PROBLEM-BASED LEARNING IN TEAMS FOR A CLUSTER WIDE CYBER SCIENCE CLASS

THE STUDENTS: CORONET SCHOOLS GIFTED AND TALENTED YEAR 10 SCIENCE

WHAT THEY DID

PROBLEM-BASED LEARNING IN TEAMS
DEEP THINKING SKILLS
EXTENSIVE USE OF ICTS
POWERFUL LEARNING EXPERIENCES
GLIDING PHYSICS
WAITOMO CAVE CHEMISTRY
HUMAN POTENTIAL (AUT)
GOAT ISLAND ECOLOGY

GLIDING: A GREAT WAY TO LEARN PHYSICS
ACKNOWLEDGEMENTS

The foresight of the Ministry of Education to enable teachers to be involved in research projects involving ICT’s is commendable. The partnership with CORE education has been fantastic and provided us with the tools for effective research and presentation skills to ensure effective the dissemination of our findings.

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Please feel free to contact me with any comments or feedback

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Chapter 1 Introduction

This chapter outlines some of the background and rationale behind the establishment of this project. Key aspects of the project are then outlined. Following this the aims and objectives are established along with the significance of the project. A literature review of the key aspects outlined can be seen in Chapter 2.

Background and Rationale

This project offered a fantastic opportunity to bring together many of the aspects of Science Education which I believe in and have a background in from previous research. The rapid development of ICT’s is opening many doorways which were previously difficult to open through the logistical issues of distance and travel.

Science is a fascinating and relevant subject to all people, yet it is often misunderstood and in fact loathed by many. Problem-based learning (PBL) in activities related to real life day-to-day situations relevant to the students are used in this project to create ‘powerful learning experiences’. The use of problem-based learning helps ensure that students use higher order thinking skills. The researchers background in yachting (designing and building boats and sails), other high performance sport, and even backyard work on home-designed solar heating for the pool etc has certainly ensured that good science is seen as relevant and enjoyable.

The opportunity to bring together teams of gifted and talented students from small and often isolated rural schools through the extensive use of ICT’s and face-to-face at topic based camps also presented itself as part of this project. This meant that the students selected for this project would experience student directed learning (SDL) in their teams whilst doing their work.

Gifted and Talented Programmes

Many schools do offer special programmes for their few gifted and talented students. These are usually school based and include events such as camps, guest lecturers, visits to universities and various other organizations and businesses. Some departments in schools offer opportunities in various events such as Australian science, math or English. In science a few schools offer CREST (Creativity in Science and Technology) as a challenge to students. This programme is supported by the Royal Society of New Zealand (RSNZ) and provides great opportunities for students to engage in supported research. Students can start this program at Intermediate school with First CREST, or later at secondary school, with Bronze CREST. First CREST and Bronze are both assessed and organised within the school, however, Silver and Gold Crest both have external consultants (often University or
CRI (Crown Research Institute staff) with an interest in helping students. There is an approval process to work through with the RSNZ before work really starts. Gold CREST has a significant input in planning and assessment from the RSNZ assessor.

The RSNZ also run ‘Realise the Dream’ (RTD) which still has mainly top regional Science and Technology students although it is now open to other disciplines. This is what used to be known as the ‘National Science and Technology Fair’. There are other avenues students can get through the selection process to RTD such as ‘Bright Sparks’ (Electronic projects) and CREST Silver or Gold. CREST projects are often among the top science fair entries since they have good support structures and clear guidelines and check points (milestones).

Few schools actually pursue activities such as CREST often citing workload for staff and students as an issue. The new qualification NCEA (National Certificate of Educational Achievement) is often cited as one of the contributing factors. Student research offers both real learning experiences and an opportunity for them to link with top consultants, such as staff from universities, CRI, and Young Engineers. These people are very enthusiastic and keen to assist our young science and technology students.

There is also the chance to represent New Zealand overseas at events such as the International APEC Youth Science Festival held in various countries. Ten students from the researchers school have been overseas with New Zealand teams with some international successes. They found the trips to be a fantastic, perhaps even a life changing, experience. The researcher attended one of these as a supervising teacher with twelve NZ students in Seoul, South Korea, along with 500 students from 39 counties around the Pacific Rim. Seeing these top international students meet face to face and interact was a great experience. They all had something in common - a love of science and genuine ability. Cultural backgrounds were diverse yet this mattered little to these students; they just ‘got on with it’ and really enjoyed each other’s company.

CREST is an example of project-based work, one which gives students opportunities to work on real problems with real people. Jane Gilbert of NCER (Chief Researcher for the New Zealand Council for Educational Research) made some comments in her Keynote address at ULearn, Christchurch, September 2006. “Minds are resources that can be connected to other resources in order to generate new knowledge”. She also commented “Knowledge Age schools need to be producers, not consumers, of knowledge” and that we need to move away from “Learners as passive consumers of knowledge” to “learners as active producers of knowledge”. Silver and Gold CREST students have had projects, which emphasise these ideals.

One year 11 student is currently embarking on a Gold CREST project over the next 18 months exemplifies the process. She has a passion for dairy farming and research. Her project looks at ways of enhancing water quality in stock troughs and after this has been established she will look at what affect clean water has on milk quality. She has done projects that have built towards this since Year 9 and in Year 10 was selected to go to ‘Realise the Dream’ where she completed her Silver CREST. This year she assisted Dr Susie Wood, a top NZ freshwater biologist from a Nelson Laboratory, with the sampling and processing of local trough water for a
Cyanobacteria study. All of this has helped her build knowledge and to establish links with key people.

Following is figure 1.1 which outlines the links with some of the people who will be involved in her Gold project, and what knowledge she will need and its source.

**Figure 1.1. Gold CREST Project: Key links**

**Gold CREST Project**

I. **Knowledge**
   A. Publications: Library, journals, reports etc.
   B. Internet: Searching websites etc.
   C. Learned: Previous work such as projects.

II. **Consultant 1:** Dr Neville Jopson: Statistics and experience in animal trials (Dunedin).

III. **Consultant 2:** Scientist, trial design (Wellington).

IV. **Consultant 3:** Dr Julie Hall, Links with other top scientists. Heterotrophic plate counting (Hamilton – laboratory).

V. **Consultant 4:** Dr Susie Wood (Nelson).

VI. **Consultant 5:** Electronics experts, one of her peers and a former top student.

As can be seen from the above outline this type of project-based work certainly equips students well for life beyond school. The researcher’s school has been heavily
involved with this type of work over the past decade or more and there is a pattern. Students who show the initiative, creativity and drive to succeed in these projects all do very well in their chosen vocation.

Preparation for CREST Silver or Gold Projects

PROBLIT students working in their teams on smaller problems or projects gain ideal preparation for larger, open-ended projects, such as CREST Silver or Gold. Students need to learn the research skills and think at a higher level if they are to be successful.

The PROBLIT Project

When this project was initially proposed it was part of a CoroNet application for major Gifted and Talented (G&T) initiative funding. This proved to be successful and within weeks the PROBLIT project became part of an e Fellowship supported by the MOE. The rationale behind selecting G&T students from this cluster for PROBLIT was:

1. At each year level there are usually very few students who could be described as genuinely gifted and talented. Teaching of the ‘top’ science class is restricted by the fact that many students would not cope with work at a much higher level and hence teaching is often directed towards the middle level of the class.

2. The scattered nature of these schools means that students do not interact with other students from other schools throughout the cluster on a regular basis. Some do have limited contact on the sports field.

3. Shared ICT resources such as Knowledge Net and Video Conference facilities were already in place and hence enabled quick establishment of the project.
The CoroNet ICT Cluster

Table 1.1
CoroNet Schools’ details: PROBLIT 2006

<table>
<thead>
<tr>
<th>School</th>
<th>Roll (Year)</th>
<th>Decile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coromandel Area School</td>
<td>317 (Y1 - 13)</td>
<td>3</td>
</tr>
<tr>
<td>Mercury Bay Area School</td>
<td>719 (Y1 - 13)</td>
<td>4</td>
</tr>
<tr>
<td>Morrinsville College</td>
<td>688 (Y9 – 13)</td>
<td>6</td>
</tr>
<tr>
<td>Paeroa College</td>
<td>285 (Y9 - 13)</td>
<td>2</td>
</tr>
<tr>
<td>Te Aroha College</td>
<td>390 (Y9 - 13)</td>
<td>5</td>
</tr>
<tr>
<td>Thames High School</td>
<td>619 (Y1 - 13)</td>
<td>7</td>
</tr>
<tr>
<td>Waihi College</td>
<td>823 (Y7 - 13)</td>
<td>4</td>
</tr>
<tr>
<td>Whangamata Area School</td>
<td>442 (Y1 - 13)</td>
<td>5</td>
</tr>
</tbody>
</table>

Research Project Outline:

An extract from a letter to parents

PROBLIT (Problem-based-Learning in Teams)

This project combines cooperative group learning and problem-based learning for Gifted and Talented Year 10 students throughout the Coronet cluster. They are to be brought together both face-to-face and through the extensive use of IT such as video conferencing. Teams of two or three students from many of the eight cluster schools will be selected during Term I. The selection will be based on intellectual ability in science, work ethic and an innate love of science. The curriculum will be followed using a problem-based approach in school teams who then combine their findings on a given topic. They will be assessed in their teams through IT based testing strategies. Face-to-face camps will be based around some aspect of the curriculum at venues such as the North Shore’s AUT and the ‘Millennium Institute of Sport and Health’ for the ‘Human Body’ topic. They will also have the opportunity to do CREST research projects using consultants from Universities, CRI’s and other such establishments.

Professor Darrell Fisher of Curtin University of Technology (WA) will assist with analysis of the effectiveness of the programme taking into consideration students’ perceptions of their learning environment, focusing on aspects such as: equity, involvement, self-efficacy, relevance and students’ science-related attitudes.

The Programme

This programme provides a great opportunity for the gifted and talented science students to extend themselves, with support from the wider scientific community and their peers both within their own school and throughout the cluster. Enjoyment from the experience of learning together is paramount. The extended use of IT such as VC will enable this to happen along with the planned camps, which will be based around units of the Year 10 Science curriculum.
Key Components of the Project

Student Selection

Year 10 students were selected for this project. Although there were a number of area schools within the cluster, most schools had a better idea of who their top science students were after a Year 9 science programme. It is good for students to have some focus in their last year before NCEA begins in earnest.

Gifted & talented students come in many forms. However, for the purposes of this project, the focus was on the following qualities that become more important where a certain amount of trust is required.

HEW has been coined.

**HEW**: Horsepower, Enthusiasm and Willpower

- **Horsepower** is simply the intelligence and innate ability to solve problems and think laterally.
- **Enthusiasm** is the love of science and joy of finding out new things.
- **Willpower** is simply the ‘work ethic’ or ‘doing the hard yards’ to successfully accomplish a task.

Other significant issues

- Students will have no behavioural issues or exhibit any anti-social behaviour.
- The teams of two or three students will ideally have among their number a parent who can at times assist with transport and or help with the running of the camps (needs to be the right sort of person).
- Students will ideally (but not vitally) have Internet access at home and be computer literate.
- They will have a wide range of interests, such as various leisure activities, sport, etc.
- They will be good communicators and get on well with peers and adults.

For most schools entering the programme G&T coordinators gave a number of selected students handouts about the programme to ensure they were aware of the programme expectations. From these the final team was selected.

Previous work by the researcher has shown that three was the best number of students for a team. This is usually the sort of number of ‘top’ science students in Year 10 science.

However, at one school twins were ranked third so both were included (although a scientist may consider one in one out same genetics ideal!). Another school had two Māori students at the top and this provided an opportunity to assess how they found the learning experience of PROBLIT. The rest of the schools were all teams of three (a late entrant, Coromandel Area School, had two).
Teamwork and Assessment

Previous research on cooperative learning and assessment (COLA) in Science has shown that students show a positive improvement in their attitudes and enjoyment of Science when they work and are assessed in small cooperative groups (Johnson & Johnson, 1999, Lowe, 2004).

Project Time and PROBLIT

Excellent opportunities exist for G&T students keen to try their hand at projects such as making a Science Video showing a scientific principle and CREST. Students, however, never get extra time for this sort of activity. This project takes the students out of their regular science class and gives them the freed up time to do the Problem-Based-Learning in Teams (now coined PROBLIT). This means they have the time to engage in the stimulating challenges of their science programme.

Student Directed Learning (SDL)

Since the students will in general only receive online help from me as their science teacher, they are essentially engaged in SDL where they need to show initiative and resourcefulness. They will work on problems and case studies in their school-based team of two or three students. They will use resources such as the library, science texts, Internet, local people and science staff at their own schools. They need to have the confidence or self-efficacy to work as a team with minimal direct teacher input.
Problem-Based Learning, by its very nature, actually requires students to be working independently.

**Problem-Based Learning**

This type of project highlights how many modern educators are thinking and leads towards the use of Problem-Based Learning as a key component of this project. Problem-Based Learning actively encourages students to become problem solvers in the ‘real world’ developing higher order thinking skills and a sound knowledge base (Capra and Ryan, 2002). They are given problems that encourage them to access existing knowledge and then use this to solve whatever problem they are presented with. This type of thinking can be assessed using Biggs SOLO taxonomy (Biggs and Collins, 1982). This will be discussed at length in Chapter 2.

**Face-to-Face Camps**

There were 4 camps planned with one being held each term. Three were three day camps and one a two-day camp. All camps were scheduled to commence on Sunday to reduce the impact on other classes. The purpose of the camps is essentially twofold:

1. They bring the students together so they can enjoy each other’s company and exchange ideas. The relationships formed help to enable better online communication when they know the other students better.
2. They get to experience genuine and powerful learning through the topic based activities such as ‘Gliding and the Physics of Flight’.

**ICT’s and PROBLIT**

The prime focus of this project is the way that students learn and what they learn. The use of ICT’s are vital in that they actually enable the project to occur. There is a base set of ICT’s which can be taken as standard throughout this project. Applications such as: searching for information, downloading and sorting through relevant material etc. The mode of communication with the various groups for this project was initially asynchronous, using e-mails. It was planned to have one Video Conference (VC) session each week, which might include ‘guests’ such as engineers, scientists etc, who would be able to log into the Coronet VC from their own work sites.

As the needs arose, different ICT’s used during this project were included in the discussion of the relevant aspect for which they were required. This included the use of ICT’s by professionals at events such as the science camps.
**Work Space**

Ideally, they would have the use of a small room they could call their own with computer access and a whiteboard. They might well do some practical work during their regular science periods, and maintain contact with their classmates.

**Key Stake Holders**

This project involved communication with a lot of people, all of whom needed to be kept informed. They were:

- The students.
- Their parents/caregivers.
- The HOD Science and their science teacher (sometimes the same person).
- The G&T coordinators.
- The IT teachers.
- The school Principals.

**The Research**

Since this is a research project it must have good academic rigor if the results are the help us lead the way forward. Hence this component will form a significant part of the project as a whole. The project does by its very nature include top young students from a good number of schools. Their welfare and academic progress was always considered the number one priority for the duration of this project.

**Aims**

- Use ICTs to bring together teams of gifted and talented students from throughout the CoroNet region as an online community of learners to work cooperatively towards achieving common goals.

- Allow students the experience of learning science in a relevant and enjoyable context through a supported problem-based approach in teams, hence taking responsibility for their own learning.

**Objectives**

To determine the effect of problem-based learning in online teams:

- on students’ attitudes towards science
- and on students’ learning outcomes

To determine the feasibility of the ICT rich programme.
**Significance of this project**

The draft document for consultation among New Zealand teachers *Science in the New Zealand Curriculum* document (Ministry of Education, 2006) outlines the key competencies required by people to take their place in society. These are built up over time and five key competencies are identified (p.11).

- Managing self
- Relating to others
- Participating and contributing
- Thinking
- Using language, symbols and texts

It is clear that this project encompasses all of these key competencies and further more the use of teams, problem-based-learning and real life contexts is fully endorsed by educators such as Jane Gilbert, again from ULearn 06:

**LEARNING**

- Involves *generating* knowledge *not storing* it.
- Is primarily a *group* not an individual *activity*.
- Happens in *real world* problem-based contexts.
- Should be *just in time* not just in case.
- Needs to be *a la carta* not *en bloc*.

Jane Gilbert (2005) suggests (p. 207) that:

> A small number of projects designed to engage interested students in research or other real-world activities currently exists in schools. These include the Young Enterprise scheme for senior economics students, the CREST awards scheme and the science fairs for science students….

As can be seen this project addresses many of the areas of learning outlined here.
CHAPTER 2 LITERATURE REVIEW

Overview

In this chapter previous research on the key aspects of the PROBLIT project are investigated. Essentially this falls into two main categories for the students.

1. How the students are learning which includes: Teamwork and assessment in those teams, problem-based learning, student directed learning and relevant learning experiences. Much of this is enabled through an online environment.
2. What they are learning: The main objectives of this project, student attitudes towards science and their learning outcomes.

How the PROBLIT Students are Learning

Teamwork (cooperative learning)

Rationale

While positive cognitive outcomes are very important for secondary school students as they progress through their college years, without positive attitudes towards their science subjects they are unlikely to pursue a science-related career or maintain a lifelong interest in science. In fact, many will often have negative attitudes towards the activities of scientists and science-related issues. If we wish people to be able to make informed and non-emotive decisions on many of the science-based issues likely to face society in the 21st Century, then positive attitudes are important. In many countries, the promotion of favourable attitudes towards science is viewed as a central aim of science education (Fraser, 1981b; Kelly, 1986).

Many successful modern companies spend a lot of time, money, and effort in developing the ‘team ethos’. Team-building activities are fundamental to their staff development programmes and are seen as invaluable. Over the past 20 years the number of providers of these activities has risen significantly. The employment officer of Grayson's Laboratories (personal communication, September, 1995) stated that the single-most important factor, when they consider employing staff, is the ability to work cooperatively in a team. Whereas there are some jobs that can be filled by individuals who prefer to work on their own, these are rare and often of a temporary nature and so the good team member is often the most prudent staff selection.

Wellins (1991) in his modern business book ‘Empowered Teams’ perhaps best summarises how effective teams can work in the following quote (p. 146):

Effective teams are not just collections of people. Rather they comprise an entity that is greater than the sum of its parts. This means that team members must work together closely and make every effort to cooperate and support one another.
Kroll, Masinglia, and Mau (1992) observed that we should use evaluation procedures that match the instructional format that is used and hence if students frequently work in small groups then they should be assessed in those small groups.

Gilbert (1990) observed that activities in which students manipulate ideas and materials themselves lead to deeper processing of ideas. There is a need to find viable and practical alternatives to the passive activity of listening to the teacher and answering short factual questions.

Both of these viewpoints lead to the conclusion that educationalists should be doing more group work and group assessment in our secondary schools. As far as testing is concerned, Murray (1990) recommended alternative methods such as allowing group discussion prior to testing could be the subject of further research. Similarly, Atkins (1993) recommended that current assessment methods should be changed to include increased emphasis on the assessment of small group work. Thus, there is a need for more research in this area.

In the *Science in the New Zealand Curriculum* document (Ministry of Education, 1993) it was suggested (in the section on enhancing achievement) that learning is enhanced when (p. 10): ‘Students have the opportunity to clarify their ideas, to share and compare, question, evaluate, and modify these ideas, leading to scientific understanding’.

Some prominent researchers suggest that team learning is one way to reduce the negative influence from peers on students’ will to succeed. Robert Slavin (see page 17) and William Glasser are two such researchers.

William Glasser (1969, 1986) suggests in his books, such as *Schools Without Failure* and *Control Theory in the Classroom* a slightly different approach to the other researchers. He approaches the problem by trying to address the large number of failures in high schools.

Unless you have your head in the sand, you cannot fail to agree that about half of the secondary students in your regular classes make no consistent effort to learn. In fact if you take a close look at the young people in your greater family, you will see that close to half of them are firmly entrenched in this no-effort group. (Glasser, 1986, p. 8)

Glasser (1986) states that ‘in a control theory learning–team school, where the teacher is less of a lecturer and more of a facilitator-manager, there would be few major discipline problems’ (p. 56). This is because in learning teams, where the students gain immediate satisfaction, it makes no sense to disrupt. With the teacher helping student teams to realize that there are better ways to handle frustration than choosing anger, any students who are temporarily frustrated can in fact be helped. Glasser also comments on the relevance of the material students are taught. Teaching can be more ‘empowering’ to the students if they can relate to such material.

Unlike a sports team where better players are respected and admired by lesser players, classroom achievers are much more likely to be resented than
accepted for their academic success. What they gain in power they lose in friendship (Glasser 1986, p. 70).

This philosophy is the basis for the formation of Glasser’s so-called learning teams. According to Glasser (1986), there are eight basic reasons that learning teams will succeed in motivating most students:

1. Students gain a sense of belonging by working in teams of two to five.
2. Belonging is the initial motivation for students to work and as they achieve success those who had not achieved previously sense that knowledge is power and will want to work.
3. Stronger students find it satisfying to help weaker ones because of the power and friendship associated with a high-performing team.
4. Weaker students find it satisfying because every little effort helps the team cause. When they worked alone, a little effort received no reward.
5. Students have less dependence on the teacher. They are encouraged to depend more on themselves, their own creativity and on other team members. Such a level of interdependence gives the students both power and freedom.

Historical Development of Cooperative Learning

Cooperative learning has been recognized as an effective learning tool for a very long time, even as long ago as the reign of the Babylonian Talmudin times BC. In the first century BC, the Roman philosopher Seneca Quintillion advocated cooperative learning with statements such as ‘Qui Docet Discet’ which means, ‘When you teach you learn twice’. Johann Amos Comenius (Komensky) (1592-1670) was a theologian and educationalist from Czechoslovakia and Poland. He was considered very modern at the time in his thinking and believed that students would benefit by being taught and teaching other students. In the late 1700s the Reverend Dr. Andrew Bell (1753-1832) (Bell, 2001) pioneered cooperative work while teaching in Madras, India (Bell, 2001). While this was forced upon the teaching profession through teacher shortage, the idea of basically older students (called ‘monitors’) cooperatively teaching younger ones was a great success. On his return to England he encouraged schools to adopt ‘the Madras System’. By the time of his death in 1832, some 10,000 schools were using his method. At the same time Joseph Lancaster forced by a shortage of teachers, was developing a similar system of ‘monitors’ (Lancaster, 2001). Lancaster was funded to travel to America to set up ‘monitorial schools’ in New York and Philadelphia.
The Modern Era

Many modern researchers share common ideas and goals for their cooperative learning strategies. Their research is tailored to investigate the effect of their particular environmental set-up on these ideas. The developmentally appropriate academic skills and better interpersonal skills are often the main focus of research. The competitive structure of most classrooms is seen as excellent for the winners, who become well-motivated students with high status (Ames & Ames, 1984), but in order to have winners you must have losers who become low-status students. These students often become resentful and may often use attention-seeking ploys to cover their low status.

The work and philosophies of some prominent cooperative learning researchers are outlined below. Details of some of the various strategies they have developed and evaluated are considered beyond the scope of this report.

Robert Slavin

Robert Slavin and his co-workers developed STL (Student Team Learning) methods at the John Hopkins University. Slavin shares the view of other researchers that students’ peers often drive the change in attitudes from primary school to secondary school. Slavin (1995, p. 3) stated that:

As students enter adolescence, the peer group becomes all-important, and most students accept their peers’ belief that doing more than is needed to get by is for suckers. Research clearly shows that academic success is not what gets students accepted by their peers, especially in junior high school.

He goes on to comment about the problems of low achievers. ‘After a while, they learn that academic success is not within their grasp, so they choose other avenues in which they may develop a positive self image. Many of these other avenues lead to anti social, delinquent behavior’ (Slavin, 1995, p. 4). Slavin was instrumental in developing STL methods, some of which were based on the work by DeVries and Edwards (1973), also at Hopkins University.

Spencer Kagan

Spencer Kagan, the director of Cooperative Learning in California, devised and developed a structural approach to cooperative learning. Kagan’s approach has similar concepts and basic beliefs to the Johnson and Johnson model (see below) and teachers are able to quite freely integrate the two approaches. In his more recent work, Kagan (1998) referred to ‘new cooperative learning’ where teachers are encouraged to use simple cooperative structures and strategies to convert existing lessons into cooperative ones. This approach is more likely to be readily accepted than having to devise specific cooperative lessons.

New Zealand researchers Brown and Thomson, both at Victoria University of Wellington, New Zealand, noted that Kagan’s approach fits well with the nature of New Zealand teachers. They saw New Zealand teachers as being creative and active, and prepared to try a range of structures. Brown and Thomson (2000) have observed
the extremely innovative way in which they are able to apply Kagan’s structure to their regular classroom activities.

David and Roger Johnson

Brothers David and Roger Johnson from the University of Minnesota are often viewed as modern day ‘heavyweights’ in the field of cooperative learning. Much of their recent work is modeled on their original work (Johnson, Johnson, Holubec, & Roy, 1984). Since then Johnson and Johnson have established a basic model for cooperative learning in the classroom. Johnson and Johnson (1987, 1989, 1991, 1994) established the basic idea of three-goal structures and suggested that there is no reason why these structures cannot be integrated into the same lesson. The goal structures are competitive, individualistic and cooperative. The following statement summarizes feelings about students and these goal structures.

We believe that all students should be able to compete for fun and enjoyment, work autonomously on their own, and cooperate effectively with others. Just as important, students should know when to compete, when to work on their own, when to cooperate. Johnson and Johnson (1999, p. x).

Johnson and Johnson (1999) go on to define these structured learning goals in a classroom context where these lessons are structured so that students:
1. engage in a win-lose struggle to see who is best in completing the assignment;
2. work independently to complete the assignment; and
3. work together in small groups, ensuring all members complete the assignment.

Structured learning goals can be thought of as a combination of the following:
- A learning goal is where mastery or competence in a particular subject area can be demonstrated.
- A goal structure is the way in which students interact to achieve their goals. They may have either no effect on the success or failure of others or a positive effect. The students essentially engage in competitive, individualistic or cooperative efforts.

Summary: Johnson and Johnson

Johnson and Johnson (1987, 1989, 1991, 1994, 1999) are regarded as leaders in the field of cooperative learning and they often provide analogies with the key elements of successful sports teams where members will often exhibit loyalty, commitment and effort well beyond what would be expected from an individual acting alone. Playing on in the face of serious injury in a key rugby or basketball game are common examples. They establish structures and conditions where a successful cooperative team is most likely to succeed as opposed to a pseudo-learning group where students are simply put into groups to perform various tasks. It is acknowledged that while high performance cooperative groups are rare, educators can move their groups towards this goal through a well-structured cooperative learning programme.
Elizabeth Cohen

Elizabeth Cohen (1986) focuses mainly on how a cooperative group operates. She states that if the group is to work to its potential, a group needs to work within a well-established structure, and therefore should be more effective than individuals working alone. Most students will have had limited exposure to effective cooperative group work and as a result need to be taught this. Cohen used the concept of a *norm*, which is simply a rule for how one ought to behave. When the group members accept and display evidence that they are operating to a suitable set of *norms* the norms have become *internalised.*

Cohen emphasises the need to ensure that all students in a group participate equally, including less successful students (usually of low status within the classroom) who often struggle to contribute to discussions and learn less. High-status students tend to dominate group discussions. Groups need to review their own performance for the contribution of individuals within the groups. Are group members all talking, listening and asking questions about other members’ ideas or suggestions? Cohen (1984) found that students who talked and worked together more learned more from the curriculum than those who talked and worked together less.

**Individual accountability**

‘The purpose of cooperative groups is to make each member a stronger individual in his or her own right’ (p. 29) is a basic philosophy of Johnson and Johnson (1999). Students not only learn the skills of working in groups but also are able to perform to a higher standard on their own. Students need to acquire a sense of responsibility to learn well themselves and also assist the learning of their teammates. They cannot achieve this if they simply ‘hitchhike’ on the work of others, but ensuring compliance needs to be done in a non-threatening manner. Students will not commit to the risk of failure unless they feel they are in a safe learning environment.

**Cooperative Learning in New Zealand**

Brown and Thomson in New Zealand place a high emphasis on teaching of the relevant skills that enable students to operate effectively in a cooperative group. Much of their work (Brown and Thompson, 2000) is based on the structure set up by Johnson and Johnson (1987, 1989, 1991, 1999), and clearly acknowledged as very influential. Brown and Thomson (2000) also refer to the work of Kagan (1994), which states that students must have both the *will* and the *skill* to work effectively in a group. After careful examination of the essential skills listed in the New Zealand Curriculum Framework (NZCF) document (Ministry of Education, 1993) Brown and Thomson see that while the primary school sector often addresses the skills of teamwork and interpersonal skills this is not always the case in the secondary sector, where many teachers see their responsibility as being subject-based only. Brown and Thomson examine both international and national trends in the development of the modern curriculum where there is a trend to integrate skills, attitudes and values along with ‘deep’ thinking and learning processes.

The NZCF recognizes that competence and achievement are strongly associated with attitudes to learning and there are also frequent references to equity, life-long learning
skills, cooperation and achievement. It is argued that many of these attitudes and skills, along with individual responsibility, are difficult to learn effectively in the competitive, individualistic environment typically encountered in New Zealand secondary schools.

Whereas New Zealand may be viewed as multicultural, its bicultural foundations are seen as very important in our education. Brown and Thomson refer to the work by Glyn and Bishop (1995), which suggests that Māori-preferred teaching and learning styles, along with cultural practices, are largely supported by cooperative learning strategies. The adoption of such styles and practices could be advantageous to both Māori and other students.

In some of his earlier work, Brown (1992) was able to establish that many New Zealand secondary school students value the help they receive from their peers. After a six month trial in some New Zealand secondary schools one of the students working in cooperative groups made the statement: ‘Other people were able to help me to better understand the topic. It helped me also to be teaching other people because it helps me to remember a large amount of work (p. 19)’.

Brown and Thomson (2000) maintain that all students’ thinking is stimulated by cooperative learning processes, supporting studies by Johnson and Johnson (1992) and Cohen (1994). That some students are able to explain concepts and ideas to students of lower ability is mutually advantageous.

Brown and Thomson (2000) follow the paradigm that teaching relevant skills and applying them is an integral part of successful cooperative learning. This is a view shared to a large extent by Johnson and Johnson (1987, 1989, 1991, 1999), and Kagan (1994), who maintain that the best place to teach teamwork skills is in the context of authentic teamwork activities.

Summary

While the concept of cooperative group work may be thousands of years old there has been a considerable amount of research done within the last century in the so-called ‘modern era’. While there are a number of differences between the various researchers in the establishment and organization of cooperative groups, there are a number of common elements, which include:

1. The need for the group to enjoy learning and have fun working together with a real sense of belonging.
2. The need for the group to have achievable and measurable goals.
3. The need to work cooperatively together in order to achieve higher levels than would be achieved as individuals.
4. The need to try to ensure that all members of the group contribute to the group and are individually accountable.
5. The need to ensure that there are suitable structures and tasks in place to assist students in the development of the appropriate cooperative skills required for group success.
In a study by Lowe (2004) where the science related attitudes of Year 9 and Year 10 students working and being assessed in cooperative groups were shown to improve significantly the following statement is made in summary (p. 163):

The opportunity to allow students to develop their interpersonal skills in a team environment, along with their understanding and enjoyment of science, is well worth the effort required to establish cooperative group work. As teachers we cannot sit back and allow significant numbers of our students to have negative attitudes towards the exciting and vital subject of science without trying to improve this.

**Problem-Based Learning (PBL)**

The development of Problem-based learning

Problem-based learning was introduced to McMaster University Medical School in Canada in the 1960’s. From this point it has had an increased following, especially within medical education where it became common place relatively quickly. Schwartz, Mennin and Webb (2001) claim that in fact by 1989 eight of the 127 medical schools had either totally PBL curricula or separate PBL tracks. Some 96 others had components of PBL. It has since spread to many other university faculties such as the Health Sciences, social work, engineering architecture, business, law, economics, and management. Auckland University use it to a large extent in Finance and in their commerce degrees beyond stage 1.

Cambourne (1998) states that:

The fundamental objective of Problem-based learning is to equip students with skills and information that will transfer from school/university to … professional life. It is the intention that PBL will instil in students life-long learning practices…… Problem-based learning engages students in learning and reaching new levels of understanding (p. 20).

**What is problem-based learning?**

Barrows and Tamblyn (1980) (Howard Barrows is described as one of the originators of PBL Schwartz, Mennin and Webb, 2001) define problem-based learning as a method of learning in which learners first encounter a problem, followed by systematic, student-centred enquiry process. Schwartz, Mennin and Webb (2001) suggest that typically in PBL the teacher is a facilitator rather than a source of information. Students will typically:

1. First encounter the problem ‘cold’, without doing any preparatory study in the area of the problem;
2. Interact with each other to explore their existing knowledge as it relates to the problem;
3. Form and test hypotheses about the underlying mechanisms that might account for the problem (at their level);
4. Identify further learning needs for making progress with the problem;
5. Undertake self-study between group meetings to satisfy the identified learning needs;
6. Return to the group to integrate the newly gained knowledge and apply it to the problem
7. Repeat steps 3 to 6 as necessary; and
8. reflect on the process and what has been learnt.

Problem-based learning versus problem-solving learning

Savin-Baden (2000) discusses this issue stating the focus of problem-based learning is in organizing the curricular content around problem scenarios rather than subjects or disciplines. Students work in groups or teams to solve the problems or situations. They are not expected to come up with a predetermined set of ‘right answers’ but they are expected to engage in the complex situation and sort out what information they need and skills they may need to acquire in order ‘solve’ the problem. This approach can be diverse and flexible across many disciplines and diverse contexts. The focus is around problem scenarios rather than discrete subjects.

Advantages of Problem-based learning

“Smart questions are essential technology for those who venture into the Information Highway. Without strong questioning skills, you are just a passenger on someone else’s tour bus. You may be on the highway but someone else is doing the driving.” (McKenzie 2000)

This quote from Jamie McKenzie underscores the fact that questions need to be searching if students are to engage in much deeper thinking.

Capra and Ryan (2000) suggest that PBL places students in an active role as problem-solvers and confronts them with situations that reflect the real world. One of the prime goals of PBL is to foster critical thinking and problem-solving skills. The greater relevance of what is being learned also results in increased motivation of students.

The New Zealand Curriculum: Draft for consultation (Ministry of Education, 2006) document highlights the need for the key competencies. One of these is ‘Thinking’ and a description of this is (p.11):

Thinking is about using creative, critical, metacognitive, and reflective processes to make sense of and question information, experiences, and ideas. These processes can be applied to research, organisation, and evaluation for all kinds of purposes – developing understanding, making decisions, shaping actions, or constructing knowledge. Intellectual curiosity is at the heart of this competency. Students who have well-developed thinking and problem-solving skills are active seekers, users, and creators of knowledge. They reflect on their own learning, draw on personal knowledge and intuitions, ask questions, and challenge the basis of assumptions and perceptions.
The same document suggests that by studying science students:

- develop a coherent understanding of the world, based on current scientific knowledge;
- learn that science involves particular processes and ways of developing and organising knowledge and that these continue to evolve;
- use their current scientific knowledge and skills for problem solving and developing further knowledge; use scientific knowledge and skills to make informed decisions about the application of science and its implications with regard to their own lives and the environment.

As can be seen problem-based learning sits well within the new curriculum.

Problem-based learning and the traditional curriculum

Comparisons of problem-based learning with traditional curriculum are often demanded by educators in order to make judgement on the effectiveness of the new technique. In a paper by Schwartz, Mennin and Webb (2001), which examines 22 case studies, 20 are medical related, one is from architecture and one is from engineering, the conclusion is drawn that some fundamental issues arise as they would for any innovations in education. The work was done at the University of Manchester. They are relevant to PBL because of the:

- resistance of faculty and students to change as substantial as moving from traditional curriculum to one that includes PBL;
- fear of loss of control and of the unknown;
- unfamiliarity of many faculty members and students with the philosophy and practices of PBL;
- intense scrutiny that PBL is subjected to in order ‘to prove’ that it works at least as well as traditional methods.

They then go on to summarise the key lessons learnt if PBL if it is to be successfully implemented and they are (pp. 172-175):

1. Leadership and sound governance are crucial in introducing and implementing PBL successfully.
2. There is an absolute ‘buy in’ and ownership of a PBL curriculum by faculty and staff.
3. The importance of effective faculty development programmes in preparing staff for PBL is often underestimated with negative consequences.
4. Effective communication and collaboration in preparing for the integrated approach utilized in PBL are essential but are more complex and demanding than in more traditional curriculum.
5. Conflict and uncertainty about power and control related to teaching and learning will arise.
6. Assessment methods have to be consistent with how students are learning in PBL.
7. Dealing with dysfunctional groups or individual problem students is a fundamental part of small group PBL.
PBL versus traditional assessment are essentially of an incompatible nature according to Savin and Wilkie (2004). They suggest that it is not possible to say that PBL is any better than lecture-based learning as there have been no quantitative studies done. Bond and Feletti (1997) suggest that it is impossible to accurately compare PBL and traditional curricula as there are too many variables to control. They go on to suggest that it may be possible over a five-year period through the use of an instrument such as the ‘Student Course Experience Questionnaire (SCEQ)’ Sydney University (2006).

Savin-Baden and Major (2004) suggest a large range of appropriate methods for assessing PBL. These include: group presentation, Individual presentation, tripartite assessment (three submissions from the group and individuals averaged), case-based (again medical), portfolios, reflective journals (online), reports, self-assessment, and collaborative assessment and peer assessment.

What the PROBLIT Students are Learning

This section documents some of the previous research surrounding the objectives of this project, which are:

To determine the effect of problem-based learning in online teams:
- On students’ attitudes towards science
- and on students’ learning outcomes

Attitudes

Historical Development of the Concept of Attitudes

The modern concept of attitudes has developed over a long period of time with some of the first research and ideas published early last century.

Shrigley, Koballa and Simpson (1988) suggest that Fleming (1967) provided the most significant study about attitude as a modern concept. Fleming (1967) points out that around the turn of the 18th century artists used the term attitude largely to describe the posture of a stationary figure and later actors and dancers performing. This sense is still retained in a secondary role today where the term ‘attitude’ is used to describe events such as an aircraft in flight. Fleming credited Charles Darwin as being the first to associate emotion with the concept of ‘attitude’ when he used it to describe the emotional readiness of animals in a state of crisis. Shrigley, Koballa and Simpson use the work by Thomas and Znaniecki (1918) to explain the attitudes and morale of the early Polish immigrant farmers in the United Sates. Thomas and Znaniecki (1918) tried to understand unexpected results in productivity that arose when the physical demands of workers and work conditions were changed. They eventually invoked attitudinal and psychological explanations when physical reasons such as fatigue did not sufficiently explain production figures in the industry.

Fleming (1967) claims that it was primarily Thurstone (1928), with his manifesto ‘Attitudes can be measured’, who ensured that attitude would remain because it could now be quantified. Shrigley (1983) notes that Likert who followed Thurstone,
simplified the process with an item analysis technique, which allowed the data of respondents of statements to also serve as measures of validation (Likert, 1932).

Despite the term ‘attitude’ having very popular current usage, the meanings given to it can vary considerably (Koballa, 1988). Its widest meaning includes many educational objectives and outcomes other than those that are essentially cognitive or physical (Mathews, 1974). Shrigley (1983) maintains that ‘attitude’ is central to human activity yet education researchers have had considerable difficulty understanding it, because it often appears inconsistent and even fickle. Some are tempted to abandon it or even deny its existence. Shrigley stated that it is generally agreed that attitude is not innate, but learned as part of culture. Shrigley (1988) suggested that feelings are central to attitudes towards science or toward a particular scientific concept or phenomenon. The three parts of the attitude trilogy are affection, cognition, and conation.

Some of the critical differences in the reactions of one child with those of another to their schools expectations are often a function of their intelligence and differences in their preferences, attitudes, drives, needs, interests and values. Often a student may exhibit a disinterest in a particular subject and as a result be viewed as a poor student while in another subject in which they are interested, may be seen as intelligent. A positive attitude towards a subject may not necessarily equate to an interest though an attitude implies a disposition to react in a particular manner towards that subject. Getzels (1969) maintains that it is our interests rather than our attitudes that drive us. The attitude ‘behaviour-link’ appeals to many science education researchers but there is an element of uncertainty surrounding this link in the eyes of some researchers. Shrigley, et al (1988) suggest that ‘the relationship of attitude and behaviour is probably correlational rather than literal.’ (p. 676)

Education research has focused attention recently on affective outcomes, particularly attitudes. This attention has arisen because affective variables are seen to be just as important as cognitive variables in influencing, and possibly predicting, learning and other outcomes (Koballa, 1988). Shrigley, et al (1988) suggest that there is much confusion surrounding the fundamental principles of attitudes. Some of this confusion involves mixing concepts of attitude with belief and value with opinion. Shrigley (1983) derives the following composite definitions of the key elements to the attitude concept:

1. Attitudes are learned; cognition is involved.
2. Attitudes predict behaviour.
3. The social influences of others affect attitudes.
4. Attitudes are readiness to respond.
5. Attitudes are evaluative; emotion is involved. (p. 438)

The Development of Instruments for the Measurement of Attitudes

In a study to revise and validate a Likert (1932) science attitude scale for young scientists by researchers, Misiti, Shrigley, and Hanson, (1991) comment that ‘during the middle school years attitudes are formed that influence science course selections in the high school and college’ (p. 525). Following on from this, if there is not a positive student attitude towards science then career choices of the best students probably will not include the sciences and engineering. Consequently, development
and validation of attitude measuring instruments needs to be maintained if research into attitudes is to be continued. According to Germann (1988) attitude researchers must clearly define the construct being investigated and its place within the larger theoretical framework. They must then demonstrate the reliability and validity of the instruments used to measure it. This has not always been the case and there are difficulties comparing findings that use different terminology but measure similar attributes or, conversely, use similar terminology but measure different attributes (Brophy & Good, 1986). Fraser (1978c) points out that there are three important problems associated with several instruments to assess attitudes to science. These include low statistical reliability, a lack of economy of items, and often conceptually distinct attitude dimensions being combined into a single scale and thus presenting a confusing mixture of variables.

Attitudes towards the science disciplines have been assessed since the 1960s and one of the earliest and frequently quoted examples was a study by Perrodin (1966). Perrodin (1966) examined over 500 fourth, sixth and eighth-grade students in the United States. His assessment was in the form of open-ended statements such as ‘The study of science is more important than…’ The students completed these questionnaires and then the data were summarised and categorized by Perrodin to make final qualitative judgments.

Moore and Sutman (1970) developed and field-tested the Scientific Attitude Inventory (SAI) for use with secondary school students to test for intellectual and emotional attitudes towards science. The SAI comprises 60 items ranging from knowledge of laws or theories of science to feelings about being a scientist. After investigating 30 studies of the SAI, Munby (1983) questioned its validity, noting that it was the most popular attitude instrument at that time. Baker (1985) described the SAI as having two scales, one positive and one negative. He calculated the total attitude score by subtracting the negative scale from the positive. Other studies using the SAI did not report the method of calculation nor separate scales (Munby, 1982). Moore and Foy (1997) revised SAI but did not report any changes to these conceptual difficulties. Thus, doubts of validity continue to be raised (Munby, 1997).

Many instruments for the measurement of attitudes have now been developed, with the majority following Likert’s (1932) style that sums rating scales (Gardner, 1975a, 1975b). Fisher’s (1973) 20-item Likert scale for junior high students was developed using a jury of science curriculum experts to generate areas of interest within the attitude object. Statements were then written to match each subcomponent. This instrument had good correlations, reliability and internal consistency. The Likert scale has a different point scale for positive and negative statements reflecting their degree of agreement with that statement. It should be noted that an important feature of the Likert scale is that their intention is often obvious to respondents who could fake the responses to reflect more positive or negative responses. This is why it is important that the students know that there are no ‘marks’ for this and their response sheets are anonymous if possible. The Likert scale is presented in Table 2.1.
Klopfer (1976) alleviated the semantic problems caused by the multiple meanings attached to the term ‘attitude’ to science. Klopfer classified six categories of conceptually different attitudinal aims (Shulman & Tamir, 1972).

**Self-Efficacy**

No study on attitudes and young people would be complete without some reference to self-efficacy. Prof Albert Bandura of Stanford University, regarded by many researchers as a top world authority on self-efficacy, defines self-efficacy (Bandura, 1986, p. 391) as “peoples’ judgments of their capabilities to organize and execute courses of action required to attain designated types of performance.” Essentially it is confidence in one’s own ability which in turn can influence (Bandura, 2004):

- The choices we make.
- The effort we put forth.
- How long we persist when we confront obstacles (and in the face of failure).
- How we feel.

Bandura (1994) maintains that self-efficacy is one of the key factors in self-motivation.

Self-beliefs of efficacy play a key role in the self-regulation of motivation. Most human motivation is cognitively generated. People motivate themselves and guide their actions anticipatorily by the exercise of forethought. They form beliefs about what they can do. They anticipate likely outcomes of prospective actions. They set goals for themselves and plan courses of action designed to realize valued futures (p. 75).

Unlike attitudes, science self-efficacy has only been investigated in recent years with work by researchers such as Baldwin, Elbert-May and Burns (1999) who developed an instrument to measure science self-efficacy.

There has been little research in New Zealand on the development and validation of instruments to measure self-efficacy although Dalgety, Coll and Jones (2000) developed and validated an instrument for use with tertiary chemistry students- Chemistry, Attitudes and Experiences Questionnaire (CAED). The effect on self-efficacy of cooperative group work and assessment could be significant, but is regarded as beyond the scope of this study.

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**Table 2.1.**

*The Likert Scale*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Statement</td>
<td>1 point</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Positive Statement</td>
<td>5 points</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

---
The New Zealand Curriculum: Draft for consultation (Ministry of Education, 2006) outlines the Key Competencies required to be developed by our students for the 21st century, one of these is ‘managing self’ and this is described as (p. 11):

Managing self involves self-motivation, a “can-do” attitude, and the ability to establish personal goals, make plans, and set high standards for oneself. It is about students knowing who they are, where they come from, and where they fit in.

Students who can manage themselves are enterprising, resourceful, reliable, and resilient. They act appropriately and are aware of the effects that their words and actions may have on others. They have strategies for meeting challenges and know when and how to follow someone’s lead or to make their own, well-informed choices.

Self-efficacy and a can-do attitude are essentially synonymous and hence measurement of self-efficacy forms part of this research (Details of the instrument used can be found in the Methodology, Chapter 3).

**SOLO: Deep Thinking**

An important part of this research is that students engage in deep thinking as a result of being engaged in problem-based learning. Measurement through the use of the SOLO taxonomy is seen as the best way of achieving this.

Two Australian academics, John Biggs and Kevin Collis, developed the SOLO cognitive processing taxonomy. As a paper by John Hattie and Gavin Brown (2004) of Auckland University suggests, it categorises mental activity by quantity and quality attributes of the activities required by students or by the observable products of student work.

Details of the SOLO taxonomy appear on the next page.
SOLO taxonomy (Biggs & Collis 1982, Biggs 1996) is used as a measure of higher-level thinking. SOLO: Structure of Observed Learning Outcomes

Table 2.2
SOLO Taxonomy

<table>
<thead>
<tr>
<th>Name</th>
<th>Descriptor: Solo Taxonomy</th>
<th>SOLO Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pre-structural</td>
<td>(Confused or irrelevant responses, responses do not relate to the question, does not remember the question, says “I don’t know”, restates the question, makes a guess as to what response is required, wishes to finish quickly without even considering the problem)</td>
<td>1</td>
</tr>
<tr>
<td>2. Uni-structural</td>
<td>(Makes use of one relevant point or feature, generalises in terms of one aspect, finishes quickly, conclusions inconsistent, jumps to conclusions on one aspect.)</td>
<td>2</td>
</tr>
<tr>
<td>3. Multi-structural</td>
<td>Involves two or more relevant points or features but does not link them which may result in inconsistency especially when drawing conclusions, generalises in terms of a few limited aspects.)</td>
<td>3</td>
</tr>
<tr>
<td>4. Relational</td>
<td>(Involves and relates two or more relevant points or features and gives an overall concept or principle, generalises well within a given context, consistency within a given context, but may be more consistent when going into other contexts.)</td>
<td>4</td>
</tr>
<tr>
<td>5. Extended abstract</td>
<td>(Recognises alternative approaches and searches for alternative explanations, evaluates and improves basic subject knowledge, generates new approaches, uses meta-cognition, recognises cross-curricular links.)</td>
<td>5</td>
</tr>
</tbody>
</table>

Relevant uses of the SOLO taxonomy.

Globally the examples of the use of SOLO are growing with universities leading the way. It is an integral part of many courses and the assessment of them.

There has been some work in New Zealand through Auckland University where Gavin Brown (2002a) suggested that most NZ secondary school students take a more surface approach to their learning. He found from a group of Year 11 science students that study was in fact going over the year’s work to improve their knowledge and pass assessments. In his PhD dissertation (Brown, 2002b) he states that while teachers preferred deeper thinking they had to use a surface teaching approach in order to prepare the students for high stakes assessments such as NCEA.

In Australia Maguire (1988) used SOLO as part of an evaluation of bright and gifted students from elementary and junior high school. The students were working independently in small groups on projects.

In the conclusion to their paper for Auckland University’s asTTle (Assessment Tools for Learning) programme, John Hattie and Gavin Brown (2004) comment (p. 26):

SOLO is a hierarchical taxonomy based on an analysis of the structural characteristics of questions and answers. It identifies characteristics of increasing quantity and quality of thought.
Students must be able to master both surface and deep thinking and they can gain such proficiencies if teachers require, through their questioning of learning and/or via the nature of the assessment tasks, students to develop both surface and deep thinking.

**Exemplars: Online uses of SOLO.**

There are two modes of online learning with the most common being asynchronous communication. This involves essentially e-mails, forums etc as the basic means of communication. The other is synchronous which is the use of IM’s (such as MSN, Skype) and chat rooms. The following two projects have used SOLO to establish the level of ‘deep thinking’ involved in each of the respective programmes.

- Holmes (2004) from Australia used SOLO in the analysis of an asynchronous online discussion between 28 teachers retraining in the field of mathematics. The findings were of interest in that the levels of thinking online showed at least 50% were about the multi-structural level on SOLO however some student’s levels did remain low for the entire duration of the study.

- In a study by Slack, Beer and Armitt (2003) of Sheffield University in the United Kingdom, students from four European counties collaborated and communicated to carry out a problem-based learning in occupational therapy. They were to complete two assignments using essentially entirely synchronous communication in the form of chat rooms and IM’s. All of the history was recorded and analysed using SOLO. This was thought to be one of the first studies of its type. The nature of IM’s often means shorter comments but there was a significant amount of higher level thinking among most of the groups.

To sum up SOLO is a very useful tool especially when used in conjunction with problem-based learning programme no matter what the format or age level of the students.

**Conclusion**

There is a lot of good research on many of the components of this project, teamwork, Problem-based learning, student-directed learning, attitudes and their assessment, the assessment of deep thinking using SOLO and powerful learning experiences in relevant contexts. This project encompasses all of these.
CHAPTER 3 METHODOLOGY

The objectives of this project are:

To determine the effect of problem-based learning in online teams:
  • on students’ attitudes towards science
  • and on students’ learning outcomes
To determine the feasibility of the ICT rich programme.

The methodology will reflect these objectives looking to get the best possible data from a wide range of sources.

To Determine the Effect of Problem-Based Learning in Online Teams

On students’ attitudes towards science.

Attitudes: Quantitative Data

Prof Darrell Fisher of Curtin University (WA) will assist with analysis of the effectiveness of the programme using a combination of instruments.

The instrument was drawn together from a variety of validated and reliable instruments and although the numbers are small it should give us an indication of any changes in attitudes within the groups. An outline of a statistical validation process can be found in Lowe (2004) where the Test of Science Related Attitudes (TOSRA) was validated for the first time in New Zealand secondary schools. The group is small statistically and this is always going to compromise the data collected. Below is an outline of the scales and numbers of items within each scale. A copy of the instrument can be found in Appendix A.

The instrument will be administered to the group as early in term 1 as possible (pre) with the post being left to as late as possible in term 4 (post). This to allow for as much change as possible since the group is small statistically and significant results are less likely over a shorter time interval.
Table 3.1
PROBLIT: Instrument for assessing attitudes.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Number of Items (questions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning about the world:</td>
<td>6 items</td>
</tr>
<tr>
<td>Learning to learn:</td>
<td>6 items</td>
</tr>
<tr>
<td>Involvement:</td>
<td>7 items</td>
</tr>
<tr>
<td>Cooperation:</td>
<td>8 items</td>
</tr>
<tr>
<td>Equity:</td>
<td>8 items</td>
</tr>
<tr>
<td>Attitude Towards Computers:</td>
<td>8 items</td>
</tr>
<tr>
<td>Student Self Efficacy:</td>
<td>8 items</td>
</tr>
<tr>
<td>Total Scales: 7</td>
<td>Total Items: 51</td>
</tr>
</tbody>
</table>

Ethics

The students were given 'secret' numbers to identify themselves for the instrument. They were asked to save this somewhere safe. This helped to retain their anonymity. Each school was also numbered. Having the students identified as single units significantly improves the project statistics.

The parents of the prospective PROBLIT students were given a written document outlining the programme including the research aspect and requirements. This was done prior to final student selection and there were no issues arising. The G&T coordinators facilitated this process.

When the final list of those students selected was complete all parents and principals were given approval forms outlining the nature of the project and the associated research. A copy of the approval forms can be found in the appendices, (Appendix D and Appendix E).

Use of images

There were two further approval forms required, one was needed for publication of video and images on the Biotechnology Hub after the Video Conference with Dr Jim Kaput (USA) and Dr Lyn Ferguson (Auckland University) while the other was needed for publications relating to this project. The permission form for the VC can be seen in the appendices (Appendix 6) while the permission form was essentially identical with the inclusion of written publications.

Attitudes: Qualitative Data

Interviews

The students were interviewed at each of the camps after the initial ‘Human Potential Camp’. Interviews were recorded using an Olympus digital recorder. Once they were downloaded they were converted to MP3 files using iTunes and then Garage Band
where I was able to edit them for the purposes of presentations. Appropriate sections of the audio were transcribed for this report. The content of the interviews was similar for each camp as it was important to note changes in student responses. At the final ‘Goat Island’ camp there were some extra questions asked.

A. Student Interviews 1: Caving trip 11-13 June 06

Start: Do you mind if I record this interview?

These are broken into 3 parts. Note: Prompts to be used at the interviewers discretion and if the students got ‘off track but it was interesting’ the interview was continued.

1. How you are finding the programme?
2. Support structures that are working and ones that need attention?
3. Suggestions to improve the programme?

1. How you are finding the programme?

a. Are you enjoying working in your team on these projects and problems? Prompts, why etc if not, why not?
b. How do you think your team has progressed over the first part of the year? Prompts, elaborate as required, how have you improved, has it become easier? Etc.
c. Are you communicating with people such as other teams or specialists to help you with problem solving? Prompts, Has this increased? If not do you plan to? etc
d. What aspects of the programme do you enjoy the most, the camps, working as a team etc?
e. What are you doing to ensure all team members are contributing to the team effort? Prompt is it working, any improvement needed?

2. Support structures that are working for your team and ones that need attention to help you achieve better.

a. How is the actual area you work in for you, do you have a space you regularly work in? Describe where you work?
b. The CoroNet schools are all different. What do you think would be the ideal environment for your team to work in?
c. Have you had enough support from people at your school, such as IT and GAT teachers, bearing in mind they are very busy and often under resourced? How could things be improved and what suggestions do you have if any?
d. Are you getting enough support from me, are you having to do too much? Prompt are you finding it easier now, or is it still too hard? etc.

3. Suggestions to improve the programme.

a. Do you have any suggestions as to how we could improve what we are doing?
4. General points
   a. Are you using the SLO’s or ‘what you are meant to know,’ much?
   b. How do you assign tasks, or do you?
   c. Do you have much communication with other teams or people?

Thanks for this, really appreciated.

Goat Island Interviews (last camp)

The following extra questions were asked of the students.

1. Which types of questions in the projects have you found more interesting and/or enjoyable? The big picture focus questions or the SLO’s (The what you need to know stuff)?

2. What have you learnt about your learning and what parts of the programme have you enjoyed?

3. How have you enjoyed working with other students like yourselves from the other schools?

4. We are possibly going to have a camp early next year for the Year 10 G&T students. Part of this may be to tell them about this programme. If your team was asked to speak to them about the programme (and you might), what would you tell them?

5. What do you think of the idea of having a Year 13 student (a sort of i Tutor) working in the same area as you (ie in the same pod of computers) who could give you the occasional bit of help eg computer stuff or even the science?

6. Would you like to do this in a few years time?

B. Parents, principals, HOD science teachers, G&T Coordinators and IT support teachers.

I collected feedback from this group of stakeholders from a range of sources and they included:

- E-mails from online archives. I am using smart mailboxes which sort received and sent from various groups.
- Informal conversations at camps. I have ensured that a good range of teachers and parents have been on the camps.
- Telephone calls.
- Questionnaire sent out to all of the stakeholders by e-mail in term 4 after the last camp. Details below.

Note: Some of the feedback I asked for from this group was not just for the assessment of student attitudes, but also other objectives. I will only list the questions to parents as the others were just variations to suit their position. These other questions will be seen in the Results, Chapter 5.
Feedback Questionnaire for Parents

Could you please answer the following questions as best you can. Simply fill in the spaces after each question and return it to me as soon as possible please. The support from parents has been fantastic,- thank you for this.

1. How have you found your child’s attitude towards their science program this year?

2. What are your thoughts on the program from a parent’s perspective?

3. What improvements could be made (consider all areas here) if this program were to continue?

4. If you have been on a camp as parent help how have you found this aspect of the program?

5. Any other comments about the program?

Thanks for your help with this, it is really appreciated. Don’t hesitate to contact me if you want to ask any questions or chat about the program.

The fun and enjoyment side of the work comes from observations at camps, online archives and comments (especially via the .mac e mails sent out to the group as a whole).

To Determine the Effect of Problem-Based Learning in Online Teams

On student learning outcomes

The main method of assessing student-learning outcomes has been the use of SOLO to measure the ‘deep thinking’ that goes into the projects submitted by the students in their teams. This is described fully in Chapter 2. Literature Review.

The students submitted their completed projects by uploading to .mac groups. They were then checked and marked both traditionally, content etc. and using SOLO. The students also completed a number of online tests which had the results submitted via e-mail. This was useful for the students to ensure they were learning basic science principles and they enjoyed doing them.

The data collection timeline and a research grid summary are outlined below:
Table 3.2

**PROBLIT: Data Collection Timeline**

<table>
<thead>
<tr>
<th>Year</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>Action</td>
</tr>
<tr>
<td>Term 1</td>
<td>Term 1 first administration of science attitudes instrument PROBLIT)</td>
</tr>
<tr>
<td>Term 2</td>
<td>Observation and videotaping of team activities. Student interviews.</td>
</tr>
<tr>
<td>Term 3</td>
<td>Student interviews.</td>
</tr>
<tr>
<td>Term 4</td>
<td>Second administration of science attitudes instrument (PROBLIT)</td>
</tr>
<tr>
<td></td>
<td>Student interviews for qualitative data.</td>
</tr>
<tr>
<td></td>
<td>Teacher interviews for qualitative data /Parent Consultation for qualitative data.</td>
</tr>
</tbody>
</table>

Table 3.3

**PROBLIT: Research Grid Summary.**

<table>
<thead>
<tr>
<th>Main Research Question</th>
<th>Indicators</th>
<th>Data Sources</th>
<th>Timing and frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>To determine the effect of problem-based learning in online teams on students’ attitudes towards Science.</td>
<td>Equity, Involvement, Self-efficacy, Relevance, Science-related attitudes, Enthusiasm, Working as a team, Enjoyment, Creativity</td>
<td>Use of the instrument PROBLET Pre and post</td>
<td>Term 1 and Term 4 2006</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Student consultation, Science teacher consultation, Parent consultation, Informal discussion/interviews, Academic professionals, students, teachers, parents</td>
<td>Term 4, Term 4, Ongoing</td>
</tr>
<tr>
<td>To determine the effect of problem-based learning in online teams on students’ learning outcomes with reference to their problem solving skills and abilities</td>
<td>Problem solving skills, Higher order thinking, Produces original ideas, Student work</td>
<td>SOLO scores, Assessment results, Observations</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Communication skills</td>
<td>Asks questions, seeks help when needed. Frequency</td>
<td>Online archives</td>
<td>Ongoing</td>
</tr>
</tbody>
</table>
To Determine the Feasibility of the ICT Rich Programme

The last objective is to accumulate data on all aspects of the project that could influence any future decisions on the viability of the programme and its continuation. These aspects include:

1. How and what the students have achieved in their science.
2. How students have found the programme and working with other gifted and talented students from the area.
3. Funding and cost sustainability.
4. ICT capability of the schools within the cluster.
5. Time demands on the project director.
6. If this approach to teaching is seen as desirable by the leadership of the CoroNet Cluster.

This data will be extracted from all of the material outlined above and archived, other sources included:

- Meetings I attend of the G&T coordinators running the CoroNet TDI.
- Meetings of the CoroNet principals where I can present findings.
- Budget details of spending over the year.
- Conferences where touching base with other like-minded individuals helps with feedback and generates other ideas for implementing such a programme.
CHAPTER 4 THE LEARNING EXPERIENCES: PROBLIT SCIENCE CLASS

This chapter outlines some of the learning experiences the students have had both at school and in their camps. The following list outlines some of the aspects that were addressed:

- The HOD Science of all contributing schools was asked to submit their ‘scheme of work’ for Year 10 Science. A scheme for the PROBLIT course was established from this in conjunction the Science in the New Zealand Curriculum document (Ministry of Education, 1993).
- The ‘problem’ or ‘focus question’ had to invite responses that would encourage students to answer at the highest level of SOLO (extended abstract).
- In the case of all camps, once I had established contact with the key personnel I would clearly establish what I wanted the students to get out of the particular camp. I always e-mailed the project outline to them and they were able to then structure their presentations to suit. This worked very well.
- The use of ICT’s by professionals as part of their work was always highlighted to help establish the relevance of their use with the students.
- Communication between groups was assisted when all students were made members of .mac goups named Problit Science. This meant they could e-mail all members of the group and had secure access to each other’s details, work done and other resources.
- The context had to be ‘relevant’ and where possible provide a ‘powerful learning experience’.
- The camps needed to have a strong element of fun with good opportunities to bond and enjoy other students’ company.
- Students were taught that they must reference and acknowledge the sources of all material they have used.

Camp Experiences

Introduction

Staffing

The camps were in general staffed with two teachers including the researcher and two or three parents. The teachers were either G&T teachers or science teachers and they came from different schools for each camp to help spread the cost of relief around the cluster. This also gave more teachers the opportunity for direct involvement and feedback. There was plenty of parental support each time we went away. The types of activity were varied to ensure students got a good overview of the varied nature of science.
Documentation

As with any EOTC (Education outside the classroom) there is a certain amount of documentation and BOT approval that needs to be in place before the proposed trip can occur. It was decided gain approval centrally at Morrinsville College to simplify the process. Following is the list of documentation required.

- RAMS (Risk analysis and management system) form for the specific activity.
- A crisis management plan (camp staff need to be made aware of this).
- Liability release form (for gliding only, no form-no gliding).
- Medical clearance form (gliding only).
- Application for EOTC for BOT.
- Permission form for parents/caregivers.

Human Potential

This unit of work was to be based around the Human Body and with the 2006 Commonwealth Games due to start during term 1 this was thought to be a good topic to start with since there was already plenty of media attention on the games and the performance of our athletes. It was also important to have the first face-to-face meeting and meet the students from the other schools early in the programme.

The Programme

Auckland University of Technology (AUT) was one of the key players in the preparation and assessment of our top athletes. They were keen to put a programme in place for this group of students. This was in fact found to be a common attitude among various tertiary institutes who assisted during the year, which was great. AUT were also currently filming and presenting a programme entitled ‘Human Potential’ on TVNZ Channel 1. The students were asked to watch this in the lead up to the games and their first camp.

The focus question for their project was:

‘Describe how the following features of the human body work together and change with training to allow for optimum possible performance.’

- Cardiovascular system and how it functions.
- Respiration (include lungs, blood and the respiration equation).
- Digestion and nutrition (include basic food tests which you may like to try in a laboratory).
- Muscles, joints and connective tissue (cartilage, ligaments).

The students were asked to prepare two presentations in PowerPoint for a simulated youth conference at the games. The first one was a simple one outlining how the basic body systems normally operate. This was to be shown to the entire class on the first night prior to the AUT visit. This would allow me to help them with IT presentation skills and ensure they had a good base knowledge of the human body.
The second one was to be after the camp to answer the big-focus question applying what they had learned from the experts. Students were also directed towards ICT’s such as human body podcasts available from a variety of sources such as the BBC or the free iTunes online Music Store. They could then listen to these on their iPods or MP3 players. Some of these audio clips were excellent.

Camp Details

The daily requirements for such a camp were organised via e-mail right down to details such as transport for this widespread group. The students paid half of the cost ($40) of the three-day camp, which was the same for all of the camps. The students came together as a group very quickly at the Auckland Central Backpackers (ACB) in the middle of Queen Street, which was a marked change in environment for these rural students.

The students’ first showing of their PowerPoint presentations on the data projector (donated by HP) in their teams to the rest of the group showed good signs as they were well prepared and enjoyed the challenge as there were many foreigners walking through ‘our room’ at ACB.

The following photographs show activities the students were engaged in.

Photograph 4.1
*Muscle Balance test: AUT*

Photograph 4.2
*VO₂ Max: English Rugby Player*

Photograph 4.3
*Top NZ Nutritionist: Jenni Pearce: AUT*

Photograph 4.4
*Measuring forces: Duncan Reid: AUT*
Putting it all Together

The students were exposed to some of New Zealand’s top health professionals as far as sport is concerned. They then had to make the link with what they had learned about the basics before AUT and after.

The photographs above show the intensive use of ICT’s to test the athlete’s fitness and strength.

- In photograph 4.1 attached probes are measuring the relative strength of each muscle in the particular antagonistic pair. They help performance and reduce the risk of injury.
- In photograph 4.2 levels of gases entering and leaving the body are all monitored and when the athlete was exhausted at the finish a blood sample was analysed digitally to get a lactose read out (an indicator of aerobic fitness levels).
- In photograph 4.4 the forces of impact (or take off for long jump etc) are measured using pressure plates to help improve technique/performance and reduce injury.

Student Access to the Material from School

On returning home all of the photographs and movie clips are put onto a web site. I found by far the easiest way was to use the mac system of iPhoto to iWeb to Publish, which automatically prepared the photographs for publication. The student then had access from school (and their parents for interest) the next day and they could get on with their project using our own material.

Cave Chemistry

This unit was held at Waitomo caves and was based around the ‘Chemistry of Caves’. The previous unit on Earth Science had essentially lead us to the caves with sedimentary limestone formation followed by uplifting and then chemical weathering. The caves’ future has been under question as far as sustainability and tourism are concerned. How the caves and tomos are formed involves some good acid/base chemistry and equilibrium.

The focus question was: “How can cave environments be effectively managed to ensure that they remain available to future generations of New Zealanders?”

They preceded this camp with some basic chemistry, much of it web based. There was a small practical component where they were asked to bubble CO₂ into a test tube of limewater, making observations, and then heating once the white precipitate had dissolved.

They students had four distinct experiences for this topic.

1. A talk by Waitomo staff with good models and samples at the Education centre.
2. A visit to a cave open to the public with no controls.
3. Walk through a commercial cave (Ruakuri), this is well-monitored (CO₂ levels etc) and set up at great expense (Over $3 million) for tourists with walkways and atmosphere control.

4. A traffic controlled cave, Zweiholen, where only between 500 and 1000 people go through each year. This was to be a ‘genuine cave experience’ for the students.

The Camp

We stayed at an old farm cottage owned by the Auckland Speleo Group (ASG) and as such it was set up for cavers with squeeze tables, ropes off walls and numerous charts showing the labyrinth of caves recently discovered (and hints of those yet to be discovered). It was on the Stubbs farm a family, which has been caving for generations. It was very primitive, right down to the loo with a view and twelve person bunks (six on each layer). The students loved it even when the power was off all the second day due to huge storms (which were not a problem when we were in the caves!). The technology challenge was how to cook pizza with no power. Each team had to bring and prepare a meal for all of the teams. This was a great exercise in teamwork and cooperation with the motivating factor being food rather than academic success this time.

The following photographs show some of the real experiences the students (and staff) had during this visit.

Photograph 4.5
Controlled Atmosphere: Entry Ruakuri Cave

Photograph 4.6
Walkways: Reduce foot traffic in cave

Photograph 4.7
Zweiholen: Genuine caving experience

Photograph 4.8
Water: Continuing to play its part
Gliding

This unit was our ‘Force and Motion’ unit and was to be based on gliding at the Piako Gliding Club based at Waharoa near Matamata. The pilots and support staff were technically very proficient and were able to offer a great physics experience. We had planned a reserve day at the end of the week in case of inclement weather. There were two types of flights on offer.

1. A winch tow where the glider is pulled by a 1200m long wire in the same fashion as a kite is launched. The powerful V8 motor at the windward end of the airfield can haul two gliders one after the other.

2. A tow by a plane and release at a given height.

In both cases the glider would carry a GPS unit to record details of each flight for downloading later.

The Focus Question

‘How do glider pilots use the principles of the conservation of energy to enjoy long extended flights?’

The Camp

We stayed at the airfield bunkhouses and used the main committee room for our evening activities. There were some fantastic gliding DVD’s that helped out with understanding the principles of flight and how awesome some of the sights can be. One of the parent helpers with a gliding and flying background had brought his computerised flight simulator in order that the students could experience simulated flight in a range of planes. This worked well with the big screen and the data projector.

The morning started with a lecture on glider flight with some principles of physics, such as how and where to look for thermals to gain ‘free’ gravitational potential energy. The students picked up this type of idea very quickly: “You look for fluffy cumulus cloud at the top and dark patches on the ground at the bottom where more heat is absorbed from the sun.” There was certainly an air of excitement at the point when we took the gliders out of their hanger and helped with the pre-flight preparation such as polishing the wings to reduce friction. A ground-based lesson on the controls and how they worked completed the preparations.
Flying

The students found this a fantastic experience and all had the experience of two flights the first was a winch, followed by a plane tow. The glider had dual controls with the pilot in the rear seat. A good number of students were able to take full control for the entire second flight from release to just before land (our super pilots said, “You only get one chance at landing a glider!”).

The following photographs portray some of the experiences the students and staff were to experience during the day. We had students help with accurate recording of the exact times of all flights. This was aviation law and would also enable us to identify GPS data later specific to each student’s flight.

Photograph 4.10
Preparation: Buckle in your team mate.

Photograph 4.11
Preparation: Attach the towline under the watchful eye of Pilot Bill Mace

Photograph 4.12
The winch power source: V8 engine

Photograph 4.13
Winch launch: Note thermal clouds
The students had fantastic learning experiences with this activity. Even when we had delays due to the ‘weakest link’ breaking there was some great physics involved. The wire was unforgiving in the case of a glider getting stuck or wheel problem so a simple link of synthetic rope to a specified breaking force simply broke instead of the glider. See it pictured with one of the students.

Back at Home/ICT’s

The students had their project to complete using all of the material available to them. They were now expected to be more resourceful and look wider for information such as glider mass to do kinetic energy calculations etc. This time they were directed to a website where they could download a GPS reading program (See You) specific to gliders. They needed to set it up with the correct location and then load on the flight data, which they were e-mailed. These were IGC files and in fact tiny, being between 2KB and 8KB for up to 10 minutes of flight. Pilots refer to height in feet, which avoids confusion when talking about distance along the ground in metres. The graphs and data were available in any selected units.
Using this they were able to:

- Watch their animated flight in 3D from any angle.
- Get the data from any point on a flight path, such as speed, height and position.
- Get any plots they like such as altitude versus speed.

A flight that picked up a thermal is pictured (figure 4.1) and from this the gravitational potential energy gained from this is easily calculated. The pattern on the ground shows the actual path travelled relative to the ground.

**Figure 4.1:** Flight path: 4/9/2005 15.13h
Figure 4.2 Plot of altitude (m) vs time (actual minutes): 4/9/2005 15.13h

Goat Island

This unit was our ‘Ecology’ and we stayed near Goat Island Bay only a few minutes away from the Bay and the University of Auckland’s “Leigh Marine Laboratory”. The Marine Reserve runs 800m out to sea and is about 2km along the coast. Goat Island is close to shore and the shallow channel between the mainland and the Island provides a clear, relatively safe environment for snorkelling. About a 30 minute drive away is Tawharanui, which is on the next peninsular south. There is a marine Park there (being redesignated a reserve soon- more strict regulations) and an 18 month old mainland island reserve.
The Project Brief

New Zealand’s Endangered Species and World Biodiversity

Your team has been selected to submit a report (MS Word) to the appropriate government ministries such as: the ‘ministry of conservation’ and the ‘ministry of environment’ (these and other appropriate government ministries are at: http://www.kec.org.nz/greenlinks/nzgovt.asp)

You have been asked to investigate the following question.

“The protection of New Zealand’s many unique species is very important for the world’s Biodiversity. Why is this and how are we doing?”

You are to consider: Marine reserves, off shore islands and mainland islands, how each of these exclude relevant predators (common law, geographical, fencing).

As can be seen from this question responses invited from the students are certainly at SOLO Extended abstract level.

Tawharanui

We met one of the ARC rangers here and had an informative talk and walk around the predator fence (right across the peninsula). The monitoring and eradication of the various pests was highlighted along with the immediate impact removing these from the food web had on our native species such as the Dotterel. There were still issues to deal with and a range of possible solutions was outlined.

Photograph 4.18
Ranger Maurice explains.

Photograph 4.19
Tawharanui: The predator fence end
Auckland University: Leigh Marine Laboratory

We had a talk and presentation by Arthur Cozens of Auckland University where he outlined the history of Marine Reserves and fascinating results they have been getting around New Zealand. The use of ICT’s was evident with equipment such as remote-controlled video cameras underwater (see screen shots below) and very sophisticated teaching equipment for various marine life. Some of this was worth $12000 and let go on a fish! There is a good reward of $200 for anyone who catches and returns one.

![Remote Video 1998](image1.jpg)

**Photograph 4.20**
Poor Knights: Remote video 1998 (1.20 m triangle and bait station)

![Remote Video 2004](image2.jpg)

**Photograph 4.21**
Poor Knights: Remote video 2004

After a fascinating trip by glass bottom boat around Goat Island we were ready to experience being amongst it ourselves.

![Snorkeling](image3.jpg)

**Photograph 4.22**
PROBLIT team: Ready to snorkel in the marine ecosystem.
Camps: A Summary

The science camps were a huge success achieving all that had been planned, both from a pure learning point of view and as an opportunity for G&T students from such a wide range of schools to interact. The allowance of time for this was an important aspect of the camps. They also created a sense of envy with the students back at school that ‘your science is cool’. These learning outcomes will be covered in more detail in Chapter 5.

More deep thinking:

While we were doing activities such as caving students would go on to talk about ‘sedimentary rocks’ even though we were doing ‘Chemistry or other things such as jobs at Waitomo in the Tourism industry. This certainly lends weight to some suggestions that we are too narrow and prescriptive in what and how we teach. Here are students learning what they are interested in through genuine experience.

Video Conference Experiences
**Planned VC Meetings**

From the beginning of the project it was planned to have weekly VC sessions where any issues could be raised and specific teaching points covered. The students all had different science timetables and the booking schedule for the VC rooms throughout the cluster was becoming congested. We eventually settled on the best VC time to suit most students. This worked well for a while; however, the students were missing out on the same subject each week and this began to take its toll. The VC sessions could have been moved to lunchtime and the students could have taken their lunch break during science. However, one school had lunch an hour earlier than the others. As a result of these factors the VC sessions were on a much less regular basis than planned.

**PROBLIT VC Debate**

Human Reproduction is part of the Year 10 curriculum and as such it needs to be covered. This topic was approached in the following manner:

**Human Reproduction**

**Part 1**

The students were asked to simply cover the basics of this topic and given the guidelines or SLOs (Specific Learning Outcomes). It was simple matter of copy and paste from various recommended URL’s. A controversial issue debate involving birth technology was one way of getting the students involved and thinking at a higher level.

Following is the outline of the brief given to the students.

**VC Debate: Brief**

**Moot: “That surrogate motherhood is good for mankind.”**

**Background**

The daughter of a 42-year-old woman was diagnosed with cancer of the uterus; she had to have surgery which involved removing her uterus. The daughter had been married for some time and the young couple desperately wanted a child of their own. The mother offered to carry their child for them since the daughter’s ovaries were still fine. This did in fact happen in Australia and the mother gave birth to her own grandchild making everyone happy.

Meanwhile in the USA some career women have ‘no time’ to spend in a state of pregnancy and opt to ‘rent a womb’ where some women charge up to $120,000 to carry their child for them.

**What to do:**
You need to find out how this is done and get some good cases to back up your argument no matter which side you have been asked to be on, the negative or affirmative. You will not be told this until only a few days before the debate.

Mrs Fitzgerald (Morrinsville College G&T person) will adjudicate this debate, as she is very experienced with debating. This will be a first attempt at a VC debate.

A message from Mrs Fitzgerald:

“Remember a debate is: a formal, structured and civilized argument! No name-calling or rudeness no matter how heated the debate gets. It is all about arguing your side's case logically. You may need to have a close look at the idea of rebuttal, which is essentially just dealing with the opposition team's argument.”

Teams:

**Red Team** (Southern)
- teamwi
- teamta
- teammv

**Green Team** (Northern)
- teammb
- teamwa
- teamampa
- teamco

Speakers: Will be given 4-6 minutes each and the team leaders will be given 2-3 minutes for the reply. You will need to vote for your team leaders, (perhaps each of you could e mail your selections to me). You will need to work well together and communicate both before and during the debate.
You will need another way of communicating with the other teams within your own group of three or four schools and this will be by Skype.

While there were only a few technical hitches (this was the first time a few schools had used Skype to IM) the debate went very well. The students had done sound research around the topic and came up with some good arguments and rebuttals. The students said in a number of e-mails that it was ‘mean not telling them’ which side they were on, as they had to study both sides.

Northern Green were awarded the debate 290 to 271 they were the affirmative team. The formal mark sheet can be found in the appendices (Appendix B) at the end of this report. The marks were recorded on the student records.

If time permits we are planning another debate on:

**MOOT:** ‘*It would be good for New Zealand’s ecology if the tip of the Coromandel peninsular was fenced off and made a reserve.*’

This was the part of the Ecology unit, which addresses one of the major obstacles to reserves, ‘not in my backyard, thankyou’. We had some interesting discussions on the Goat Island camp when it was suggested. It was fine until they remembered the fact that ranger Maurice had told them all cats had to go, including their moggy!
**PROBLIT: Who Wants to be a Millionaire?**

This was based on the television series of the same name and was on the topic “Human Potential”. The questions were asked in order rotating through the schools with the rest muting their VC (the VC is sound controlled; the sound activates that particular team to appear on screen). Teams were allowed to use two lifelines a text or phone call, if their VC room had one. If the team got the question right they were awarded 10 marks, if they got it wrong it was thrown open to the first team to unmute their VC control, if they got the question right they were awarded 5 marks, but wrong minus 5. We had a number of rounds before finding the eventual winners. The idea of lifelines was a problem with some schools having a blanket ban on cell phones and no VC room phones.

This went very well but was very noisy; one team got told off for making too much noise in their non-sound proofed VC room. Having fun learning this way was really enjoyed. The marks, as with all activities, goes onto their student records.

**Nutrigenomics by VC.**

Nutrigenomics is a new branch of Biotechnology. This looks at how our genetics affects the way our bodies handle various things such as food, type 2 Diabetes, Crohns disease etc. Dr Jim Kaput of the USA was visiting New Zealand for a conference and he expressed an interest to work with some Year 10 students on VC. He would work from Auckland with Dr Lyn Fergusson of Auckland University. The PROBLIT group of students was available and keen.

The VC was coordinated by a teacher Fellow Mrs Sara Loughnane and linked with the Biotechnology Hub for schools by Mrs Cathy Bunting. It was to be video taped in Wellington by Aisling McCarthy. I was in Christchurch at the time with CORE Education and I joined the VC from Christchurch College of Education.

**Format:**

The students were all on VC at their respective schools and had been previously e-mailed a set of questions to ask. This was done first, and then after each team had asked a few questions, they were given the opportunity to ask any other questions, which they did.

The video footage was then placed on the Biotechnology Hub for use by New Zealand schools after the appropriate ethical consent forms had been obtained from the student’s parents for the use of their images on the Internet (see Appendix F).

Dr Jim Kaput really enjoyed working with the students. Following is an extract from an e-mail he sent to the CoroNet Principals. The full e-mail can be seen in Appendix C.
Dear Principals,

I am writing to let you know how impressed I was with your students – they were engaged and interested. They also seemed to enjoy the interaction, as did I. This is most impressive since Lynn and I were touted as the experts and many young students would not be as comfortable. Although some of the questions were prepared for them they also had an opportunity to ask questions on their own – which they did with enthusiasm.

Regards
Jim

This use of ICT’s is only going to grow as it is a very cost-effective way of taking top people around the world to any audience.

Note for sharing ICT such as this.

The opportunity existed with their project for any other interested school group such as Y12 and 13 Biology. The size of VC rooms does restrict this and it would be better if schools could put VC’s such as this via the network to a particular classroom. More students could then interact using IMs and the VC could be saved onto DVD or hard disk.

Below are some screen shots from the video taken from the VC session on Nutrigenomics of two PROBLIT teams.
**Parent night VC**

A parent report night was held soon after the students mid-year reports had been issued (a copy can be seen in the Appendix G). It seemed appropriate to hold this using the VC. There were only three parents who could not make this event, held on a Wednesday evening at 7PM. We did have a technical issue with one school and their login but otherwise it was very successful. Most parents took along their child as IT support, which was good. We rotated around the different groups of parents fielding various questions. The parents enjoyed the occasion and found out all they needed to know.

**AgResearch Day: Hamilton**

This group of students were invited by Agresearch to attend a special training and information day at their site in Hamilton. This was held at the end of the first term in the holidays. A good number of the students were able to attend this very informative day.

Focus was on ‘How to do a research project’.

- There was a talk and a PowerPoint presentation on how to get started and what steps need to be taken to ensure a good project.
- Some AgResearch scientists did presentations on current research project involvement. There was usually some great IT involved with many of the projects they told us about. These often involved remote monitoring.
- Students were offered help should they be involved in a project for Science Fair or CREST.

This was to be a very worthwhile event and gave the students a good insight into some real projects being done by real people.

**Dr David Lowe: NIWA Greta Point**

It is planned to hold another VC later in November taking advantage of a top New Zealand (and world) authority on green house gases and global warming, which is very topical and I suspect will remain so. The students will ask Dr Lowe questions they have prepared as part of their Ecology project. The questions will be rotated around the cluster, as has been the norm to date.

**Student Style “Who wants to be a millionaire?”**

This is planned for a revision of the student work. This time the students do all of the questioning and answering in their teams from each school’s VC room. This should be fun and involves setting good questions to a time limit. Following are the rules sent to the students:
Rules: Usual rules with a few changes.

1. Each team has a topic to do eg gliding or Goat Island I will give you these unless you e mail me 1st with one you particularly want be in quick.

2. They make up the questions and know the answers.

3. They run it from their school VC and as before rotate around the schools, 10 points if you get right, if you don’t or pass, anyone can interrupt and try to get a bonus of 5 points if it’s right, lose 5 if it’s wrong. You have 6 minutes each for your set of questions.

4. Life lines if you like, 1 text to anyone you like. You only have 90 seconds then your lifeline is gone.

Course Work and ICT Experiences

Some of the topics we studied which did not have a camp where the experience was ‘real’, incorporated the use of ICT’s to help the students get an appreciation of what is happening now. In all cases the ‘focus’ question that involved the deeper thinking was outlined and then followed with the main SLO’s for the unit. A number of relevant links were always given to them, but they were expected to find more of their own and document these in the references. A typical unit was the Geology Unit titled ‘Tsunami Watch’ with the focus question being:

“How well are we prepared for a Tsunami at a New Zealand beach resort such as Pauanui?”

This topic was fantastically planned as the students started on it 3 days before the ‘fake’ Tsunami warning coming in from Tonga! The use of ICT’s in this unit included accessing remote cameras located on beaches and in volcano craters. The students enjoyed doing this unit. The unit can be found in Appendix H.
CHAPTER 5 RESULTS AND CONCLUSION

Introduction

The results of this research project will be presented in line with the initial objectives outlined earlier in this report. ICT’s form an integral part of this project and, as such, comment will be included throughout this report when, and if, they are seen as relevant in the enhancement or restriction of the project and its delivery. The final conclusions outline what has been found during the project; what implications this may have for future research. The direction of our future science teaching has been indicated to a certain extent by the new draft curriculum document (Ministry of Education, 2006) but as science educators perhaps we need to take the lead. This issue is also discussed here.

The Effect of Problem-Based Learning in Online Teams on Students’ Attitudes Towards Science

Quantitative Results: The Results from the Instrument PROBLIT

Statistical data on Pre and Post Administration of PROBLIT

With a final sample of 17 students the numbers were relatively low for statistical purposes. After the first administration the means and standard deviations were as outlined in Table 5.1:

Table 5.1
Student Attitudes: Pre PROBLIT Administration

<table>
<thead>
<tr>
<th>Scale</th>
<th>Mean (Pre)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning about the world:</td>
<td>3.44</td>
<td>.44</td>
</tr>
<tr>
<td>Learning to learn:</td>
<td>2.43</td>
<td>.80</td>
</tr>
<tr>
<td>Involvement:</td>
<td>3.90</td>
<td>.61</td>
</tr>
<tr>
<td>Cooperation:</td>
<td>4.13</td>
<td>.53</td>
</tr>
<tr>
<td>Equity:</td>
<td>4.39</td>
<td>.90</td>
</tr>
<tr>
<td>Attitude Towards Computers:</td>
<td>3.18</td>
<td>.41</td>
</tr>
<tr>
<td>Student Self Efficacy:</td>
<td>3.67</td>
<td>.49</td>
</tr>
</tbody>
</table>

There was in fact little significant shift in these values with the post PROBLIT administration in late October 2006. The analysis was done using SPSS software by Curtin University of Technology (WA).

D. Fisher (2006) of Curtin University, suggests that these values are high by international standards, which leaves little room for improvement in these attitudes by the students. B. J. Fraser (2000) also of Curtin University, suggests that it is common
for student attitude with this age group of students to decrease during their schooling, hence no change in attitude is in effect an improvement on the norm and the figures can be looked upon as encouraging.

ANOVA was used to determine whether there were any statistically significant differences between the perceptions and attitudes of the science students from the different CoroNet schools and none were found.

These results are also pleasing in that the attitudes of the students from the different schools throughout the CoroNet cluster are all in fact very good by international standards.

**Qualitative Results: Attitudes and Learning Environment**

The data collected from the key stakeholders about student attitudes have been organised into three sections. The first one is perceived student attitudes as seen by the key stakeholders: students, parents, principals, HODs, gifted and talented coordinators. The second considers various aspects of the PROBLIT learning environment seen to potentially affect student attitudes and hence learning outcomes. The third section looks at views on the assessment issue of Problem-based learning in teams versus traditional learning. The effect this has on student expected learning outcomes and resultant student attitudes are discussed. One aspect of the learning environment that is important with this age group is what their peers think about them this is also covered under the learning environment. In the interests of privacy all names used in the transcripts and questionnaire responses are fictional.

**Section one: Perceived Student Attitudes**

**Student Interviews**

When I interviewed the teams of students at each of the last three camps I found that they were very enthusiastic often and went beyond the initial question. However, if it was considered relevant to the programme evaluation, the thread was carried on. The students’ responses could be pulled apart and categorized but the flow of how they are thinking would be lost, hence I have tried to keep the responses together where possible. Team number (school) and where the interview took place are noted with each team interviewed. Table 5.2 outlines the time and location of the camps:

<table>
<thead>
<tr>
<th>Time</th>
<th>Camp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term 1:</td>
<td>Human Potential (Auckland) no formal interviews.</td>
</tr>
<tr>
<td>Term 2:</td>
<td>Waitomo Caves</td>
</tr>
<tr>
<td>Term 3:</td>
<td>Gliding (Waharoa)</td>
</tr>
<tr>
<td>Term 4:</td>
<td>Goat Island (Leigh)</td>
</tr>
</tbody>
</table>
General Thoughts on their Experiences With PROBLIT.

Team 3 (Goat Island)

How are you finding working with the students of similar ability?

*It’s good to work with people like ourselves, from other schools. They are open-minded look outside the square, and don’t mind doing something different*” (Sonya).

*The camps are cool we get to do what we are actually learning* (Toni).

Which camps did you enjoy the most?”

*The caves were cool, the gliding was good actually... all the camps were cool. Auckland was great coz we went to the gyms and stuff* (Toni).

Team 5 (Waitomo Caves)

What aspects of the programme do you enjoy the most?

*The camps are fun, but also we can do it however we want-we don’t have to follow set instructions by a teacher* (Janet).

*Even if it’s the long way around, we do it* (Sam).

Team 5 (Gliding)

How are you finding working with the kids of similar ability from other schools?

*Its great* (Janet).

*Coming to these camps reminds us there is more of you. Usually there are just the three of us in the VC room. Coming here and there is everyone who’s doing the same thing and we can learn off each other and we have a fun* (Pip).

*A LOT of fun* (Janet).

Team 7 (Gliding)

How are you finding working with the kids of similar ability from other schools?

*The camps are really cool and when we had skype for the debate it was cool too* (Laura).

What about the learning style - how are you finding this style of learning?

*You get to experience what you are learning* (Jane).

Team 1 (Gliding: Joined programme at this camp)

How are you finding working with the students of similar ability?
Before I came I thought there would be heaps and heaps of brainy kids here and I wouldn't fit coz I would be like the dumbest there coz I am from school 1 and but yeah it’s been really cool and sharing knowledge with know with them and they share with us and it's really cool meeting people from other places. It was kinda weird when we first came but it’s OK now –we’re really enjoying it. It’s a real fun way to learn (Korina).

Questionnaire responses: Parents

This group of key stakeholders had a very high response rate to the questionnaire. They seemed to enjoy an opportunity to contribute however possible to the learning of their children and that of other students in the future.

1. How have you found your child’s attitude towards their science program this year?

Toni has always been fairly self motivated and conscientious. However, once she got her head around what was expected and how it was going to work, we have seen her interest and desire to achieve in science really grow. The experiential learning camps have been a highlight and have given her a real appreciation how text book science fits into the real world. I don’t feel this would have happened with just classroom science (Parent 1).

Silvia has been really positive about the programme, and has enjoyed the stimulation of meeting other gifted students from around the region - other brains to spark off and to compete with. She's greatly enjoyed all three camps she attended: the excitement and privilege of heading away, and the considerable interest of the topics covered there as well (Parent 2).

Excellent attitude. She enjoys the projects, the way she works in a group with her friends and loves the research and asking questions of the adults she knows to fill in the gaps or better understand what she finds on Internet. She is looking forward to next year and learning more science as opposed to trying to avoid it if she hadn't enjoyed it. It is interesting how she has related some of her geography learning to the science projects, with some good lateral thinking, so I would say that the problem-based learning and keeping an eye on the big picture seems to work well (Parent 3).

Claudette has had a positive attitude throughout the year. The experiential trips have been both socially and intellectually stimulating for her – the best part of the programme of course!(Parents 6).

Michael has enjoyed the wide variety of subjects covered, especially how the practical "go out & do stuff" tied in with the more theory-based learning (Parent 7).

For Faith, it has ranged from apprehension, frustration (with fellow team members and school co-ordinator at times), to the fun and excitement and the friendships and bonds that were made with the other groups, and the invaluable knowledge and experiences gained from the camps (Parents 8).
Diana is very focused in things she is interested in so it is no surprise that she enjoyed this program, as she enjoys science and her attitude towards this program was excellent (Parents 9).

2. What are your thoughts on the program from a parent’s perspective?

As with Sonya, once we got an appreciation of what the program was really all about I began to appreciate what an amazing opportunity she had been given. The growth in self management and self discipline skills, information gathering and computer skills, self expression and a real appreciation of how science “fits in”, combined with a lot of fun and mixing with other gifted students, has been outstanding (Parent 1).

Year 10 is an excellent time to introduce this programme - after the initial settling-into-college year, but before NCEA begins to bite. It's provided Silvia - and others - with something to really get their teeth into, at a point where they might begin to get bored and restless in a mainstream class. The students seem to have responded well to the privilege of being invited on the programme - not taking it for granted, but getting stuck in and making the most of it. Personally, I particularly like the hands-on practical application of something like the gliding camp - what a cool way to learn about the physics of flight (Parent 2).

From my perspective I think that the program was a good challenge for Liz and provided her with exciting experiences working with her peers (Parent 4).

I like the process of enquiry learning and the concept of stimulating enquiry by the real life experiences. I like the meeting up of students from other geographical locations and the fresh stimulus they provide. I wonder if the likes of our son, who is less likely to enjoy academia, would respond to such an opportunity and if this is a programme which is sustainable within the current school economic climate (Parent 6).

Has given Victoria untold memories and experiences that money can’t buy. It has also opened her mind to what is out there in the big world (Parent 10).

**Questionnaire responses: Principals**

1. What sort of feedback have you had on the Problit program and from which interest groups?

The major contact with the programme has been through the feedback reports from Paul – I have then checked the understanding of his information with my HOD science and some of the kids; the parental feedback has been incredibly positive and I know the kids have really enjoyed, and gained positively, from the experience. (Principal 4)

All very positive from students to teachers to members of the community. It was spoken about positively at a PTA meeting last night (Principal 1).
Very positive from parents, students and staff. I have appreciated being kept in the loop by yourself. Your regular e-mails and photo gallery were excellent (Principal 3).

**Thanks (Principal 3).**

**Questionnaire responses: HOD Science**

1. How have you found the Problit students’ attitudes towards their science program this year?
   Very positive ---They seem to be keen and proud of what they have achieved (HOD 1).

   I really enjoyed working with the group particularly seeing their interaction with other like-minded students. It was particularly good because I had been our group’s teacher in Year 9 (HOD 2).

**Questionnaire response: CoroNet ICT coordinator**

Great, enthusiastic, positive. Always engaged, able to follow instructions, or ask Paul for assistance. (They have NEVER asked me or the G&T coordinator for assistance in defining the expected work/outcomes.)

**Discussion**

Students’ attitudes are clearly reflected in the comments above. The opportunity to mix with like students also comes through as a strong motivating factor in the case of the camps where face-to-face meetings occurred. The attitude towards PBL was also very positive in all interest groups.

**Section Two: PROBLIT Learning Environment and Attitudes**

Following are the responses from various groups that relate to the perceived learning environment created through the PROBLIT 06 Science programme.

**Student Interviews**

**Team 4 (Waitomo Caves)**

What were you saying about the caves?

_Oooh they’re beautiful- it’s more than you’d expect you’d expect a cave to be. All scary as, and slippery as floors, heaps of drops and everything, everything was on display. Everything showed all its best views to you, you didn’t see nothing bad (Terry)._  

_I didn’t realize a cave was like that (Claudette)._  

_I thought a cave was like a big round hole that went so far and then a dead end or go out through the mountain or something (Terry)._
Yeah ((Claudette)).

This is like an artist’s dream when you think about it coz in art you don’t use rulers and compasses like graphics- you just draw it straight off your head. That’s what a cave is like- they’re just out of there. It’s just amazing what you learn when you are not paying attention coz we’re just mucking around yet were learning a lot without thinking about it (Terry).

**Team 8 (Gliding)**

How are you finding working with the other students of similar ability?

*I am really enjoying it coz the kids that are here like from other schools and stuff they are really cool and really into the whole science thing and the camps are real fun as you just get to do much more than your normal science classes. You get to do extra work and extra fun.*

How are you finding looking at questions in a bit more depth?

*I find it really cool. We are not stereotyped with the rest of the class who can only learn about one thing. You can go in depth like learning about things you are really interested in like the engine in the winch was really cool. If I was in a normal class camp we wouldn’t learn about that stuff- everyone would get bored and we are with people who enjoy the same things as us and we are encouraged to think outside the square- think of the bigger picture. Learning about the clouds was cool as (Louise).*

You mentioned the clouds and the warm patches?

*Yeah um we learnt that certain clouds are developed by the hot patches on the ground and like I never knew that. It’s all about the cumulus and how when they go up there- they use the thermals to get more height and go there (Louise).*

*It’s so cool. Now every time I see a cloud I will say, hey look (Louise).*

**Questionnaire responses: Parents**

1. If you have been on a camp as parent help how have you found this aspect of the program?

The camps were invaluable. It not only demonstrated how the science they were learning had real application in their everyday lives but gave them the chance to “get their hands dirty” and do it for themselves. On top of that came activities pushing a few personal boundaries (including some of those of their nameless parents) in a fun environment which all helped build both self reliance and team bonds (Parent 1).

*I really enjoyed helping at the camp, it wasn't something I have ever really done before. I found myself having to reduce my knowledge to their level to explain things and found this hard... I am not a trained teacher. The kids had a fantastic experience gliding, the looks on their faces showed it for the whole weekend. It was well*
organized and really couldn't have gone better. I will certainly help in this way again if asked (Parent 3).

GREAT!! The one common point made by parents and teaching staff alike was that they are a great group of students to be with. They interact well together and their behaviour was exemplary (Parent 5).

I didn’t go on a camp as such. I attended the gliding day at Waharoa. It was great. The kids were smiling from ear to ear. They had to be learning (Parent 2).

Fiona – I attended the Goat Island camp. I found it well organized and educational for me too!(Parents 9).

2. Any other comments about the program?

Problit has given Sonya a higher level of interest in science, leadership skills, computer skills, self-management skills and presentation skills. But more than that it has taught her to start going the extra mile, not just taking things at face value and looking for consequences and interactions. All these are the very skills she will require when she enters into tertiary education (Parent 1).

Just a huge thank-you for making it happen - it's been a wonderful experience for Silvia, and inspiring and cheering for those of us who have felt a bit under-inspired by the current system (Parent 2).

I like it. It is a fantastic way of learning and I can tell it has really kept the interest and hence motivation to do science in the kids involved. I am sure given a choice pretty much all of them would do it again (Parent 3).

School wasn't like this when Selene and I were students! (some time ago admittedly). It would be great to see more students offered this opportunity. While enjoying the "experience" each camp offered, I thought the group was well aware of the "BIG PICTURE" and had sound understanding of its place in the scheme of things (Parent 5).

A great learning experience for the kids and I'm sure they all appreciated the opportunity to participate (Parents 7).

We hope the students realise how lucky they were to be chosen for this programme because of the experiences they had and the knowledge they gained (Parent 8).

Keep doing it if you can. I would be nice to change the way of teaching and have this method available for a select few like your program and the likes of Montessori. Cost will always be the prohibiting factor. We appreciated that Diana was able to participate and thank you very much for your efforts (Parents 9).

Questionnaire responses: HOD Science
1. Have they shown less reliance on science staff over the course of the year?

_These students have been pretty self reliant throughout the year. Traits considered when choosing them! (HOD 1)._  

2. What improvements could be made (consider all areas here) if this program were to continue?

_Nothing springs to mind here—I have been impressed with both the programme and its outcomes (HOD 1)._  

3. If you have been on a camp as a teacher/scientist how have you found this aspect of the program?

_I really enjoyed working with the group particularly seeing their interaction with other like-minded students. It was particularly good because I had been our group’s teacher in Year 9 (HOD 1)._  

_Great for the students to have had such an opportunity and long may it continue (HOD 2)._  

_Questionnaire responses: Principals_

1. Do you have any comments on the type of work the students have been doing in this course.

_I am a scientist and have really enjoyed the higher and diverse thinking that has been the cornerstone of this programme. I will watch with interest to see other dimensions of talent explored within our cluster (Principal 4)._  

_I have liked the range of activities, the student-focused learning and the balance of theory to practical (Principal 3)._  

_It seems fascinating and I love the range of activities (Principal 1)._  

_The camps have obviously been very successful in achieving their learning goals (Principal 2)._  

2. Any other comments about the program?

_‘I know our pool of students are “talented” but they are probably more “coachable” and hardworking than others – it would an interesting curiosity for me to have satisfied about where in the talent pool (vis. International understanding of talent pool) they are placed (Principal 4)._  

_Outstanding (Principal 1)._  

_The fact that we are so keen to support it again in 2007, from our own funds, is testimony to the high regard that we hold for the programme. The work being done is
exactly the sort of work that we should be developing further in our regular school courses (Principal 2).

**Peers**

The students’ peers were not interviewed but comments were sought from the students and parents in order to establish the general feeling of their peers about the programme.

Most of the students reported a certain amount of envy from their classmates about the PROBLIT programme they were on:

Team 4 (Goat Island)

Have you had any feedback from your class?

*Yeah it’s the special needs class (all laugh) (Pip).*

*Most of them are really jealous….what did Bill say? (Janet).*

What…o in graphics I was talking to this guy Bill and he’s like ‘so wens yout next camp?’ , being sarcastic because he didn’t think we had anymore camps ooh it for ecology and we are going snorkeling and er a glassbottomed boat …and like its next weekend (laughter) and goes grrrrrrrrrr (more laughter) …….He says you guys never get to anything that’s normal science thing. (Pip)*

*I think they get the impression we never do any work (Janet).*

*But we do (Pip).*

*Because they dont see us (Janet)*

Out of sight out of mind (interviewer).

*I think they just think we just go on camps (Janet).*

The following e-mail from Team 2 was an interesting response when I suggested that they could present their PowerPoint to their science class when they got back.

**Hi Paul**

*We have been thinking about what you said about presenting our slide show to our science class. We think that although it would be good for us to practise our presentation skills this would not be a good idea. The other students already feel jealous about the camps we have and opportunities we get through this science and I think it could seem like we were rubbing it in their faces. I know this is not true but can understand why they would feel that way.*

*Linda and team*
As can be seen from the examples above their classmates did like the programme there were on. I did, however, get some feedback from a couple of schools via parents about a bit of ‘tall poppy’ knocking. An example is below.

Parent 10

Sonya has been very enthusiastic all year. There were some stages of the unknown as to what they were missing in the normal science class. At the beginning of the year the students suffered some of the “tall poppy syndrome” from their peers. They had to be able to handle this. However, once that was overcome, the attitude was very enthusiastic.

In general, however, the attitudes of their peers were very positive towards the programme and those who were lucky enough to be part of it. Most of the students in the programme were very positive and outgoing kids and this would also have contributed to the positive attitudes towards what they were doing in science.

Section Three: Problem-Based Learning in Teams (PROBLIT) versus Traditional: Assessment

Introduction

The fact that students were assessed in teams and using a PBL approach to their science for the year was always going to create some issues with various stakeholders in the project. This is understandable given the variation from the ‘norm’ in most New Zealand schools. When this project was established it was decided to follow the Specific Learning Outcomes of each school as closely as possible to enable these students to sit the same examination as the rest of their class. While matching programmes across all of the schools was difficult, a reasonable match up was managed. The students in some cases actually sat the end of unit tests when they had finished the unit. The following data from students, parents and principals helps give an outline of some of these issues:

Student Interviews

The students were asked questions about how they felt about the types of problems they had been set and what affect they thought this had on their learning.

Team 3 (Goat Island)

How have you found the variation in the questions - we have had basic questions and extension type questions. How have you found these?

The SLO’s were quite easy, not easy, but quickest to learn. Once you got to the extension questions you had to think a bit more - it sort of took you a bit deeper - it sort it made it more interesting. It was in more depth (Sonya).

What have you learnt about how you learn?
Sometimes a teacher is good for getting an answer straight off but this way you have to find out for yourself... we work in the library and find it out ourselves from books and the Internet. But we can go and find a teacher if we really need one (Toni).

Team 2 (Gliding)

How do you find the learning style?

It is more interesting but also it takes so much longer because you can’t do as much. Like learn as many different things coz you couldn’t spend this much time on every subject like going gliding and everything when we are at school. At school we spend most of our time finding information - we don’t seem to have as much time to study it and actually remember it (Linda).

I enjoy doing the practical work coz it’s lotsa fun and it makes the work more interesting but it takes quite a bit of time ... it’s good for our jobs or career or whatever, but for our exams it’s different from what out class are doing (Sharon).

Team 5 (Gliding)

The types of questions you have been asked; you have an extension question and the SLOs. Lets look at the SLOs first.

Those are ok - we like them because we actually know them, like it’s basically answer this question and then go onto the next one (Janet).

It sort of gets us started instead of going onto the high question (Pip).

The formats ok with them?

What we usually do is copy them onto the notes and answer it on a power point slide (Janet).

What about the extension questions how - have you found those?

We thought they were interesting especially the debate topic. That was a good one. We had a good discussion with the librarian there - lots of people talking around the school it’s quite interesting actually how it would ... something in the real world it’s not just learn this, it’s because this could happen (Janet).

What have you found about how you are learning?

I think like we have got way better working in a small group - we are used to just sitting back in class, and going, “o yeah that one’s number three,” and sitting there (Janet).
We have definitely got better at working together - then we get we learn more coz we bounce off each other (Pip).

And we understand things better if we explain it to other people (Janet).

**Questionnaire responses: Parents**

The questions I asked of the parents were quite general in nature leaving plenty of room for the opportunity to add in extras about assessment and their child’s science programme. At times both parents had written the response together and this has been indicated after the transcript.

1. What are your thoughts on the program from a parent’s perspective?

   Our child seems easily bored and certainly finds some of the current school subjects less than challenging, so having something like this which is completely out of left field in terms of the learning experience is great. She has loved the camps and the contact with her peers by VC and for us, in a relatively small school with limited choices of subject to stretch her with, it has been excellent. I initially had some concerns about the lack of exams which mean there appeared to be no easy way of ensuring she was keeping up with her peers, but having looked at the work she is doing and had a talk with one of the science teachers at school we were satisfied that she was well ahead (Parent 3).

   I agree this is an ideal way to learn. It suited Diana, however, I don’t believe it would be ideal for all students. We are so entrenched with school certificate, UE and NCEA etc I can’t help but wonder whether Diana has learned the correct material to meet the needs for exam, (I do not hold much stores in the need for exams anyway) PBL appeals to me more than the need to pass exams, however, you have to do what you have to do to gain the tools to achieve what you want to achieve in life. If those tools include NCEA, so be it (Parents 9).

   Attention needs to be placed on aligning Problit with the classroom curriculum for the parents. I feel really sorry for the students that have dropped out of the program because their school/parents feel that they weren’t learning what they needed to achieve in science for that year without appreciating what they were learning (Parent 1).

   I think that the program didn’t cover the aspect of the curriculum that will be tested in the exams. Now I know that there is more to education than passing exams but exams are hurdles that need to be overcome. Most of the kids that I know on the program were borrowing books and notes from the rest of their class to catch up with the curriculum program (Parent 4).

   I thought a little more information to parents with regards to 'course' content would have helped. (Perhaps is just wasn't fed back to us from our Peter) (Parents 5).
**Questionnaire responses: Principals**

The questions I asked of the principals reflected the fact that as a group they are quite well read on educational research and well informed on future thinking and directions. A good idea of the bigger picture was taken for granted.

1. Jane Gilbert mentioned in her Key Note address at Ulearn that schools often have a role of ‘sorting and ranking’ students and she backs the idea of students working in teams on project-based work. While I have attempted to ensure all SLO’s etc are covered, schools do vary in their science courses and the few students (3) who have left the programme have said it is easier to just do the stuff in class and they will get good marks in the exam. The focus questions have really got them thinking at a very good level. (These could always be extension questions in exams.) Parents have asked about this, but do comment that the gains far outweigh the losses. Do you have any thoughts on this issue?

*I believe this programme in essence is piloting a way of bringing talented students to the fore in a very positive way – not as being “different” from the others, but allowing them to be encouraged to be strong meta-cognitive thinkers and doers. Some students will find this okay to do at home, or wherever, but it is the socialization of this work that is critical. Scientists (and others) do not work in isolation. We are collaborative thinkers – drawing on challenges and strengths of others… this is what these kids learn I believe (Principal 4).*

*Of course the gains outweigh the losses. In fact, I do not personally believe that there are any losses. The students will easily pick up on anything that they might have missed in class and they will have far superior skills and motivation levels as a result of being part of the programme (Principal 2).*

*If we wanted more of the same would we have started on a programme like this, this is meant to be for G&T, hence extension and thinking outside the square. Well done (Principal 3).*

*I think life is about more than just year 10 exam results (Principal 1).*

**Discussion**

The samples of student transcripts in this document certainly reflect the group as a whole. They had evolved a similar approach to the work I sent them, getting the SLO’s done and then getting on with the more interesting question. They enjoyed the freedom to explore and come up with their own answer. However, at times there was the underlying issue of the exam and, “how will I do?” This is quite understandable from a top student Year 10 student, the bigger picture ‘down the track’ may seem further away to them. I was very impressed with the maturity shown by the students when we talked about this issue, they knew it would be good for them and its been fun.

The parents represented the biggest return rate of all questionnaires and they certainly put a lot of thought in to their responses; they were all positive about the learning that
was occurring and knew it was a good way to learn even there were some questions about exams, NCEA and assessment issues. They were progressive in their outlook and were keen to see it work.

The principals certainly took the stance that this is the way ahead and what the students are learning using PBL should be useful in the future.

PBL versus traditional assessment are essentially of an incompatible nature according to Savin and Wilkie (2004). This is mainly due to the non-exact nature of material covered by the problems set for a PBL course; they are designed to ‘match’ the prescribed curriculum. There are some fantastic and searching questions set by New Zealand science teachers in examinations, which should never be overlooked as healthy debate continues.

The Effect of Problem-Based Learning in Online Teams on Students’ Learning Outcomes

Deep Thinking Skills

The assessment activities that had strong elements of ‘deep thinking’ were marked using SOLO to determine the thinking levels of the respective teams.

SOLO Results

Table 5.1
Solo Scores: School 2

<table>
<thead>
<tr>
<th>School 2</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>September</th>
<th>October</th>
<th>Nov.</th>
<th>Mean</th>
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<tbody>
<tr>
<td>SOLO Level and SOLO Score</td>
<td>Human Potential</td>
<td>Earth Watch</td>
<td>Farm</td>
<td>Waitomo</td>
<td>Reproduction</td>
<td>Gliding</td>
<td>Goat Island</td>
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Table 5.2
Solo Scores: School 3

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### Table 5.3
_Solo Scores: School 4_

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| Relational | 4 | | | \(\bullet\) | \(\bullet\) | |  
| Multistructural | 3 | \(\bullet\) | \(\bullet\) | \(\bullet\) | \(\bullet\) | |  
| Unistructural | 2 | | \(\bullet\) | | | |  
| Prestructural | 1 | | | | | | |

### Table 5.4
_Solo Scores: School 5_

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| Ext.abstract | 5 | \(\bullet\) | | | | \[3.9\] |  
| Relational | 4 | \(\bullet\) | | \(\bullet\) | \(\bullet\) | |  
| Multistructural | 3 | \(\bullet\) | \(\bullet\) | \(\bullet\) | | |  

### Table 5.5
_Solo Scores: School 7_

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<th>October</th>
<th>Nov.</th>
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<td>Farm</td>
<td>Waitomo</td>
<td>Reproduction</td>
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Table 5.6
Solo Scores: All schools

<table>
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<th>June</th>
<th>September</th>
<th>October</th>
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<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

Mean | 2.8 | 3.0 | 3.0 | 4.0 | 4.0 | 4.5 |

Figure 5.1
Plot of SOLO Scores over the year for each unit.
Discussion

The teams all showed a significant improvement in their deep thinking skills and this is backed up by the SOLO results. While there are too few for any significant statistical analysis the trend is clear. The students also really enjoyed this aspect of the work (see earlier transcripts).

CREST Success

While it was hoped that more students would have the time to be able to do significant open-ended research projects, this was not the case as the course work used up most of their time. However there were two projects selected for the Ingham’s East Waikato Science & Technology Fair, one from Te Aroha and the other from Morrinsville. Both won prizes, with the latter winning the Best Science in the Fair. This was selected for the New Zealand ‘Realise the Dream’ held in December. They won a major award; ‘The Livestock improvement award’. The girls have recently completed a Silver Crest award (One is not part of PROBLIT). The advantage these students had was previous experience with CREST and science fairs and hence the associated core skills for good research; they also had assistance from their statistics consultant, Dr Neville Jopson of Abacus Biotech Dunedin.

Tests and Examinations

While the regular science course done by their classmates has some elements in common there are significant differences. Three science HODs told me at a recent in-service day that they had in fact tested the PROBLIT students with the regular class tests when they had finished the unit and they ‘were right up there in the excellence category’. At the time of this report the examination results were not available but the students are doing very well when doing assessments not based entirely on the PROBLIT course.

Māori Students

One of the schools had two high performing Māori students, a boy and a girl. A number of their comments about the enjoyment and learning opportunities are including in this report along with the other students. They are both very positive about their experience, as are the parents. The boy has found the experience so rewarding he has accepted the challenge of doing the end-of-year speech for the junior school prizegiving on December the 13th. This is a big call and his G&T teacher said that she is very proud of him for agreeing to do this on such an important occasion.

To Determine the Feasibility of the ICT Rich Programme

Introduction
This project was part of the Ministry of Education E Fellowship programme with some input from the Gifted and Talented initiative won by the CoroNet cluster funded by the Ministry. While funding and a desire for the programme to run based on the outcomes achieved are important, the scope of this objective was to consider any factors that may limit the future success of the programme in areas such as ICT’s, environment and the necessary support structures.

**Environment**

Students are by nature very resilient; however, some common issues, which did impede their ability to operate efficiently, were evident. Many secondary schools do not have rooms where a group of students such as the PROBLIT team can work; most of them have found spaces such as libraries and computer rooms often with other classes present. This report simply highlights the issues and recognises that these things are often beyond the control of the teachers trying valiantly to manage ICT systems. Suggestions are made throughout and at the end of this report some possible systems that may help are suggested. Issues arising from this scenario are:

- Students cannot work and talk in many of these classes, and talk is an important part of efficient operation of a learning team.
- At times some teams had to literally walk around school looking for an unbooked room (or one with some space), at times failing altogether.
- Students suggested a white board for their planning and mind maps would be good.
- The ICT capability of each computer they use does vary significantly (outlined below).
- At some schools the computers did not have the programmes or capability really needed for the students to excel.

Below is a transcript of one team’s responses to questions on this issue. This was common:

**Team 7 (Waitomo Caves).**

I would like you to describe where you usually find yourselves around the school.

*Well on different days we are sometimes in the library, and then other days we are in the computer room, but sometimes the computer room is full (Laura).*

*Depends which classroom is booked or not (Peter).*

*Like if the commerce room is booked we go to the library (Jane).*

If you are able to design your own place to be what would it be like?

*A white board (Peter).*

*They have to be our own computers (Laura).*
Like laptops (Peter).

So we can do whatever we want on them like programmes coz on the school computers some things we can’t do. So we can look up images and stuff (Jane).

Like those videos we can get it on the school computers like we can’t use them for that like media player (Peter).

What about QuickTime?

We don’t have that (Peter).

I think some computers do (Sonya).

Learning Team Support and Selection

Support

The gifted and talented coordinators had the responsibility for the day-to-day needs of the PROBLIT teams and they had time from the G&T initiative for this role. This was fine for many of the student requirements but they did have other needs arising such as IT or science help. Students reported that they tended to approach different teachers for help depending on their requirements.

The students were asked at the last camp how they would respond to the presence of an iTutor (in their iProject room). iTutors would be good Year 13 students with good ICT skills and general ability who have the privilege of using the computer but would assist students, such as the PROBLIT teams, when they need it. Some student responses to this were:

Team 3 (Goat Island)

How would the idea of a specialized little room where senior students with non contacts with skills in IT and general skills could do their own work but have you in there?

That would be a good idea - it would be like away from any other classes and you wouldn’t get interrupted.

How would you get on with this age group?

Pretty good. Need someone who can relate to us (Sophia).

Team 7 (Goat Island)
What about working in a room with 3 or 4 computers and a Year 13 student to help you out from time to time? How do you reckon that would go down?

*I reckon that would be pretty good*” (Diana).

*That would be cool, especially if were in your own room and not getting interrupted all the time* (John).

The need for a good working environment and support is important. This project has highlighted what would be needed in an ideal world if in fact students are to learn this way. We can only work towards this as funds allow us to.

**Team Selection**

Three students from 2 different schools withdrew during the year. I was able to interview one of the two boys who said it was just as easy to get the work from the teachers in class and he would still do well in the exam at the end of the year. The other school had the situation where two left, including the captain, who left in term two; she was a strong driving force for the team and once the boy left the team was in tatters. The school supports the PROBLIT programme and the G&T coordinator makes the following comment:

“Give them a camp beforehand showing them PBL & SDL models & accompanying expectations, then they choose if the programme is for them. Some kids are not mature enough mentally & emotionally/ skill wise to learn autonomously. Foundation needs to be laid down first.”

It is important teams have the social skills to gel together quickly and focus on their goals, which are to master the PBL and SDL approaches, and get on well with other CoroNet G&T students.

**Communication**

This is a very important aspect of any programme with a significant online content and some issues do arise that place limits on the success of a programme such as this. These are outlined below. Most communication was asynchronous. In many cases satisfactory solutions were found which are included.

**The students and their parents**

School e-mail addresses were used for most daily needs between the teacher and the students. Copies were sent home if this was seen as appropriate. The PROBLIT team all became members of .mac groups that gave them the capability of e-mailing the entire group at once (along with access to course work and space to upload their work on idisk). Issues that arose during the year were:

- Well over 100 bounced messages from schools, usually over full inboxes or changed e-mail addresses in the case of two schools. This creates a lot of work at times to rectify.
• Some teams and individuals were poor communicators when using e-mail.
• Two schools e-mail system was down for a week (virus related).

Table 5.7 is a chart outlining team e-mail activity to date (mid November):
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<thead>
<tr>
<th>School</th>
<th>e-mails sent to</th>
<th>e-mails received</th>
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<tr>
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<td>Team 8</td>
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</table>

Note: Some schools were not part of the programme for the entire year and team 4 were great Skype users, hence reducing the need for e-mails.

1. The communication improved significantly when I suggested captains (based on communication). The teams all took up my recommendation with this.

2. A web-based e-mail would be much better using G mail or Yahoo. Both have well over 1GB of storage capacity (some schools allocated 200KB at the start of the year). G mail also has the ability to pop mail to another address along with a good storage capacity for the students own e portfolios for documents.

*Teachers: HOD science, G&T coordinators, IT teachers and principals*

These people all need to be kept informed and work with the students from time to time. Most researchers have found teachers quite difficult to contact by e-mail. This is possibly due to:

1. No computer available.
2. No time to access one, as teachers are very busy.
3. No need to usually, so there is no habit.

During this project this aspect improved significantly, and if teachers actually had a workspace they went to at the start of each day with their laptops I am sure it would help considerably.

*Synchronous communication*

The use of IM’s through Skype was attempted when VC on a regular basis no longer became an option. Teams who were able to use Skype communicated quite frequently with the program director. The use of IM’s means teams who have concurrent science periods can communicate with each other on a regular basis. Some schools banned Skype, citing security issues, but most are now on board. A possible solution is the use of ‘Knowledge Net’ with a chat room/IM type of scenario being set up.
Online Resources and Access

The CoroNet ICT coordinator Philip Buchanan made the following comments about possible improvements of the programme and sustainability:

I believe that using a common Learning Management System (KnowledgeNET - KN) as a base format of content and instructions delivery, where all supervisors and advisors can have easy access, is essential for sustainability.

Units of work, or projects, camp info’ would be usefully located on KN and be reusable (and easily edited). The forum on KN would be a very useful resource and communication vehicle.

Gail Wortmann, Teacher of the Year 2002 in Iowa, USA, has been running an online physiology course for 16 and 17 year old students. She said that they use WebCT and Skype to deliver the course. WebCT was, however, supported by the University of Iowa and its cost maybe prohibitive.

A combination of .mac for photo/movie resources and some e-mailing along with course material and forums on KN would possibly be the best and most efficient way of managing the project in the future. The proposed linking of KN with students’ management systems KAMAR would give parents automatic access to material posted on KN - this is another move to make this sort of project easier to manage.

Summary

A project such as this is always going to be demanding on resources and as we progressed through the year improvements were made. As long as schools continue to want to improve the learning experiences of their students and continue to improve the resources available to them, then this programme is a feasible option.

Making it Happen

PROBLIT findings and implications

This project along with previous work (Lowe, 2004) backed by significant research has shown that:

- Problem-based learning in teams does work and the students’ attitude towards their science programme is enhanced.

- Top students can cope with Student-directed learning (SDL) but they need some support structures in place to be successful.
• The relevant context of the problems is important and if they can experience it for themselves the learning is enhanced. An element of physical involvement is even better.

• Gifted and talented students from a range of schools brought together with a common goal do show personal growth and enjoyment from the experience.

• Their deep-thinking skills as defined by Biggs & Collis (1982) have improved significantly.

• We can’t always compartmentalise science into topics. Waitomo caves were great for: Chemistry, Biology, Geology, Physics and interdisciplinary work.

• Trying to mix traditional teaching and problem-based learning for the purpose of assessment creates problems for the students.

• Students do enjoy extensive ICT use as long as they not frustrated with under specified equipment.

• Students need dedicated workspace if they are to do projects such as this.

If we want to effect change we need to take action in order to effect that change. This programme highlights a number of strategies that need to be put in place if we are to progress and achieve the desirable outcome of better preparing our students for life beyond school. Some of the changes that need to be made are big and require some significant infrastructure change. This is best achieved if we move at a manageable rate towards our goals. The PROBLIT project has taken the first step towards achieving some of the desired outcomes and building on this is the best initial action plan. Outlined below are some suggested strategies to enable the full implementation of problem-based learning. A possible action plan for the researcher and the cluster follows.
PROBLIT 2007

The CoroNet principals have supported PROBLIT for 2007, which is excellent and shows the foresight to take on new challenges. At the time of writing this report there is still some consultation of key stakeholders to be completed. There is, however, very good support from the Science HODs and other teachers who have responded to date.

PROBLIT Course

The course will be run on the same basis as this year with a few significant changes to the programme. The G & T coordinators have planned a camp for G & T Year 10 students early next year. At this camp, in addition to other planned activities, students will be given an outline of PROBLIT and what is required of them. I would like to have some of this year’s PROBLIT students chat to them about the programme. During interviews at the last camp this year the PROBLIT students said they thought it would have been good for them to have this sort of support and they were keen to help out next year. To sum up changes to the course for 2007:

- Better preparation of the students for Problem-based learning (and associated SDL) and the outcomes expected.
- More stable e-mail addresses and bigger mail boxes. Google would be ideal as mail can be ‘popped’ to other e-mail addresses and has huge capacity.
- PROBLIT is the course and all assessment will be based on the work done during the course.
- The Year 10 curriculum document will guide the content of the course via the ‘Problems’ set.
- Students opting for the course will be do so in the knowledge they will be involved for the entire year.
- Schools will be trying to ensure that PROBLIT students have suitable workspace and computing facilities along with support.
- An interdisciplinary project will be attempted if there is support from the contributing schools. The most likely context would be the ‘Waitomo Caves’ problem that could involve: Science, Social Studies, Maths, English, Economics and Technology.
**PROBLIT and Project Work: Workspace and Support**

**Workspace**

The PROBLIT students this year had a huge variation in computer capability and workspace available. Students doing project work do need appropriate space and equipment to do so if they are to achieve to potential.

Some schools, such as Mercury Bay Area School, have mini laboratories located at the back of an existing laboratory with a glass window and door enabling supervision and help. The students have access to computers and basic laboratory equipment. Many projects require access to computers with good specifications in their own space, again with a degree of supervision. Many secondary schools have the bulk of their computers tied up in computer rooms with associated issues of access. Perhaps more schools need iProject rooms where students are able to work on projects in their teams.

**Support**

Students will have teachers in the background supporting their projects but at times need help with ICT issues or approach to problems. The PROBLIT students certainly liked the idea of selected Year 13 students giving them some help with their work in areas such as ICT and problem attack. Selected year 13 students could become iTutors with the bonus of having a workspace (iProject room) for their regular study during non-contact time, but a responsibility to help out the students working on their projects from time to time.

**Gifted and Talented Students**

PROBLIT has shown one way to get our more able Year 10 students to experience deep thinking, SDL and meet with other like-minded able students from a wide range of schools in relevant and meaningful situations. The Ministry of Education (2000) document endorses this approach to gifted and talented education and in a working party report to the Minister of Education (2001) the following statement is made:

> Programmes for gifted children must be learner-centred, flexible, continuous and co-ordinated, and encourage creative and complex thinking, and the desire to search for greater understanding (Part Two, p.1).

PROBLIT certainly fits this description.

**What sort of projects?**

This can be taken a step further by branching into supported Cluster-Based Projects (CBP) such as CREST projects.

- The students who have proved their ability to work independently previously through programs such as 1st CREST (at Intermediate), Bronze CREST or
PROBLIT can then attempt Silver CREST and later the prestigious Gold award.

- There would be support for the cluster through a Cluster CREST Consultant (CCC) who can provide support for the cluster science teachers and help link students with appropriate consultants from Universities, Crown Research Institutes and Futureintech Young Engineers.

- The principals of CoroNet have supported Problit with a time allowance in the role of the CREST consultant for the cluster. The Royal Society of New Zealand (RSNZ) has indicated at this stage they support such a move.

- Time for such projects can be generated for Year 9 and Year 10 by simply doing the project in the place of the PBL task(s).

- Year 11 to 13 students can generate time through the judicious selection of the Achievement Standard(s) from NCEA they wish to substitute with their project.

**Suggested Strategies for the Implementation of Problem-based learning to regular science classes**

**The Junior Science Course**

- For Year 9 and Year 10 science drop the Specific Learning Outcomes (SLO’s) but keep them in mind.

- Set up a Problem-based course in contexts relevant to the students.

- Ensure there is a least one learning experience such as ‘Waitomo’ outside the school. Others could be in the form of guests on VC with some two way interaction or virtual field trips eg. LEARNZ.

- Students are to work and be assessed in self-selected teams of three (or two).

- Teachers will facilitate the work with some: ‘Keystone Lessons’ (where a class explanation is deemed necessary), practical work, and the appropriate use of ICT’s.

- Assessment of projects will be done using SOLO and traditional methods.

- Encourage and allocate time for students to do more open-ended projects such as: CREST or the ‘Make a video illustrating a scientific principle’ contest.
Conclusion

The gifted and talented students from throughout the CoroNet cluster have experienced learning opportunities not normally available to them, however, one of the most important outcomes of the project has been the linking of like minds through ICT’s and face-to-face camps. The students’ attitudes and love of science and learning in general has certainly grown through these experiences.

Problem-based learning in teams has been shown both through this project and significant other research to be a very powerful method of engaging students in ‘real world’ problems and scenarios. This is a strong indicator of one way forward to better prepare all students for the future they face.

The rapidly expanding face of ICT’s will continue to offer huge opportunities for students from anywhere on the planet to work together on significant projects with common goals, so producing new knowledge and skills.
REFERENCES


Fraser, B. J. (2000, May). Personal communication.


Sydney University, (2005). *2005 Student Course Experience Questionnaire (Sceq)*

Thomas, W., & Znaniecki, F. (1918). *The Polish peasant in Europe and America.*
Chicago: Chicago University Press.


APPENDICES

PROBLIT QUESTIONNAIRE

<table>
<thead>
<tr>
<th>My Secret Number</th>
<th>I have a twin</th>
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<tbody>
<tr>
<td>(Remember this!)</td>
<td>(Circle one)</td>
</tr>
<tr>
<td></td>
<td>Yes/No</td>
</tr>
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<table>
<thead>
<tr>
<th>ETHNICITY</th>
<th>My gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Circle one)</td>
<td>(Circle one)</td>
</tr>
<tr>
<td>NZ/ NZ Māori /Other</td>
<td>Male/ female</td>
</tr>
</tbody>
</table>

### directions

1. **Purpose of the Questionnaire**
   This questionnaire asks you to describe important aspects of your science-learning environment, which you were in last year & the start of this year (before PROBLIT). There are no right or wrong answers. This is not a test and your answers will not affect your assessment. Your opinion is what is wanted. Your answers will enable us to improve future science teaching.

2. **How to Answer Each Question**
   On the next few pages you will find 52 sentences. For each sentence, circle only one number corresponding to your answer. For example:

<table>
<thead>
<tr>
<th>Almost Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Seldom</th>
<th>Almost Never</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   - **In this class . . .**
   - 8  I help the teacher to decide how well I am learning.  5  4  3  2  1

   - If you think this teacher *almost always* asks you questions, circle the 5.
   - If you think this teacher *almost never* asks you questions, circle the 1.
   - Or you can choose the number 2, 3 or 4 if one of these seems like a more accurate answer.

3. **How to Change Your Answer**
   If you want to change your answer, **cross it out** and circle a new number:
<table>
<thead>
<tr>
<th>Learning about the world</th>
<th>Almost Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Seldom</th>
<th>Almost Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 I learn about the world outside of school.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2 My new learning starts with problems about the world outside of school.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3 I learn how science can be part of my out-of-school life.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4 I get a better understanding of the world outside of school.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5 I learn interesting things about the world outside of school.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6 What I learn has nothing to do with my out of school life.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
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<table>
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<th>Often</th>
<th>Sometimes</th>
<th>Seldom</th>
<th>Almost Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 I help the teacher to plan what I'm going to learn.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>8 I help the teacher to decide how well I am learning.</td>
<td>5</td>
<td>4</td>
<td>3</td>
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</tr>
<tr>
<td>9 I help the teacher to decide which activities are best for me.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>10 I help the teacher to decide how much time I spend on activities.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>11 I help the teacher to decide which activities I do.</td>
<td>5</td>
<td>4</td>
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<td>12 I help the teacher to assess my learning</td>
<td>5</td>
<td>4</td>
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<table>
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<th>Sometimes</th>
<th>Seldom</th>
<th>Almost Never</th>
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<td>13 I discuss ideas in class.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>14 I give my opinions during class discussions.</td>
<td>5</td>
<td>4</td>
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<tr>
<td>15 The teacher asks me questions.</td>
<td>5</td>
<td>4</td>
<td>3</td>
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<tr>
<td>16 My ideas and suggestions are used during classroom discussions</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
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</tr>
<tr>
<td>17 I ask the teacher questions.</td>
<td>5</td>
<td>4</td>
<td>3</td>
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<tr>
<td>18 I explain my ideas to other students.</td>
<td>5</td>
<td>4</td>
<td>3</td>
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</tr>
<tr>
<td>19 Students discuss with me how to go about solving problems</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>20 I am asked to explain how I solve problems</td>
<td>5</td>
<td>4</td>
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<td>2</td>
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</tr>
<tr>
<td>Cooperation</td>
<td>Almost Always</td>
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<td>Sometimes</td>
<td>Seldom</td>
<td>Almost Never</td>
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<td>21 I cooperate with other students when doing assignment work.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
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</tr>
<tr>
<td>22 I share my books and resources with other students when doing assignments</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
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<tr>
<td>23 When I work in groups in this class, there is teamwork.</td>
<td>5</td>
<td>4</td>
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<td>1</td>
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<tr>
<td>24 I work with other students on projects in this class.</td>
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<td>4</td>
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<tr>
<td>25 I learn from other students in this class.</td>
<td>5</td>
<td>4</td>
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<tr>
<td>26 I work with other students in this class.</td>
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<tr>
<td>27 I cooperate with other students on class activities.</td>
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<tr>
<td>28 Students work with me to achieve class goals.</td>
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<td>4</td>
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<table>
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<th>Sometimes</th>
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<tr>
<td>29 The teacher gives as much attention to my questions as to other students’ questions.</td>
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<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>30 I get the same amount of help from the teacher as do other students.</td>
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<td>4</td>
<td>3</td>
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<td>1</td>
</tr>
<tr>
<td>31 I have the same amount of say in this class as other students.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>32 I am treated the same as other students in this class.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>33 I receive the same encouragement from the teacher as other students do.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
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<tr>
<td>34 I get the same opportunity to contribute to class discussions as other students.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>35 My work receives as much praise as other students’ work.</td>
<td>5</td>
<td>4</td>
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<td>36 I get the same opportunity to answer questions as other students.</td>
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<table>
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<th>Often</th>
<th>Sometimes</th>
<th>Seldom</th>
<th>Almost Never</th>
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</thead>
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<tr>
<td>37 I am good with computers.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
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<tr>
<td>38 I like working with computers.</td>
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<td>4</td>
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<td>39 Working with computers makes me nervous.</td>
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<td>3</td>
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<td>1</td>
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<tr>
<td>40 I am comfortable trying new software on the computer.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>41 Working with computers is stimulating.</td>
<td>5</td>
<td>4</td>
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<td>2</td>
<td>1</td>
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<tr>
<td>42 I get a sinking feeling when I think of using a computer.</td>
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<td>4</td>
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<tr>
<td>43 I do as little work as possible using a computer.</td>
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<td>4</td>
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<td>44 I feel comfortable using a computer.</td>
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</tr>
<tr>
<td>45 I find it easy to do what I want in science.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>46 I am good at using science.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>47 My colleagues ask me for help in science.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>48 I find science easy.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>49 I outdo most of my colleagues in science.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
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<tr>
<td>50 I have to work hard to keep up in science.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
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<tr>
<td>51 I am intelligent at science tasks.</td>
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<td>4</td>
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<tr>
<td>52 I help my colleagues with their work in science.</td>
<td>5</td>
<td>4</td>
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Appendix B

Debate Code: PROBLIT Debating
Prepared VC Debate: Year 10 Cyber Science : CoroNet
Place: VC CoroNet: (Red:Mv,Ta, Wi) (Green: Wa, Mb, Pa)

Subject: “That surrogate motherhood is good for mankind”

<table>
<thead>
<tr>
<th>Matter 40</th>
<th>Manner 40</th>
<th>Method 20</th>
<th>Teamwork 50</th>
<th>Reply 50</th>
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<tbody>
<tr>
<td>Subject knowledge</td>
<td>Personality</td>
<td>Speech Structure</td>
<td>Compare teams as a whole</td>
<td>Summation and Refutation</td>
</tr>
<tr>
<td>Relevance</td>
<td>Persuasiveness</td>
<td>Introduction</td>
<td>Collective presentation of case</td>
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<tr>
<td>Logical Reasoning</td>
<td>Language</td>
<td>Peroration</td>
<td>Continuity of argument</td>
<td></td>
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<tr>
<td>Quoted Authorities</td>
<td>Appearance</td>
<td>Technique</td>
<td></td>
<td></td>
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<tr>
<td>Definition</td>
<td>Stance - Gesture</td>
<td>Strategy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refutation</td>
<td>Use of Notes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Affirmative
Team: Northern Green

<table>
<thead>
<tr>
<th>Speakers' Names</th>
<th>Matter 40 marks</th>
<th>Manner 40 marks</th>
<th>Method 20 marks</th>
<th>Total 100 marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Student A: Whangamata</td>
<td>28</td>
<td>21</td>
<td>22</td>
<td>71</td>
</tr>
<tr>
<td>2 Student C: Paeroa</td>
<td>32</td>
<td>24</td>
<td>24</td>
<td>70</td>
</tr>
<tr>
<td>3 Student E: Mercury Bay</td>
<td>32</td>
<td>25</td>
<td>25</td>
<td>82</td>
</tr>
</tbody>
</table>

Total before reply (300) | 223 |
Teamwork & General Impression (50) | 35 |
Leader's Reply (50) | 32 |
Final Total (400) | 290 |

Winning team: Southern Red

Negative
Team: Southern Red

<table>
<thead>
<tr>
<th>Speakers' Names</th>
<th>Matter 40 marks</th>
<th>Manner 40 marks</th>
<th>Method 20 marks</th>
<th>Total 100 marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Student B: Morrinsville</td>
<td>25</td>
<td>20</td>
<td>20</td>
<td>65</td>
</tr>
<tr>
<td>2 Student D: Te Aroha</td>
<td>30</td>
<td>24</td>
<td>25</td>
<td>79</td>
</tr>
<tr>
<td>3 Student F: Waihi</td>
<td>24</td>
<td>20</td>
<td>20</td>
<td>64</td>
</tr>
</tbody>
</table>

Team Totals

| Total before reply (300) | 203 |
| Teamwork & General Impression (50) | 35 |
| Leader's Reply (50) | 28 |
| Final Total (400) | 271 |

Winning team: Southern Red

Chair: Judge (Please print): Mrs Fitzgerald
Appendix C

E-mail from Jim Kaput to CoroNet Principals: 11th May, 2006.

Dear Principals,

I recently visited New Zealand to participate in a conference entitled Nutrigenomics and Gut Health which was organized by Nutrigenomics New Zealand, a NZ funded consortium of 55 researchers at the University of Auckland, and the HortRes, AgRes, and Crop and Food CRIs. Paul Lowe arranged for Professor Lynn Ferguson and me to videoconference with his Science students in the CoroNet Problit program. Cathy Bunting and Sara Loughnane contributed to the set up of the videoconference and Sara moderated.

I am writing to let you know how impressed I was with your students – they were engaged and interested. They also seemed to enjoy the interaction, as did I. This is most impressive since Lynn and I were touted as the experts and many young students would not be as comfortable. Although some of the questions were prepared for them, they also had an opportunity to ask questions on their own – which they did with enthusiasm. I think the effort put into young people is vital – especially in the science area. The science illiteracy in U.S. (and many Western countries) is quite appalling, and we all have to work to change that with programs such as yours.

It was also impressive to see the teamwork concept in action. As Lynn and I mentioned during our discussions with your students, biological science (and many other types of science endeavors) now require teamwork of specialists in many different disciplines. The science of nutritional genomics is one such example requiring specific and detailed knowledge of genetics, molecular biology, nutrition, physiology, pathology, food science, and, as we are now realizing, an understanding of how culture influences diet and food choices. Since we are gathering so much data with new high throughput technologies for analyzing DNA, RNA, protein, and metabolites, we also have to collaborate with bioinformaticists, statisticians, and computer programmers. Teaching and fostering the concept of teamwork is essential in the era of cross – disciplinary, national, and international collaborations.

Since it is very likely that you will not know who I am or what I do, I am attaching my CV in PDF format.

Congratulations on an excellent program, and let me know if I can be of further assistance.

Regards

Jim
February 2006

Dear Parents/Caregivers

Congratulations on son's/daughter’s selection in your school team of gifted and talented Year 10 Science students to take part in the problem-based learning in teams (PROBLIT) project for students from CoroNet cluster schools. This should be an enjoyable, rewarding and challenging new experience, which will equip them for the challenges of 21st century life. As with any research project of this nature you need to be fully informed of the nature of data collection and how it will be used.

As you may be aware I am working as one of ten e-fellows in the scheme funded and supported by the Ministry of Education and under the guidance of CORE Education. Dr Vince Ham of CORE is my supervisor for this project and he has reviewed and approved my research plan.

Data collection

1. Quantitative analysis
   Prof Darrell Fisher of Curtin University (Western Australia) will assist with analysis of the effectiveness of the programme, taking into consideration the students’ perceptions of their learning environment, focusing on aspects, such as: equity, involvement, self-efficacy, relevance; and students’ science-related attitudes. The students will sit a questionnaire (instrument known as PROBLIT) before they embark on the programme and again at the conclusion. Any statistically significant changes will be analysed. Only numbers will identify students and their schools to retain their anonymity.

2. Qualitative analysis
   There will be more formal interviews towards the end of the project with the students (in teams), teachers and possibly parents.

Data Collection Timeline

<table>
<thead>
<tr>
<th>2006</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term 1</td>
<td>First administration of Science attitudes instrument (PROBLIT)</td>
</tr>
<tr>
<td>Term 2</td>
<td>Observation and videotaping of team activities</td>
</tr>
<tr>
<td>Term 3</td>
<td>Terms 3/4 second administration of Science attitudes instrument (PROBLIT)</td>
</tr>
<tr>
<td>Term 4</td>
<td>Student interviews for qualitative data. Staff interviews for qualitative data /Parent Interviews for qualitative data</td>
</tr>
</tbody>
</table>

Information from this data, along with less formal observations, will form an integral part of my final report and any subsequent publication of the results and conclusions.
of this project. The final report will be seen by my supervisor and the CORE Education team, the Ministry of Education and other interested educational and community groups. Any raw data will be confidential to myself, the CORE education team, and Curtin University. The data will be stored securely at my home, CORE education and Curtin University for no more than 5 years and then destroyed. Your child’s name or image will not be used in any written publication coming from the research without prior written permission (pseudonyms will be used).

Thank you taking the time to read and consider this information. Please complete and return the form if you consent to both yourself and your child participating in the research. Please contact Dr Vince Ham at CORE 03 3796621 or myself if you have any questions or suggestions.

Yours sincerely

Dr Paul Lowe
W 078897745 (Morrinsville College)
H 078895674
M 0210545371
lofarm@xtra.co.nz

<table>
<thead>
<tr>
<th>Consent form for Parents/Caregivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Name:</td>
</tr>
<tr>
<td>Child’s Full Name:</td>
</tr>
<tr>
<td><strong>I have read and understood the information in this letter dated March 1 2006. I consent to the involvement of my child and myself in the research project.</strong></td>
</tr>
<tr>
<td><strong>I understand that at any time I can withdraw my child from the research project.</strong></td>
</tr>
<tr>
<td>Parent/Caregiver</td>
</tr>
<tr>
<td>Full Name:</td>
</tr>
<tr>
<td>Signature:</td>
</tr>
<tr>
<td>Date:</td>
</tr>
</tbody>
</table>
Dear Principal (named)

As you are aware, your school has a team of gifted and talented Year 10 Science students taking part in the problem-based learning in teams (PROBLIT) project for students from CoroNet. This should be an enjoyable, rewarding and challenging new experience, which will equip them for the challenges of 21st century life. They will need some support and guidance from staff, HOD Science and their colleagues, and your G&T Coordinator. I will be making resources produced during the project available to participating schools for their use. As with any research project of this nature you need to be fully informed of the nature of data collection and how it will be used.

I am working as one of ten e-fellows in the scheme funded and supported by the Ministry of Education and under the guidance of CORE Education. Dr Vince Ham of CORE is my supervisor for this project and he has reviewed and approved my research plan (which is attached).

Data collection

3. Quantitative analysis
Prof Darrell Fisher of Curtin University (Western Australia) will assist with analysis of the effectiveness of the programme, taking into consideration the students’ perceptions of their learning environment, focusing on aspects, such as: equity, involvement, self-efficacy, relevance; and students’ science-related attitudes. The students will sit a questionnaire (instrument known as PROBLIT) before they embark on the programme and again at the conclusion. Any statistically significant changes will be analysed. Only numbers will identify students and their schools to retain their anonymity.

4. Qualitative analysis
There will be more formal interviews towards the end of the project with the students (in teams), teachers and possibly parents.

Data Collection Timeline

<table>
<thead>
<tr>
<th>2006</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>
Term 2  Observation and videotaping of team activities
Term 3  Term 3/4 second administration of Science attitudes instrument (PROBLIT)
Term 4  Student interviews for qualitative data.
        Staff interviews for qualitative data /Parent Interviews for qualitative data

Information from this data, along with less formal observations, will form an integral part of my final report and any subsequent publication of the results and conclusions of this project. My supervisor and the CORE Education team, SMEC at Curtin University, the Ministry of Education and other interested educational and community groups will see the final report. Any raw data will be confidential to myself, the CORE education team, and Curtin University. The data will be stored securely at my home, CORE education and Curtin University for no more than 5 years and then destroyed. Students’ names or images will not be used in any written publication coming from the research without prior written permission (pseudonyms will be used).

Thank you taking the time to read and consider this information. Please complete and return the form if you consent to your students and staff participating in the research. Please contact Dr Vince Ham at CORE 03 3796621 or myself if you have any questions or suggestions.

Yours sincerely

Dr Paul Lowe
W 078897745 (Morrinsville College)
H 078895674
M 0210545371
lofarm@xtra.co.nz

<table>
<thead>
<tr>
<th>Consent form for Principal</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Name:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>I have read and understood the information in this letter dated March 1 2006. I consent to the involvement of my staff and students in the research project.</td>
</tr>
<tr>
<td>Principal</td>
</tr>
<tr>
<td>Full Name:</td>
</tr>
<tr>
<td>Signature:</td>
</tr>
<tr>
<td>Date:</td>
</tr>
<tr>
<td>cc HOD Science, G&amp;T Coordinator and BOT</td>
</tr>
</tbody>
</table>
Appendix F

New Zealand Biotechnology Learning Hub Video Conferences

Appearance Release Form: for Young Adult
Parent/guardian of child and Student both to sign.

The following rights are given on the understanding that the recordings will be used only for the promotion of improved learning outcomes for students.

1. Production: New Zealand Biotechnology Learning Hub Video Conferences, Nutrigenomics Video Conference

2. Location and date of recording: CWA New Media studio, 267 Wakefield St, Wellington, New Zealand, 5 May 2006

3. Recording rights
   My son/daughter (“the student”) and I, both give Copeland Wilson & Associates Limited (CWA New Media), the New Zealand Biotechnology Learning Hub, and its partners, licensees, clients, and the employees, agents, and their successors (“the parties”) the following rights in relation to “the student”:

   Student’s Name: 

   i) the right to photograph and/or video-record the student; and
   ii) the right to make sound and voice recordings of the student.

4. Using material in the future
   I also grant the parties continuing rights to use now, and in the future:
   i) reproductions or representations of the student’s physical likeness; and
   ii) sound and voice recordings of the student;
   iii) and/or written extraction, in whole or in part, of such recordings

   in any way they require in order to improve learning outcomes for students and/or promote the New Zealand Biotechnology Learning Hub. These reproductions or representations may appear as still camera photography and/or video images and/or digital images. Examples of required uses include (but are not limited to) transmission in any manner, subsequent video cassette and/or digital release, publication on the internet, or sales and promotional material, both in New Zealand and overseas

5. To grant the above rights to the parties, please complete and sign below:

<table>
<thead>
<tr>
<th>Name of Parent/Guardian:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationship to Child/Student:</td>
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<tr>
<td>Address:</td>
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</tr>
<tr>
<td>Phone Number</td>
<td></td>
</tr>
<tr>
<td>E-mail address</td>
<td></td>
</tr>
<tr>
<td>Signature of Parent/Guardian:</td>
<td></td>
</tr>
<tr>
<td>Name of Student</td>
<td>Signature of Student</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------</td>
</tr>
</tbody>
</table>
CoroNet: PROBLIT Science

End of Year Report 2006 (Year 10)

Name: Mini Mouse

Team: Te Aroha College

Student Learning Outcomes

1. Deep Thinking Skills (See back page)

<table>
<thead>
<tr>
<th>Team</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>September</th>
<th>October</th>
<th>Nov.</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOLO Level and SOLO Score</td>
<td>Human Potential</td>
<td>Earth Watch</td>
<td>Farm</td>
<td>Waitomo</td>
<td>Reproduction</td>
<td>Gliding</td>
<td>Goat Island</td>
</tr>
<tr>
<td>Extabstract</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
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</table>

2. Mean Grade for Projects

Student Attitude/Communication/Attendance

<table>
<thead>
<tr>
<th>Attitude (Camps/VC/Online) (✓)</th>
<th>Event (Terms III and IV)</th>
<th>Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Positive contribution at all times</td>
<td>VC Debate</td>
<td>Yes</td>
</tr>
<tr>
<td>Positive contribution most of the time</td>
<td>Gliding Camp</td>
<td>Yes</td>
</tr>
<tr>
<td>Reasonable contribution</td>
<td>Goat Island Camp</td>
<td>Yes</td>
</tr>
<tr>
<td>Contribution inconsistent</td>
<td>IT Communication Skills</td>
<td>Excellent: Caitlin is very capable</td>
</tr>
<tr>
<td>Contribution poor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments: Mini has had a fantastic year in science. She was part of a successful team and has excelled in her PROBLIT work. She is always enthusiastic and thinks well. Mini worked very well with all of the CoroNet students on the camps. She has been a real pleasure to teach and has a great sense of humour.

PROBLIT Science Teacher: Dr Paul Lowe

CoroNet Lead principal: Mr John Inger
PROBLIT (Problem-Based Learning in teams)

Explanatory Notes

1. PBL is designed to encourage higher order thinking by students and the SOLO taxonomy (Biggs & Collis 1982, Biggs 1996) is used as a measure of this.

<table>
<thead>
<tr>
<th>Name</th>
<th>Descriptor: Solo Taxonomy</th>
<th>SOLO Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pre-structural</td>
<td>(Confused or irrelevant responses, responses do not relate to the question, does not remember the question, says “I don’t know”, restates the question, makes a guess as to what response is required, wishes to finish quickly without even considering the problem)</td>
<td>1</td>
</tr>
<tr>
<td>2. Uni-structural</td>
<td>(Makes use of one relevant point or feature, generalises in terms of one aspect, finishes quickly, conclusions inconsistent, jumps to conclusions on one aspect.)</td>
<td>2</td>
</tr>
<tr>
<td>3. Multi-structural</td>
<td>(Involves two or more relevant points or features but does not link them which may result in inconsistency especially when drawing conclusions, generalises in terms of a few limited aspects.)</td>
<td>3</td>
</tr>
<tr>
<td>4. Relational</td>
<td>(Involves and relates two or more relevant points or features and gives an overall concept or principle, generalises well within a given context, consistency within a given context, but may be more consistent when going into other contexts.)</td>
<td>4</td>
</tr>
<tr>
<td>5. Extended abstract</td>
<td>(Recognises alternative approaches and searches for alternative explanations, evaluates and improves basic subject knowledge, generates new approaches, uses meta-cognition, recognises cross-curricular links.)</td>
<td>5</td>
</tr>
</tbody>
</table>

For more information see: [http://www.learningandteaching.info/learning/solo.htm](http://www.learningandteaching.info/learning/solo.htm)

2. SDL (Student-Directed Learning) was very new for many of these students. They were expected to work through problems by accessing appropriate resources and then formulate a solution.

3. ICT skills are a vital part of this project and as such will continue to be emphasised. Good communication is vital to the success of any research or business in the 21st century.

This research project is part of an eFellowship supported by the Ministry of Education and a full report can be accessed at: [http://www.efellows.org.nz](http://www.efellows.org.nz) under Paul Lowe 2K6

Dr Paul Lowe
078895674
0210545371
lofarm@xtra.co.nz
Skype: jpaullowe
Web: [http://web.mac.com/jpaullowe](http://web.mac.com/jpaullowe)
Appendix H

You are to write an informative report for your classmates on the following issue.

“How well are we prepared for a Tsunami at a New Zealand beach resort such as Pauanui?”

You are to do this as a word document with live links

You should include details on:

- Current monitoring of our coastline (see NIWA site http://www.niwa.co.nz/flash/ and the NIWA Cam-era site which has regular pictures taken along the Pauanui and Tairua beaches http://www.niwascience.co.nz/services/cam-era )


- New Zealand hazard watch site includes tsunamis: http://www.hazardwatch.co.nz/

- The causes of Tsunamis.

There are more fantastic resources at:


What you need to know (SLO’s) (Tick these off as you cover each of them).

1. Recognise the difference between folds and faults and explain how they occur.
2. Explain how the build up in pressure as a result of plate movements, followed by stress fractures in the rocks, results in earthquakes.
3. List three types of earthquake waves and relate their velocity to the density of materials through which they pass.
4. Define the terms focus, epicentre, seismometer, seismograph, tsunami.
5. Recognise that the Richter scale is a measure of the magnitude of the earthquake (as determined by earth movement) while the Mercalli scale is a measure of earthquake damage.
Appendix I

Course Completion Certificate: