to write and you get good feedback.

Tulane (iv): Putting ideas on paper (*was good*) because you have them all but they are not very definitive, by writing them down it makes them more concrete in your head.

Charlie (iv): 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 practising was the best thing to do with this cancer essay and the more practice I do, the better I get.

The teacher considered that there was more emphasis on the inquiry approach this year.

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.

At the other extreme, classroom observations indicated that three students lacked the organisational skills to make notes adequately and collate what notes they had, which meant that 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.

Four students did not produce an essay. Of the other 12 students, 4 made satisfactory efforts, 5 wrote good essays and 3 wrote 2 good essays. The teacher thought that the essays produced this year were better than those produced in previous years.

Mr S (iv): Their searching of information was better. I reckon they are better prepared (*for the exam*) than in previous years as a result of this.

Discourse

Both the students and the teacher report that the small group and class discussions played a major role in developing and broadening students' ideas about the social and ethical issues linked with cancer (Conner, 1999).

Researcher : Do you think any of the discussions helped at all?
Ann (iv): 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.

Daniel (iv): 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 you take notes*). You get a different point of view talking to them and try and make a comeback. You sort of take it in as well.

Mitchel (iv): 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 (iv): 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.... Yes. You have to know more about what you are talking about.

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. Although the discussions motivated students to find out information and sharing ideas resulted in knowledge acquisition, discussions may be inhibitory for any students who did not feel confident about their knowledge, especially if they thought that finding or knowing the 'right' answer was important. Another group discussion required each student to decide what treatment they would take if they had been diagnosed with lung cancer. This made them consider what background factors relating to the patient, family and treatments should be taken into account. Most groups tended to come to a consensus of opinion. It was when they gave the opinion of their group to the rest of the class that they realised there was more than one answer and that there were many factors that should be taken into consideration. The issues were not straight forward. Daniel described this.

Daniel (iv): You tell what you think 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).*

Students were asked to discuss an euthanasia scenario where the doctor increased the morphine dose to a lethal limit. Comments about this activity reveal that it promoted extended thought and questioning about the issues and helped students to consider more than one viewpoint.

Charlie (iv) : I think we were given a sheet on euthanasia and it had two contrasting views and that was really good because I guess if I was talking about euthanasia in my assignment I could argue for both ways now.

Sally (iv): 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.

Further, the teacher considered that the euthanasia scenario gave the students a useful case study which challenged their own values and allowed them to see more than one point of view.

Teacher (iv): I think it gave them something concrete to discuss and it raised quite a few ethical arguments there. They are probably good at arguing from what the point of view is that they genuinely believe, but I don't think they would be very good at constructing an argument if they didn't believe in it.

Metacognition

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 student did plan but just did not write plans. Some planning was enhanced when students wrote key words, key questions and lists in their journals.

The teacher realised the importance of planning and he thought it was essential.

Teacher (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 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. Some students were not accustomed to writing plans for essays.

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.

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.

Mitchel (iv): 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.

Monitoring of learning

Some students made use of key questions/key words to direct and monitor their note making and writing.

Researcher: You said you asked yourself some questions. What made you ask yourself some questions there?

Awar (iv): 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.

Ann (iv): 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.

Although many students reflected on what they needed to do, as entries in their thinking journals as indicated below, not all students used the journals in this way. This was the first time that students had ever used a thinking journal. They only tended to write in them when they were reminded and given time at end of the lesson to do so. Most of the entries were either questions or lists of information they needed to find out, which showed monitoring of learning and some planning. Three students used the journal frequently. The following are examples of statements in journals which illustrate how the students used them for monitoring by stating what they needed to do.

Marianne (j): I know what cancer is technically but I don't know what effects the individual. The same with treatments. What effects do they experience? Are there some general effects that cancer patients experience regardless of where the cancer is situated?

Terri (j): Will SPF 15 stop ovarian cancer?
Cancer treatment- stop blood supply to tumour.
Difference between malignant & benign? Structure and causes.
Learn about 1 hereditary and 1 non-hereditary cancer.
Breast/bowel/skin.

Niome (j): How do cells 'know' how old a person is when they are replaced so frequently? How/why does age affect cancer? ie. Younger girls are more likely to get cervical cancer than more mature women. Why? Must take more notes, be less lazy & catch up on all the work I missed while away. Make sure I'm reading & taking things in properly & summarising rather than just copying mindlessly.

One student wrote in his journal almost everyday. The following extracts written on different days, illustrate how he was integrating and extending his knowledge and interest in the topic.

Charlie (j): Already know about carcinogens and retroviruses. I would like to know about cancer in plant cells and prokaryote cells - do they get cancer? If so, do they get it as frequently as in humans? Do all carcinogens have the same sort of effect on plant cells as they do on humans?
Doesn't this cancer information go against our natural selection theory? ie. wouldn't mutations become cancerous and die?

The bookmarks also prompted students to ask their own questions.

Charlie (iv): Yes because I found out questions. It made me think about the things because it had all the things to think about questions (*the*

prompter bookmark) 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.

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

Liz (j): What cancers are most common in teenagers? How much does our childhood health determine our future health eg. 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?

There were many examples of where self-questioning was promoted by the use of the journals.

In contrast, other students did not find the journal useful.

Terri (iv): The journal writing didn't help me at all because I don't think on paper, I just do it in my head.

Lois (iv): It is really hard to answer them (*the questions*) because I am not used to doing that. I have to write the questions down. It is kind of weird.

Researcher: What about the prompter questions in the journal?

Lois: I usually ask (*myself*) questions, but I don't write them because it is too time consuming.

Most students did not identify the journals as being useful even though they may have used them for writing questions or key ideas which were later addressed in their essays.

There were some positive comments about the use of journals however.

Niome (iv): 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.

Niome even commented on the usefulness of the journal in her journal.

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's comments about the use of the journals were very positive.

Teacher (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. 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.

He considered that the journals helped the students to "tap into" their thinking.

Peer check

The students who completed essays swapped them for peer checking. Peer checking of draft essays was considered by some students to be the most beneficial activity for improving their essays. It gave them 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. For some students, it was the most beneficial part of the whole process of writing the essay.

Lois (iv): 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 (iv): Yes, I think it did 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 essay, half an essay and I got 33 out of 40 and I read through that 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.

Mostly it was beneficial to the reader/marker as it gave them ideas and insights into what could be written and how it could be organised, or they learned about the skills of essay writing from negative examples.

Ann (iv): 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.

Sally (iv): 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.

The teacher also thought this was a useful learning strategy.

Teacher (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.

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 because some students felt that they

did not have the appropriate background to know what could be included as either information or examples.

> Mitchel (iv): 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.

Essay
Producing an essay was an important outcome of the unit. Many students were motivated to improve their essay writing skills because it was worth 20% of the end of year exam.

> Liz (iv): I've had to get better because I have to get those marks in bursary (*the exam*). Before this year, I hadn't really tried.

When the teacher was asked if the improvement of the essays this year was due to making the processes more explicit he said:

> Teacher (iv): I think it was partly that, possibly, but certainly because the log books, they had actually written down there what they were short in, so that they knew what they had to go away and bone up on.

His comment is very important because it illustrates that he thought developing the students' self-directedness (control and determination of their own work) was more important than the instructional strategies for processing information.

Overall impressions and limitations

The processes of inquiry, discourse and metacognition have been highlighted as important for enhancing learning in this bioethical context. However, separating them is somewhat artificial since these processes are intergrally linked. For example, inquiry is not limited to individual research pursuits but is influenced by cognitive processes which can be initiated through discussions. It is also acknowledged that many other factors also contribute to how well learning takes place. Student motivation to use and apply the strategies is an essential component.

The use of the procedural strategies and use of metacognitive behaviours varied for individual students according to their prior knowledge or previous success with them and motivation to succeed. If they considered them worthwhile, or were motivated to achieve well, they used them more effectively. If the essay outcome was viewed by the students as unimportant, (in this case for five students), the strategies became redundant.

Although most students could articulate what might be done for more effective learning, many were not sufficiently motivated to use these strategies. This may have been because some of them 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, journals, key words, key questions and the essay checklist were

perceived to be useful by most students and the teacher. Opportunities for practising essay writing and obtaining feedback on progress from both the teacher and peers were also identified as being very useful. Some students used learning strategies instinctively. For example, they did not write essay plans because they considered writing was too time consuming. These students were also more perservering in that they recognised the value of producing more than one essay.

The teaching environment, especially the role of the teacher was important for dealing with bioethical issues and for promoting self-directed learning (Conner, 2000). The role of the teacher in being a facillitator is not only important so that students are encouraged to use the skills they are learning but also so that they realise the importance of those skills for achieving the desired learning outcomes (the fruitfulness).

The teacher focussed 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, eight students worked very well using the independent learning approach.

The strategies used to help students vocalise 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 this interactional structure. The group/class discussions were a 'way in' to promote students thinking and reflection on their ideas.

Implications of this study

The approach used in this unit of work encouraged many of the students to develop their abilities as self-directed learners. The response of students to the intervention indicates that successful aspects included: outlining the inquiry skills, using journals and class discussions to promote self-questioning and broaden thinking, and using strategies to help students plan and monitor their learning. More practice of the skills, particularly planning essays is recommended. The skills required for researching and essay writing in biology could be inserted in course work prior to year 13. This would allow more time for these skills to be developed, practiced and reinforced before reaching the high stakes of the University Bursary exam.

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 guidance to the learner may undermine the development of autonomous learning processes. For this reason, in order to engender a responsibility by students for their own learning, a minimum amount of teacher directed instruction was combined with tasks which enhanced metacognitive behaviours. Although the 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 be perceived by students to be more useful if the purpose of them and their possible benefits are clarified as part of the teaching. In order to allow more students to take more responsibility for learning decisions,

attention needs to be given to explicitly discussing what is expected ie. to move students away from thinking that there is a 'right' answer or 'correct' set of information, especially when communicating about social and ethical issues.

The element of student choice for directing research can be motivating for students. It also promoted self-direction and decision making regarding content and structure of the essays. However, the decisions students make are likely to be associated with their views and expectations about what teaching and learning in science is like.

Knowledge of content, procedural strategies and knowing how to reflect on and monitor progress also influences self-regulated learning (Winne, 1996). Beliefs about what learning involves, especially in this case, needed to be challenged more. 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 was expressed by several students regarding marking other students' essays.

This investigation indicates that giving instructions about self-regulation and cognition is easier than fostering actual regulation of cognition. Students must know the strategies for learning **and** be motivated to use them in flexible and strategic ways to actuate them for more effective learning.

References

Baird, J., & White, R. (1982). Promoting self-control of learning. *Instructional Science, 11,* 227-247.

Blakey, E., & Spence, S. (1990). Thinking for the Future. *Emergency Librarian,* 17(5), 11-14.

Conner, L. (in press). The inclusion of societal issues in the Science and Technology Curriculums in N. Z. and the implications for teaching. *Pacific Asian Education, 12(1) forthcoming.*

Conner, L. (2000). The significance of an approach to the teaching of societal issues related to biotechnology. *Paper presented at AERA Conference,* New Orleans, April 24 28, 2000.

Conner, L. (1999). Investigating Cancer Issues: A year 13 project. *Paper presented at the 30th annual conference of A.S.E.R.A.* Rotorua, New Zealand. 8 - 11 July, 1999.

Dawson, V., & Taylor, P. (1998). Establishing Open and Critical Discourses in the Science Classroom: Reflecting on Initial Difficulties. *Research in Science Education,* 28(3), 317-336.

Evans, C., & McCann, M. (1993). *Issues in Science.* Melbourne: Heinemann.

Flemming, R. (1986). Adolescent Reasoning in Socio-scientific issues, Part 1: Social Cognition. *Journal of Research in Science Teaching,* 23 (8), 677-687.

Geddis, A. (1991). Improving the Quality of Science Classroom Discourse on Controversial Issues. *Science Education,* 75 (2), 169-183.

Gold, R. L. (1958). Roles in sociological field observations. *Social Forces,* 36, 217-223.

Guba, E.G., & Lincoln, Y.S. (1989). *Fourth generation evaluation.* Newbury Park, CA.: SAGE.

Gunstone, R. F. (1994). The Importance of Specific Science Content in the Enhancement of metacognition. In P. Fensham, Gunstone, R., and White, R. (Ed.), *The Content of Science: A constructivist Approach to its Teaching and Learning* (pp 131-146). London: The Falmer Press.

Jarvis, S., Hickford, J. & Conner, L. (1998). *Biodecisions.* Crop and Food, Lincoln, N.Z.

Keown, P., & Crocker, G. (1996). *Values in the Curriculum Project: A community of Inquiry Approach to Values Education through Social Studies*. Hamilton: The University of Waikato.

Lipman, M. (1987). Ethical Reasoning and the Craft of Moral Practice. *Journal of Moral Education,* 16(2), 139-147

Macer, D. (1994). *Introduction to Bioethics: Supplementary Bioethics teaching notes.* Ibaraki, Japan: Eubios Ethics Institute.

Ministry of Education. (1994). *Biology in the New Zealand Curriculum.* Wellington: Learning Media.

Osborne, M., & Freyberg, P. (1985). Learning in science: Implications of children's knowledge. Auckland, New Zealand: Heinemann.

Resnick, L. (1987). *Education and Learning to Think.* Washington,D.C.: National Academy Press.

Shuell, T. (1988). The Role of the Student in Learning from Instruction. *Contemporary Educational Psychology,* 13, 276-295.

Solomon, J. (1993). *Teaching Science, Technology and Society*. Buckingham: Open University Press.

Van Rooy, W. (1993). Teaching Controversial Issues In The Secondary School Science Classroom. *Research in Science Education,* 23, 317-326.

Van Rooy, W. (1994). Teaching science using controversial issues: some guidelines to enhance student learning and motivation. *Australian Science Teachers Journal, 40*(1), 24-27.

Wang, M. C., & Peverly, S.T. (1986). The Self- Instructive Process in Classroom Learning Contexts. *Contemporary Educational Psychology,* 11, 370-404.

Winne, P. (1996). A metacognitive view of individual differences in self-regulated learning. *Learning and Individual Differences* 8(4), 327-353.

White, R., & Gunstone, R. (1989). Metalearning and conceptual change. *International Journal of Science Education (PEEL, Monash), 11*, 577-586.

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