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Understanding and enhancing learning communities in tertiary education in science and engineering

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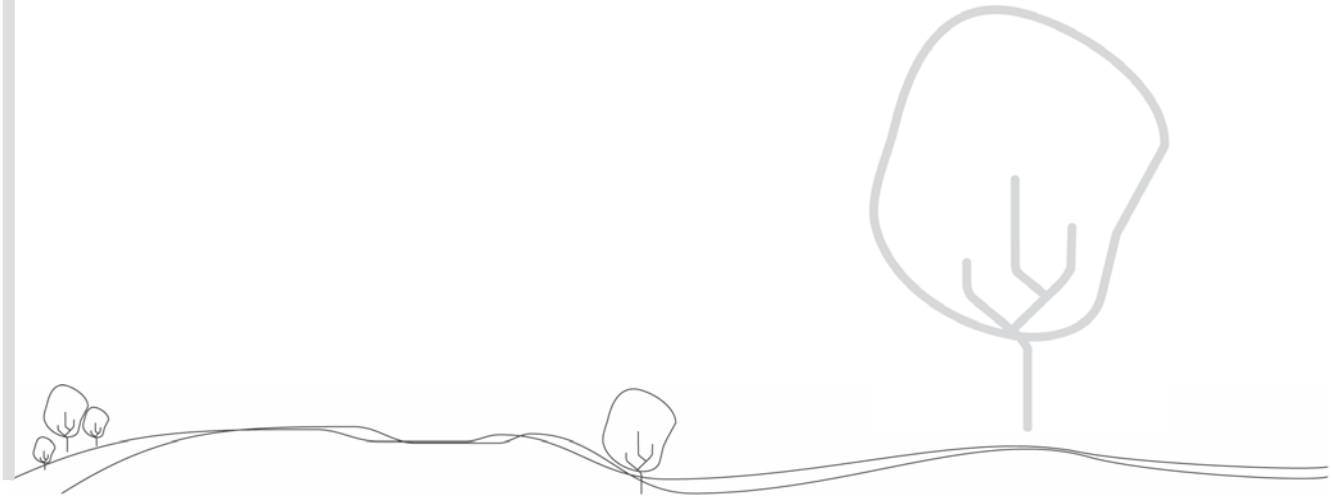

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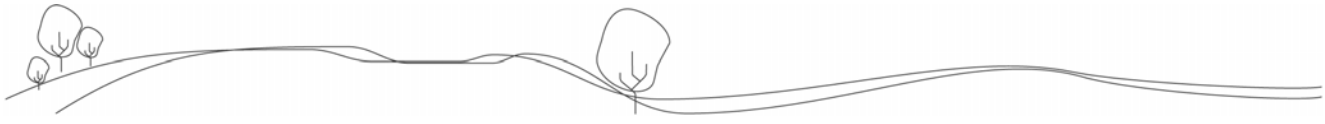

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1. Introduction

The impetus for this project grew out of our involvement in tertiary teaching in science and engineering courses. Our own experiences in undergraduate and graduate science papers, and preservice science and technology education papers, had led us to debate the learning experiences of our students. We intuitively felt that there was something lacking in those experiences and wondered about the sense of identity that these students developed through their involvement in these papers. Research by one of the project's team members (Eames & Bell, 2005) indicated that the learning environment in science and engineering in a university setting was quite different to that experienced in a science and engineering workplace. So what sort of identity were these students developing? Our own anecdotal evidence pointed to a view of something disconnected from the world of science and engineering as practiced in the working community. Our students operated in a mechanistic way of collecting knowledge to pass examinations, doing what was necessary to gain a qualification without developing a sense of the culture of doing science or engineering. We were also aware that, although there was a large body of research literature on the subject of student learning in science at primary and secondary education levels, little existed at tertiary level. There was a feeling that the learning community that operated at tertiary level might be different from that found in schools, and hence create different opportunities and challenges for students within the community. Our study, then, aimed to contribute to an understanding of the nature of learning communities in tertiary science and engineering and how they work, to enhance teaching and student achievement.

Rationale

Further to our own experiences, a number of national and international imperatives led to this study. In recent years, increasing focus, both nationally and internationally, has fallen on the quality of teaching and learning in higher education. This concern is "associated with calls for greater accountability and efficiency, increases in the size and diversity of the student population and a relative decline in the real value of funds available for higher education" (Hativa & Goodyear, 2002, p1). In New Zealand, this trend has been evident in three ways: a proposal from the Ministry of Education to evaluate, and partly fund, tertiary education organisations on the basis of their teaching (Ministry of Education, 2004); the expansion and internationalisation of tertiary student populations; and the decline in government funding per student since the Todd Report (Todd, 1994). Calls for New Zealand to develop a "knowledge economy" assume this to be driven, in part, by innovative research and development emanating from the efforts of science and engineering companies. To facilitate this, these companies need a steady supply of quality

science and engineering graduates. Tertiary institutions, therefore, need a corresponding understanding of the educational environment and approaches that are most likely to produce such graduates. Concerns about the quality of science and engineering programmes also need to be seen within the context of the widespread debate about the goals, merits, and relevance of tertiary education across all disciplines (Barnett, 1997; Dunne, 1999; Martin, 1999; Taylor, 1999; Tight, 2000). From their review of 20 years of major literature on attitudes to science, Osborne, Simon, and Collins (2003) concluded that research into students' attitudes to science is necessary to understand the continuing decline in numbers choosing to study science.

2. Aims and objectives

This research aims to build upon current research in the area of teaching and learning at tertiary level and explore the nature of learning communities in tertiary science and engineering. Specifically, the aims are to:

- contribute to an understanding of the nature of learning communities in tertiary science and engineering and how they work to enhance teaching and student achievement
- understand how the nature of the learning community might differ for teachers teaching different levels of students, and for learners over their time of participation in that community
- build capability in educational research for tertiary science and engineering lecturers by involving them in the research process
- investigate the use of a sociocultural view of learning to understand teaching and learning in higher education.

The purposes of the research are embodied in the following objectives:

- research student perceptions of learning in tertiary science and engineering—this will involve examining students' ideas about the purposes of learning events, how they learn, who they learn from, and how the nature of the learning environment impacts on their learning
- research teacher perceptions of teaching in tertiary science and engineering—this will involve examining their purposes in teaching, their perceptions of student learning, and how the nature of the learning environment has an effect on their teaching
- research interactions between teachers and students to understand how the nature of their relationship might influence learning—this will involve gathering data on teacher and student views about these relationships, observations of the relationships, and their development over time
- research the changes in learning experiences for students as they progress through their undergraduate degrees and into graduate study—this will involve following the progress of a group of students through two years of study, and asking lecturers about their perceptions of teaching students at different levels
- work alongside lecturers to scaffold research-informed development of their teaching programmes—this will involve the lecturers in planning and carrying out the research, analysing the data and reflecting on how the data may inform their practice.

Research question

This study will use a sociocultural approach to address the following question:

> What are teachers' and learners' perceptions of the nature of the learning community in tertiary science and engineering?

Although the context of this research is tertiary science and engineering, the findings will have relevance to other areas of tertiary study. In particular, the methodology of the research could be adapted to any subject area, and this study's findings are likely to have implications for other subjects within universities and polytechnics.

3. Research design and critique

Research design

As this study sought to identify the perceptions of the participants and was predicated upon the meaning of experiences, an interpretive approach (Erickson, 1998) was considered to be the most suitable. The study acknowledged the socially embedded nature of students' and teachers' experiences within tertiary science and engineering education and aimed to explore and understand their perceptions of these experiences within their contexts (Johnson & Christensen, 2000; Neuman, 2000). To this end, the project used a case study design (Bassey, 1999; Merriam, 1998) to develop in-depth understanding of the situation and to explore meaning from a number of perspectives (Merriam, 1998). A case study approach allows the influence of context to be acknowledged and explained, and analysis of data seeks to describe the interactions and practices within the context.

Interpretive studies can use a combination of quantitative and qualitative data collection, allowing for both breadth and depth of views to be gathered. In this study, data were collected from multiple sources—the use of multiple sources of data allow triangulation of the findings, which enhances its validity and reliability. Conclusions on the case can be drawn which, when situated in the context of the case, allow the reader to decide the extent to which the findings can be generalised to another context.

We were also interested to understand how the nature of the learning community might differ for teachers teaching different levels of students, and for learners over their time of participation in that community. This dictated the design of a cross-sectional, but also partly longitudinal, study.

One of the goals of the Teaching and Learning Research Initiative is to encourage partnerships between researchers to foster capacity in educational research, so we sought to build capability in educational research for tertiary science and engineering lecturers from a number of tertiary education insititutions by involving them in the research process.

This, then, was a two-year study to investigate learners' and lecturers' experiences of the tertiary learning community over time. This longitudinal approach is uncommon in the literature and will contribute to understanding student enculturation into tertiary learning communities. The study also contains a cross-sectional element permitting an analysis of teaching and learning experiences across four levels at the tertiary education institutions within the two years of the project. It involves four tertiary education institutions that represent a range of tertiary education opportunities: two universities—University of Waikato and Auckland University of Technology

(AUT)—and two polytechnics—Waikato Institute of Technology (Wintec) and Christchurch Polytechnic Institute of Technology (CPIT). The data collected from each institution were used by research partners within that institution, in collaboration with members of the research team, to write a case study of their institution.

Data gathering and handling

In this study, data were collected by means of questionnaire, interview, observation, and document analysis. The questionnaire offers the advantage that the instrument can be used to survey a large number of people within a short time period. Questionnaires can contain either closed, structured questions or open, unstructured questions, or both. Closed, structured questions are best when the sample is large, there is a finite range of responses required, and statistical analysis will be used; that is, quantitative data are produced. Open, unstructured questions are best when the sample is small, the range of responses is unknown, and meaning is being looked for; that is, qualitative data are produced (Cohen, Manion, & Morrison,2000). In this study, questionnaires containing closed questions were used to gain a breadth of data from students in each institution (see Appendices A to C for the questionnaires). The questionnaires were administered by research partners in each institution and statistically analysed by a research assistant. The findings were then co-analysed by the research partnership. The findings of the questionnaires were used to inform development of interview questions for both student focus groups and teachers.

Interviews were used to probe staff and student views more deeply. Interviews allow an opportunity to clarify responses, probe respondents, and cover an issue in depth. Interviewing can be seen as a purposeful conversation in which the participants use natural language to express themselves so that in-depth information can be gathered directly from the participants' own words (Burns, 2000; Cohen et al., 2000).

In this study, a member of the research team carried out semi-structured interviews with staff and students. One-to-one interviews were conducted with staff, and focus group interviews were conducted with students. Interviews were audio-taped, transcribed into written form, and the content analysed by the research team. (See Appendix D for interview protocols.)

A third method of data collection used was observation. As our interest was in the socioculturally-determined learning community, a view of what was happening in this community could be gained by non-participant observation. In this method, the researcher enters the community and observes without interacting. In this study, lecture and laboratory classes were observed. Data were collected on student and teacher behaviour, and student–teacher interaction. A mixture of quantitative and qualitative data was obtained and analysed, and triangulated with staff and student interview data and the document analysis. These data were collected by a researcher not employed at the particular institution and analysed by a research assistant. Outcomes not

attributable to any particular participant were then co-analysed by the research partnership. (See Appendix E for observations.)

Finally, data were also collected through document analysis. In each institution, where available and appropriate, course outlines, laboratory manuals, study guides, and assessment items were examined. In each case, the documents allowed for triangulation of the expectations and experiences of the teacher and students.

Validity and reliability are enhanced by the multiple methods used, including the extensive data triangulation as detailed above.

Research phases

The first year of the project involved a cohort of first-year and a cohort of third-year science and engineering students while the second year of the project involved second- and fourth-year students. The student sample was drawn from undergraduate science and engineering classes in the four participating institutions:

- School of Science and Engineering, University of Waikato—offers bachelor, masters, and doctorate degrees in a range of science and engineering subjects
- Faculty of Science and Engineering, AUT—offers bachelor and masters degrees, and includes subject options in applied science, mechanical engineering, electrotechnology, and applied mathematics
- Department of Science and Technology, Wintec—offers diplomas and certificates, and includes a range of applied science and technology courses
- Faculty of Design and Engineering, CPIT—offers certificates, diplomas, and degrees in electronic, computer, mechanical, and construction engineering as well as art, design, and broadcasting.

In Phase One, the first year of the project, first-year science and engineering students were surveyed during the first few weeks of their programme. Survey questions were quantitative in nature and explored the nature of their learning at school and their expectations of their tertiary study. Third-year students in science and engineering were also surveyed during this year about their learning experiences to date. This survey focused on their learning experiences during their years of study and how these experiences measured up to their expectations.

Phase Two, in the later part of the first year of the study, involved convening focus groups of first- and third-year students for interviews that probed the students' learning experiences. Interview questions at this point focused on the nature of the students' learning experiences during the year, and the social and cultural influences that affected on their learning.

In Phase Three, in the second year of the study, the now second-year students were surveyed. This survey focused on gathering quantitative survey data on the students' learning experiences in their previous year of study and their expectations for the year ahead.

Phase Four, part way through the second year of the study, involved convening focus groups of second-year students for interviews. These interviews explored the process of the students' enculturation into the tertiary science and engineering communities. In one institution, a focus group of fourth-year students was also interviewed towards the end of the second year of the study.

The case studies

Although all four case studies conformed to the research design described above, there were important differences between the cases. The following section provides a summary of each case in terms of the institutional context, data gathering methods, and participant numbers. (Refer to Appendices G to J for the full case studies.)

University of Waikato

The School of Science and Engineering at the University of Waikato has a total student enrolment of around 900 equivalent full-time students (EFTS) (domestic plus international students, who make up 10% of the total), with 25% of these being graduate and postgraduate students. These students are enrolled in one of three undergraduate degrees (BSc, BSc(Tech), or BE), or postgraduate studies (Master of Science, Master of Engineering, Master of Philosophy, Postgraduate Diploma, or Doctor of Philosophy), in a wide range of papers across all the science and engineering disciplines.

Questionnaire and focus group interview data were gathered from students in a variety of science and engineering papers. Data collection and participant numbers are summarised in Table 1.

Table 1 **Data collection and participant numbers for University of Waikato**

Data method	Participants	2005	2006
Questionnaire	Students	Year 1: n = 192 (69% male, 31% female) Year 3: n = 51 (27.5% male, 72.5% female)	Year 2: n = 62 (69.4% male, 30.6% female)
Interviews	Students and staff	Student focus groups: Year 1: two groups of five students Year 3: one group of four students Three staff interviews	Student focus groups: Year 2: one group of four students Two staff interviews
Class observation	Staff and students	–	One class
Document analysis	–	–	Course outlines, study guides, lecture notes, assessment items

Auckland University of Technology

AUT offers a wide range of postgraduate and undergraduate degrees, diplomas, and certificates via its major faculties of Design and Creative Technologies, Health and Environmental Science, Applied Humanities, Business, and Te Ara Poutama (The Pathway of Learning). The university now offers 36 bachelors degrees as well as postgraduate diplomas, masters, and doctoral degrees. The School of Engineering offers two undergraduate degrees, the Bachelor of Engineering and the Bachelor of Engineering Technology with Mechanical and Electrical/Electronic majors, and the School of Applied Science offers both the Bachelor of Medical Laboratory Science and a Bachelor of Applied Science, which has nine majors such as applied chemistry, food technology, and environmental science. The former Faculty of Science and Engineering, AUT enrolled 1,300 EFTS annually across a range of undergraduate and postgraduate degrees.

Questionnaire and focus group interview data were gathered from students in a variety of science and engineering papers. Data collection and participant numbers are summarised in Table 2.

Table 2 **Data collection and participant numbers for AUT**

Data method	Participants	2005	2006
Questionnaire	Students	Year 1: n = 52 (59.6% male, 40.6% female) Year 3: n = 23 (47.8% male, 52.2% female)	Year 2: n = 91 (52.7% male, 47.3% female)
Interviews	Students and staff	Focus groups: Year 1: one group of fifteen students Year 3: one group of eight students Six staff interviews	Focus groups: Years 2: one group of six students Year 4: one group of three students Three staff interviews
Class observation	Staff and students	–	Three classes
Document analysis	–	–	Course outlines, study guides, lecture notes, assessment items

Waikato Institute of Technology

Waikato Institute of Technology (Wintec) has three campuses in Hamilton. The main city site accommodates programmes from the schools of Information Technology; Business and Administration; Health; Communication; Education and Social Development; Science and Primary Industries, Te Toi-a-Kiwa: Māori, Pasifika and Indigenous Studies; English Language; and Media Arts, as well as most of the central administrative services. The Avalon campus on the northern outskirts of the city houses the schools of Trades, Engineering and Construction, Sport and Exercise Science, and Retail and Service Industries. The third Hamilton campus, the Horticultural Educational Centre, is situated at the Hamilton Gardens.

Wintec enrols more than 8,000 EFTS in two faculties—the Faculty of Business and Technology and the Faculty of Health, Arts and Social Sciences. These faculties comprise 12 schools of study with more than 300 full-time equivalent staff members. The institute offers programmes ranging from certificate to postgraduate degrees, including seven undergraduate degrees. Most of the programmes are at certificate and diploma level, with a practical career-based focus.

The cohort of students that took part in this study was drawn from the School of Science and Primary Industries and the School of Trades, Construction, and Engineering. The science students were all enrolled in the two-year Diploma in Technology. This is a full-time course designed to prepare students for employment in local science-based industries. There were 25 first-year students enrolled in this course in 2005, and in 2006 there were 12 second-year students.

The engineering students were enrolled in a Diploma in Technology or Diploma in Engineering, majoring in civil, mechanical, or electrical engineering. There were approximately 100 first-year students enrolled in this course in 2005, and in 2006 there were 50 second-year students enrolled.

Table 3 **Data collection and participant numbers for Wintec**

Data method	Participants	2005	2006
Questionnaire	Students	Year 1: n = 85 (89.4% male, 10.6% female)	Year 2: n=14 (35.7% male, 64.3% female)
Interviews	Students and staff	Three staff interviews	Year 2: three groups of two to five students Three staff interviews
Observation	Staff and students	–	Three classes
Document analysis	N/A	–	Course outlines, lecture notes, assessment items

Christchurch Polytechnic Institute of Technology

This case study focused on students and staff involved in the Bachelor of Engineering Technology in Electrotechnology—BEngTech (Electrotechnology)—offered by the School of Engineering at CPIT.

The BEngTech programme of study has been designed with special emphasis on a professional career in terms of the Institution of Professional Engineers New Zealand (IPENZ) profile for engineering technologists, as prescribed by the Sydney Accord for three-year engineering degree qualifications. The School of Engineering accounts for approximately 220 EFTS with the BengTech attracting 39 of these EFTS, including full-time (majority) and part-time students. CPIT has a full roll of approximately 6100 EFTS (2006).

Table 4 **Data collection and participant numbers for CPIT**

Data method	Participants	2005	2006
Questionnaire	Students	Years 1: n = 39 (100% male)	Year 2: n = 13 (100% male)
		Year 3: n = 10 (70% male, 30% female)	
Interviews	Students and staff		Year 1: one group of four students
			Year 2: one group of six students
			Year 3: one group of four students
		Three staff interviews	
			Three staff interviews
Class observation	Staff and students	–	Four classes
Document analysis	–	–	Course outlines, study guides, lecture notes, assessment items

Ethical considerations

Approval was gained for the project from the University of Waikato Human Research Ethics Committee and, where necessary, from partner institutions. All data gathering adhered to the practices approved by the Ethics Committee and included gaining informed consent from all participants, respecting the privacy and confidentiality of the participants and ensuring no harm from their participation. (See Appendix F for Ethical Consent Forms.)

As questionnaires were completed anonymously, maintaining students' anonymity was easily achieved and there were few ethical issues to address in providing access within the project to student questionnaire data. Students were interviewed in groups so, once again, anonymity was easily achieved. Care had to be taken, however, to remove any parts of student interview that specifically identified either staff or students before student interview data could be made available to research partners.

As teaching staff were interviewed individually and the nature of the interviews meant that there was a high chance that they could be identified, particularly within their own institution, staff interview data were analysed by members of the research team and only thematic summaries of the interview data made available to research partners.

Research design critique

The project proceeded well, with each phase of the research being implemented successfully. The partnership relations within the project were well founded and had opportunities to strengthen throughout the research.

Having four institutions in the project, each of which had a different academic year, semester structure, and timetable, made it difficult to find convenient times for full-project meetings as it was seldom that the times suited all the project partners. While this difficulty was mitigated to a large extent by the use of email, phone, and tele-conference to maintain ongoing communication and collaboration, opportunities to meet face-to-face are particularly helpful in building relationships and clarifying goals, and additional full-project meetings would have been helpful.

A case-study approach has allowed a distinct and contextualised picture to be developed for each institution and has produced some rich data that provide insights into teaching and learning experiences of students and teachers within those learning communities. While each case can stand alone, analysis across the four cases identifies some emergent themes that provides helpful insights into tertiary science and engineering education in New Zealand.

4. Findings

Literature review

This study takes a sociocultural approach to examining a number of factors that may have an effect on tertiary science and engineering learning communities. These factors include social relationships, and the socially and culturally-determined teaching and learning approaches adopted.

The nature and role of teacher–student and student–student relationships in tertiary learning situations have been discussed by Dawes (2004), National Science Foundation (1998), Aufschnaiter (2003), and Welzel, von Aufschnaiter, and Schoster (1999). The findings reported by these authors included that students were often heavily influenced by only one or two significant teachers; and that teachers were conscious of the language they used in shaping interactions. While studies have been done on the influence of contextual factors such as gender and socioeconomic background on students' attitudes to science, there is only a small amount of research (e.g., Yeo & Zadnik, 2004) into the way attitudes to, and understanding of, science and tertiary level study in science are shaped by their experience of lectures and learning at the tertiary level. In other studies, Ferreira (2003) and Lovitts (1996) both found that attrition had less to do with what the students bring into the tertiary institution than with what happens to them once they get there.

That social relationships in tertiary environments are important was indicated by Dalgety (2002), who found a positive relationship between a student having an associate (friend, relation) in a science field and their intention to continue studying science. Recent work by Leach, Zepke, and Prebble (2006) has also indicated that social relationships have a significant effect on the quality of students' tertiary learning experiences and their decisions to stay or leave tertiary study. These findings suggest that student choices may be strongly influenced by their social interactions.

Other research has found that tertiary science students' perceptions of their lessons are linked to their perceptions of teaching staff (Aldridge et al., 2002). Those positive about their lecturers' teaching are usually positive about classes (Waldrip & Fisher, 2001). However, teachers and students differ in their perceptions of what makes a "good" science teacher (Robertson & Bond, 2001).

An important focus of this project was to examine how student and teacher approaches to learning shape the learning community. A recent Canadian study (Kreber, 2003) replicated earlier work by Biggs (1987) and others (for example, Lizzio, Wilson, & Simons, 2002) by demonstrating a

strong relationship between student approaches to learning and their perceptions of the learning environment. Studies have shown that learner-centered teaching suits some students who find this style more engaging (Waldrip & Fisher, 2001) but other students are more comfortable with teacher-centred instruction, particularly if assessment is examination based (Aldridge et al., 2002; Mulligan & Kirkpatrick, 2000). In examining how students determine what is important and what to write down in a lecture, Johnstone and Su (1994) concluded that lectures were not really learning experiences but rather outlines, or overviews, of what was to be learned. Research suggests that students tend to prefer learning experiences that involve active participation such as those provided in laboratory work (Bennet, Rollnick, Green, & White, 2001) and various types of small group activities (Springer, Stanne, & Donovan, 1999). Stonyer, Dodd, Marshall, and Oberst (2001) go so far as to advocate the importance of group work throughout entire tertiary programmes.

Student approaches to their learning and what has an influence on these approaches have also been explored by Ramsden (2003), Lizzio et al. (2002), Case and Gunstone (2003), Prosser and Trigwell (1999), and Trigwell and Ashwin (2003). Trigwell and Ashwin examined how high achieving undergraduate students' perceptions of motivation, conceptions of learning, and their approach to their studies differed from those of other students. They found that achievement was linked to the degree to which students' conceptions of learning and their learning environment matched those of the university in which they were studying. Features of their study have been used to inform this study, particularly relating to the variation in student experience in different years of study and student perceptions of collegiality (that is, what influences allegiance to the department, school, university, and interpersonal contact).

There has also been a corresponding research interest in how tertiary teachers conceptualise their teaching (Hativa & Goodyear, 2002; Marton, Hounsell, & Entwistle, 1997; Martin, Prosser, Trigwell, Ramsden, & Benjamin, et al., 2002; Patrick, 1998; Pratt, 1998; Prosser & Trigwell, 1999). Prosser & Trigwell found that different teacher approaches interact with the ideas that students bring into the learning environment and affect the quality of the eventual learning.

Higher education scholars (Biggs, 2003; Chickering & Gamson, 1987; Exley, 1999; Entwistle, Skinner, Entwistle, & Orr, 2000; Halpern & Hakel, 2003; Ramsden, 1988, 1997, 2003; Weimer, 2003) have encouraged tertiary teachers to develop teaching approaches which take cognisance of, and build on, research findings about how students go about their learning. Ideas about best practice based on ongoing research into teacher and student beliefs and approaches, and teacher–student interactions are extensively publicised in the literature on tertiary teaching and disseminated to practitioners by organisations such as the Learning and Teaching Support Network (LTSN) in the United Kindgom.

This research study focuses on the relationships and the teaching and learning approaches that frame the learning community in tertiary science and engineering. The study recognises that interactions between participants, the language, artifacts, and tools within a learning community are socially, culturally, and historically determined. This focus is based on a sociocultural view of

learning and an understanding of the learning process acquired through both teaching and research (Brown, Collins, & Duguid, 1989; Dalgety, Coll, & Jones, 2003; Eames 2003; Lave, 1991, 1997). Learning in this view is seen as increasing participation in the community (Rogoff, 1999), which leads to enculturation (Hennessy, 1993). By investigating teacher and student perceptions of the tertiary teaching and learning experience, the objective is to determine whether, and if so, how, being a tertiary science or engineering student involves a gradual progression into full participation in a particular community of learning, and development of a professional identity.

This study is also timely as increasingly flexible delivery of tertiary education is challenging the notion of the traditional campus as a learning community. It will contribute to our understanding of what it means to teach and learn in contemporary tertiary learning communities.

The case studies

Four case studies were developed in this project, one for each of the partner institutions, and each case study is presented in full as an appendix to this report.

While the following themes emerged from analysis of the four cases, it should be noted that the themes do not apply equally to each case. Please refer to the individual case studies for more detail on the contributing data.

Emergent themes

Relationships

Students and teachers in all institutions commented that developing positive working relationships within the tertiary science and engineering community was important. This applied to both teacher–student and student–student relationships. In particular, teachers felt it important to get to know their students by name, address them as individuals, and show concern for student progress, both academically and personally. This was thought to help develop a relaxed teaching environment which encouraged student participation. Teachers saw practical classes as venues for greater relationship development as the more informal teaching situation allowed more time for one-to-one conversation. A good teacher–student relationship was also seen to assist teachers in accurately gauging student progress.

Students at all institutions acknowledged the fundamental role that their working relationship with their teacher played in shaping their learning experiences. This was apparent in factors such as approachability of the teacher, making classes more enjoyable, and motivating students to learn. Students who saw their teachers as approachable and accessible were much more likely to seek help from them and to feel encouraged to participate. Students also recognised that their relationships with their teachers developed more strongly with time, and particularly after their first year of study. In some institutions, this was credited to the smaller class sizes as students

progressed through their years of study, allowing greater individual interaction between students and teachers. Students pointed out that development of a strong learning relationship with their teacher was easier when one or only a few teachers were involved in teaching them in a particular paper.

Both students and teachers also saw value in students developing relationships with each other. These relationships were seen to provide both moral and academic support in areas such as sharing ideas and concerns about their learning, sharing notes, and collaborating in studying. Where students were not able to develop these relationships early on in their course, they were seen to be at a disadvantage and, therefore, both teachers and students felt it was important for opportunities to be provided for these relationships to be developed early.

In terms of developing a sense of belonging to a particular institution, students reported that they did develop an increasing sense of connection over their years of study but that this connection was related to the personal relationships they had formed with other students and staff rather than a sense of belonging to the institution.

Class size

A consistent theme across all case studies was the effect of class size on teaching and learning. There was unequivocal support for the benefits of small classes on student learning. Small classes were seen to promote teacher–student and student–student relationships, and to encourage greater student involvement in learning processes and hence a sense of belonging in the learning community. As noted above, relationships were reported to be stronger as students progressed through the years of their courses and classes generally became smaller. Small class sizes encouraged students to participate more actively in class, to attend more regularly when their absence would be noticed, and get help when they needed it.

Students at smaller institutions commented that the existence of small class sizes at their institution was a major attraction.

Pedagogical approaches

Of the types of learning situations most commonly encountered in tertiary science and engineering (such as lectures, practical classes, tutorials, and field trips), practical classes were the most highly valued by both students and teachers. Students found practical classes interesting and, as mentioned earlier, both staff and students found practical classes provided greater opportunities for interaction and relationship building. Practical classes were seen by many staff and students to assist students' understanding by contextualising the more theoretical aspects of their subject. Practical classes were also seen to help students learn the process and practical problem-solving skills that many teachers felt could not successfully be achieved without the practical sessions. In many cases, the vocational relevance of practical sessions was also a source of student motivation and interest.

Although practical classes were highly valued by students, they found it helpful to have a combination of theoretical and practical teaching sessions particularly when these were integated and related in a timely way. Students felt that having all parts of a particular paper—that is, lectures, practical classes, and tutorials—run by the same teacher was very helpful in integrating the theoretical and practical aspects of their course.

Lectures were a common teaching mode in all institutions and while they were seen as a useful way to organise and disseminate large amounts of course content in a relatively short time, students and staff had mixed feelings about how effective lectures, particularly those with large numbers of students and few opportunities for interacion, were in helping students understand the presented material.

Where teachers had had some teacher training, they spoke of their endeavour to be more student-centred in their approach. However, they also felt constrained in their ability to do so, believing that such approaches took more time, which then affected their ability to adequately cover the subject content they felt needed to be taught. Completion of some form of formal teacher training was reported by the teachers in the polytechnics but not in the universities.

Transition to tertiary study

Students' transition to tertiary study was generally characterised by a need for students to become more independent, self-reliant, and proactive in their learning. Successfully adapting to a tertiary study environment appeared to take most students several months, with the transition more difficult for students who had come straight from high school. Being able to quickly form relationships and connections with other students and with teachers appeared to be an important factor in facilitating this transition. The large first-year classes that students often encountered in tertiary institutions was seen as a barrier to forming these relationships.

Sporting and cultural involvement

Students reported that they were not as involved in their institution's sporting and cultural activities as they had expected to be. While students had expected a high workload during their tertiary studies, they found that the workload was higher than expected and this pressure on their time may be one reason for their generally low participation in sporting and cultural activities. In addition, many students were working part-time while studying and this may also reduce the time available for them to participate.

Research versus teaching

Although teachers generally acknowledged the dual importance of research and teaching in their work, staff in institutions whose programmes were predominantly concerned with the vocational and professional preparation of students were more likely to consider teaching as their first priority. These teachers felt they were under increasing pressure to increase their research outputs

and expressed concern that greater emphasis on research within their institutions may have a negative impact on the time and emphasis given to teaching.

Implications

The themes that emerged from the four case studies suggest that tertiary institutions need to consider ways to:

- facilitate the development of positive teacher–student and student–student relationships as early as possible in a student's time at the institution
- help students become more involved in the wider cultural and sporting activities of the institute
- create and/or maintain small class sizes to maximise learning opportunities through personal interaction and relationship-building
- help teachers develop methods to deliver high levels of subject content in student-centred ways
- deliver science and engineering courses so that theoretical knowledge and practical applications complement each other in a timely fashion
- ensure that teaching, learning and research are equally valued within the culture of the institution.

5. Limitations

The project generally went smoothly, with researchers and partners collaborating effectively to design and implement the various phases of the project to generate the necessary data. However, many of our project partners, while experienced in their own fields of science and/or engineering, had little experience in education research, and once the project entered the stages of analysing and reporting the data it became clear that more time needed to be allocated to working with partners on these aspects of the project. This is not seen as a limitation of the project partners but a limitation of the project design, which did not correctly anticipate the time and support needed for this aspect of the project. Feedback from our partners indicated that they would have liked more opportunity to meet as a team to discuss how to analyse the data, and more time to complete the case study writing.

To enhance our understanding of the learning communities that were studied, it would have been helpful to gather and include data on the retention rates within the science and engineering programmes involved in the project. These data were not collected and this was therefore a limitation of the study.

6. Recommendations for future work

The emergent themes and accompanying implications from this project suggest a number of avenues for further research, but one of the clearest indications from this project is the centrally important role played by relationships in shaping the quality of teaching and learning experiences. This finding resonates with recent research by Leach et al. (2006). While the case studies presented in this project shed light on the types of teaching and learning situations that promote relationship-building, further work is needed to examine:

- how positive relationships might be fostered early in a student's time in a tertiary institution
- the types of relationships that are most conducive to students' learning and success within a tertiary learning environment
- how these relationships change over time, and the differences between the sorts of relationships necessary for success as a first-year tertiary student compared to a third-year or post graduate student
- the extent to which cultural differences promote or constrain the development of positive relationships.

Although a direct examination of student achievement was not the focus of this project, a helpful extension of the project's work might be to investigate the effect of successful (or otherwise) relationship building on students' tertiary achievement. In other words, are those students who say their teachers are approachable and accessible, and therefore more likely to seek help from them, also more likely to be successful in terms of passing the course?

7. Building capacity and capability

The project team

The project team comprises a research team of three people who had overall responsibility for the research, and nine project partners who completed the case studies on the individual institutions.

Project team members are listed below:

Research team

Michael Forret (director)	The University of Waikato
Chris Eames	The University of Waikato
Richard Coll	The University of Waikato

Project partners

Alison Campbell	The University of Waikato
Michèle Prinsep	The University of Waikato
Rainer Kunnemeyer	The University of Waikato
Heather Stonyer	New Zealand Business Council for Sustainable Development
David Dodd	Auckland University of Technology
Jim Clark	Auckland University of Technology
Kevin Stewart	Waikato Institute of Technology
Thomas Cronjé	Christchurch Polytechnic Institute of Technology
Crispin Maclean	Christchurch Polytechnic Institute of Technology

Author affiliations

Case study: Auckland University of Technology

Michael Forret	Senior lecturer at the Centre for Science and Technology Education Research at the University of Waikato.
David Dodd	Principal lecturer in the Faculty of Design and Creative Technology at AUT University.
Heather Stonyer	Project manager at New Zealand Business Council for Sustainable Development.
Jim Clark	Senior lecturer in the Faculty of Health and Environmental Sciences at AUT University.

Case study: Christchurch Polytechnic Institute of Technology

Thomas F. Cronjé	School of Engineering, Christchurch Polytechnic Institute of Technology, Member of the Institute of Electrical and Electronics Engineers (MIEEE).
Crispin Maclean	School of Engineering, Christchurch Polytechnic Institute of Technology.
Michael Forret	Senior lecturer at the Centre for Science and Technology Education Research, the University of Waikato.

Case study: University of Waikato

Alison Campbell	Department of Biological Sciences, University of Waikato.
Rainer Kunnemeyer	Department of Engineering, University of Waikato.
Michèle Prinsep	Department of Chemistry, University of Waikato.
Michael Forret	Senior lecturer at the Centre for Science and Technology Education Research, University of Waikato.

Case study: Waikato Institute of Technology

Chris Eames	University of Waikato.
Kevin Stewart	Waikato Institute of Technology.

Building the capability of the project partners

This project has provided an opportunity for a group of tertiary educators to carry out research into the teaching and learning environment in their institutions. The project has afforded the research partners the opportunity to gain experience in all aspects of the research from designing and planning to implementing, analysing, interpreting, reporting, and reflecting on the implications of the data, both for their institution and for tertiary science and engineering education in general. Partners report that they found the project a helpful learning experience and that they would be interested in being further involved in tertiary education research in future. The connections forged during this project may provide a good basis for further collaborative research and development.

Enhancing project partners' understanding of teaching and learning

This project has enabled the project partners to examine in some detail the nature of learning communities in science and engineering education in their own and other New Zealand tertiary institutions. The findings of the study, as illustrated by the four case studies, indicate that the project partners have developed a greater understanding of the issues affecting teaching and learning in tertiary science and engineering. Some partners have indicated their intention to use the case study findings as the basis for further review and development of their science and engineering programmes.

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Appendices

Appendix A: Year-one survey

Please complete the survey by following the instructions and ticking the appropriate boxes, e.g. ☑, by putting a line around your chosen response, e.g. (Neutral).

1 I am ☐ Male ☐ Female

2 To which one of the following ethnic groups do you feel most strongly connected?

(Select one)

- ☐ New Zealand Maori
- ☐ New Zealand European
- ☐ Pacific Island/Polynesian
- ☐ Asian
- ☐ European

Other _____

_____

3 Before starting my tertiary studies this year, I was: (Select one)

- ☐ At secondary school
- ☐ In paid employment
- ☐ Traveling overseas
- ☐ Doing other tertiary study

Other _____

_____

4 While doing my current tertiary studies, I am:

- ☐ Living at home with my family/whanau
- ☐ Living in halls of residence
- ☐ Living in rented accommodation
- ☐ Boarding with another family

Other _____

_____

5	I am studying in my home city.	☐ Yes ☐ No
6	I am studying	☐ Part time ☐ Full time
7	How long do you expect to be studying at this institution?	☐ up to one year ☐ up to three years ☐ up to four years ☐ more than four years
8	Which of the following statements best describes your situation: (select one)	☐ I am new to this institution and city and I do not yet know many other students studying here. ☐ I have been living in this city for some time and I already have a group of friends who are studying here. ☐ Although I am new to this institution and city, I already have a group of friends who are studying here. ☐ Although I have been living in this city for some time, I do not yet know many other students studying here.
9	Apart from holiday periods, do you expect to be in paid employment while you are studying?	☐ Yes ☐ No

10 What are the reasons you choose to do this course of study?

(Tick all that apply and tick an extra box for the item that was the most important reason.)

☐ ☐ I need it for my chosen career.

☐ ☐ I enjoyed the subject at secondary school.

☐ ☐ Careers advice at secondary school.

☐ ☐ Family and friends advised me to do it.

☐ ☐ I felt I would enjoy this subject.

☐ ☐ Other students have told me that it is an interesting and enjoyable course.

Other _____

_____

_____

11 Please answer the four questions on the right by ticking the appropriate boxes.

Tick one box for each item that applies and, where applicable, tick two boxes to indicate the most important item.

Ways of teaching and learning	11 a Which of these have you experienced in your past education?	11b Which of these did you find enjoyable?	11c Which of these helped you to understand what you were studying?	11d Which of these do you expect to do in your tertiary study?
Completing book or worksheet based exercises and problems	☐	☐ ☐	☐ ☐	☐ ☐
Lecture or presentation from teacher	☐	☐ ☐	☐ ☐	☐ ☐
In class discussion or debate with teacher and pupils	☐	☐ ☐	☐ ☐	☐ ☐
Practical activities, e.g. laboratory, workshop, or project work	☐	☐ ☐	☐ ☐	☐ ☐
Preparing and making a presentation to the class	☐	☐ ☐	☐ ☐	☐ ☐
Personal reading and research	☐	☐ ☐	☐ ☐	☐ ☐
Field trips and activities outside the school	☐	☐ ☐	☐ ☐	☐ ☐

12 Please answer the two questions on the right by ticking the appropriate boxes.

Tick one box for each item that applies and, where applicable, tick two boxes to indicate the most important item.

Sources of help and information	12a At secondary school, where would you go to for help with your studies?	12b During your tertiary studies, where do you expect to go for help?
Teacher of the course	☐ ☐	☐ ☐
Family/whanau and friends	☐ ☐	☐ ☐
The Internet	☐ ☐	☐ ☐
Library or other books	☐ ☐	☐ ☐
Classmates doing the same course	☐ ☐	☐ ☐

The next set of questions are about what you expect it will be like studying in a tertiary institution. Please circle one of the following, Strongly agree, Agree, Neutral, Disagree, or Strongly disagree, to indicate how you feel about the statement.

13 I expect to find subject content at tertiary level more difficult to understand than the subject content I studied at secondary school (high school).

Strongly agree Agree Neutral Disagree Strongly disagree

14 I expect to have a lot of free time while I am studying.

Strongly agree Agree Neutral Disagree Strongly disagree

15	I expect to be involved in my institution's sport clubs and activities while studying here. Strongly agree Agree Neutral Disagree Strongly disagree
16	I expect to be involved in my institution's cultural clubs and activities while studying here. Strongly agree Agree Neutral Disagree Strongly disagree
17	I expect to socialize most with new friends I will make while studying here. Strongly agree Agree Neutral Disagree Strongly disagree
18	I expect to socialize most with friends I had before I began studying here. Strongly agree Agree Neutral Disagree Strongly disagree
19	I expect to benefit from being in contact with active researchers. Strongly agree Agree Neutral Disagree Strongly disagree
20	I expect to find course information and resources on the web/internet. Strongly agree Agree Neutral Disagree Strongly disagree
21	I expect helpful and timely feedback on my progress from my teachers. Strongly agree Agree Neutral Disagree Strongly disagree
22	I expect to have to learn lots of facts. Strongly agree Agree Neutral Disagree Strongly disagree

23	I expect to learn practical, problem-solving skills. Strongly agree Agree Neutral Disagree Strongly disagree
24	I expect the qualification I get to help me get a job. Strongly agree Agree Neutral Disagree Strongly disagree
25	I expect lecturers/tutors to be available to answer my questions. Strongly agree Agree Neutral Disagree Strongly disagree
26	I expect to get to know lecturers/tutors on a personal level. Strongly agree Agree Neutral Disagree Strongly disagree
27	I expect to use a computer during my studies. Strongly agree Agree Neutral Disagree Strongly disagree
28	I expect computer skills to be an important aspect of my studies. Strongly agree Agree Neutral Disagree Strongly disagree
29	I expect academic pressure on me as a student. Strongly agree Agree Neutral Disagree Strongly disagree
30	I expect a heavy workload. Strongly agree Agree Neutral Disagree Strongly disagree

31	I expect to have a clear idea of what is expected of me in my courses. Strongly agree Agree Neutral Disagree Strongly disagree
32	I am looking forward to my time as a tertiary student. Strongly agree Agree Neutral Disagree Strongly disagree
33	I will be expected to produce work of a high standard. Strongly agree Agree Neutral Disagree Strongly disagree
34	I expect to feel part of the learning community in this institution. Strongly agree Agree Neutral Disagree Strongly disagree
35	I expect to be tested on things I have memorized. Strongly agree Agree Neutral Disagree Strongly disagree
36	I expect to be tested on my ability to solve practical problems. Strongly agree Agree Neutral Disagree Strongly disagree
37	I expect to go on to further study after I complete this qualification. Strongly agree Agree Neutral Disagree Strongly disagree
38	I expect to be tested on my ability to solve theoretical problems. Strongly agree Agree Neutral Disagree Strongly disagree

39	I expect what I learn to be directly relevant to my later employment. Strongly agree Agree Neutral Disagree Strongly disagree
40	I expect lectures to be interesting and enjoyable. Strongly agree Agree Neutral Disagree Strongly disagree
41	I expect practical teaching sessions, e.g. laboratory or workshop sessions, to be interesting and enjoyable. Strongly agree Agree Neutral Disagree Strongly disagree
	Thank you for taking the time to complete this survey. Please return the completed survey to the appropriate collection box.

Appendix B: Year two survey

Please complete the survey by following the instructions and ticking the appropriate boxes, e.g. ☑, by putting a line around your chosen response, e.g. (Neutral).

1 I am ☐ Male ☐ Female

2 To which one of the following ethnic groups do you feel most strongly connected?

(Select one)

- ☐ New Zealand Maori
- ☐ New Zealand European
- ☐ Pacific Island/Polynesian
- ☐ Asian
- ☐ European

Other _____

_____

3 While doing my current tertiary studies, I am:

- ☐ Living at home with my family/whanau
- ☐ Living in halls of residence
- ☐ Living in rented accommodation
- ☐ Boarding with another family

Other _____

_____

4 I am studying ☐ Part time ☐ Full time

5 How much longer do you expect to be studying at this institution after this year?

- ☐ up to one year
- ☐ up to two years
- ☐ up to three years
- ☐ more than three years

6 Apart from summer and semester breaks, do you expect to be in paid employment while you are studying? ☐ Yes ☐ No

7 What are the reasons you chose to do this programme of study? (Tick all that apply.)

- ☐ I think I need it for my chosen career
- ☐ I enjoyed these subjects at secondary school
- ☐ Careers advice at secondary school
- ☐ Family and friends advised me to do it
- ☐ I felt I would enjoy these subjects
- ☐ Other students have told me that it is an interesting and enjoyable programme
- ☐ I like the lecturer(s)/tutor(s) teaching in this programme

Other

_____

_____

_____

_____

8 What was the **most influential reason** for choosing this programme of study?
(Tick **one** only.)

- ☐ I think I need it for my chosen career
- ☐ I enjoyed these subjects at secondary school.
- ☐ Careers advice at secondary school
- ☐ Family and friends advised me to do it
- ☐ I felt I would enjoy these subjects
- ☐ Other students have told me that it is an interesting and enjoyable programme
- ☐ I like the lecturer(s)/tutor(s) teaching in this programme

Other

_____

_____

_____

_____

The next set of questions are about the changes you have experienced since you started your studies.

9 Have you used the following sources of help more, less or the same as last year?

Teacher/tutor of the course

☐ More ☐ Same ☐ Less

Family/whanau and friends

☐ More ☐ Same ☐ Less

The Internet

☐ More ☐ Same ☐ Less

Library or other books

☐ More ☐ Same ☐ Less

Tutorials

☐ More ☐ Same ☐ Less

Your institution's student

☐ More ☐ Same ☐ Less

support services

Classmates doing the same

☐ More ☐ Same ☐ Less

Programme

Please circle one of the following, Strongly agree, Agree, Neutral, Disagree, or Strongly disagree, to indicate how you feel about the statement.

10 I have less free time than I did last year.

Strongly agree Agree Neutral Disagree Strongly disagree

11 I am less organized in my study habits than I was last year.

Strongly agree Agree Neutral Disagree Strongly disagree

12 I am more involved in my tertiary institution's sport clubs and activities than I was last year.

Strongly agree Agree Neutral Disagree Strongly disagree

13 I am more involved in my tertiary institution's cultural clubs and activities than I was last year.

Strongly agree Agree Neutral Disagree Strongly disagree

14 More course information and resources are available on the Web/Internet this year than were last year.

Strongly agree Agree Neutral Disagree Strongly disagree

15 Feedback on my progress from my lecturers/tutors has been less helpful this year than it was last year.

Strongly agree Agree Neutral Disagree Strongly disagree

16 The amount of factual information that I have to remember to pass tests/assessments/exams is less this year compared to last year.

Strongly agree Agree Neutral Disagree Strongly disagree

17 I am learning more practical problem-solving skills this year compared to last year.

Strongly agree Agree Neutral Disagree Strongly disagree

18 I was involved in online learning activities last year Yes ☐ No ☐

If No, go to question 19.

If Yes, I am less involved in online learning activities this year than I was last year.

Strongly agree Agree Neutral Disagree Strongly disagree

19 Lecturers/tutors have been less readily available to answer my questions this year compared to last year.

Strongly agree Agree Neutral Disagree Strongly disagree

20 I have got to know my lecturers/tutors on a personal level more this year than last year.

Strongly agree Agree Neutral Disagree Strongly disagree

21 The theoretical parts of my studies are harder to understand this year compared to last year.

Strongly agree Agree Neutral Disagree Strongly disagree

22 My study workload is lighter this year compared to last year.

Strongly agree Agree Neutral Disagree Strongly disagree

23 I am less clear about what was expected of me in my programme of study this year than I was last year.

Strongly agree Agree Neutral Disagree Strongly disagree

24 I am finding this year more enjoyable than last year.

Strongly agree Agree Neutral Disagree Strongly disagree

25 I feel my lecturers/tutors expect me to produce work of a higher standard this year than they did last year.

Strongly agree Agree Neutral Disagree Strongly disagree

26 I feel I am more part of the learning community of this institution this year than I was last year.

Strongly agree Agree Neutral Disagree Strongly disagree

27 Practical teaching sessions, e.g. laboratory or workshop sessions, are harder to understand this year compared to last year.

Strongly agree Agree Neutral Disagree Strongly disagree

28 Lectures are less interesting and enjoyable this year than they were last year.

Strongly agree Agree Neutral Disagree Strongly disagree

29 Practical teaching sessions, e.g. laboratory or workshop sessions, are more interesting and enjoyable than they were last year.

Strongly agree Agree Neutral Disagree Strongly disagree

30 My participation, e.g. asking questions, answering questions, in lectures/tutorials is greater this year than it was last year.

Strongly agree Agree Neutral Disagree Strongly disagree

31 I feel I have been expected to work more independently in practical teaching sessions than I was last year.

Strongly agree Agree Neutral Disagree Strongly disagree

Thank you for taking the time to complete this survey.

Please return the completed survey to the appropriate collection box.

Appendix C: Year three survey

Please complete the survey by following the instructions and ticking the appropriate boxes,

e.g.  , or by circling your chosen response, e.g. Neutral.

If you change your mind or make a mistake, then cross out your choice, e.g.  or ~~Neutral~~ and then tick or circle the correct option.

1	I am	☐ Male ☐ Female
2	To which one of the following ethnic groups do you feel **most** strongly connected? (Select one)	☐ New Zealand Maori ☐ New Zealand European ☐ Pacific Island/Polynesian ☐ Asian ☐ European Other _____
3	Before starting my current programme of study, I was: (Select one)	☐ At secondary school ☐ In paid employment ☐ Traveling overseas ☐ Doing other tertiary study Other _____ _____

4	While doing my current programme of study, I am:	☐ Living at home with my family/whanau ☐ Living in halls of residence ☐ Living in rented accommodation ☐ Boarding with another family Other _____ _____
5	I am studying in my home city.	☐ Yes ☐ No
6	I am studying	☐ Part time ☐ Full time
7	How much longer do you expect to be studying at this institution?	☐ this is my last year ☐ one more year after this year ☐ two more years after this year ☐ three or more years after this year
8	Apart from holiday periods, have you been in paid employment while you are studying?	☐ Yes ☐ No

9 What are the reasons you chose to do this programme of study?

(Tick one box for all that apply and tick both boxes next to the item that was the **most** influential reason.)

☐ ☐ I need it for my chosen career.

☐ ☐ I enjoyed the subject at secondary school.

☐ ☐ Careers advice at secondary school.

☐ ☐ Family and friends advised me to do it.

☐ ☐ I enjoyed the subject in an earlier year of my tertiary study.

☐ ☐ I felt I would enjoy this subject.

☐ ☐ Other students have told me that it is an interesting and enjoyable subject.

Other _____

_____

_____

All the following questions require you to reflect on your experiences during the time you have been studying at this institution.

10	Which of these have you experienced in your current programme of study? (Tick all that apply)	☐ Completing book or worksheet based exercises and problems ☐ Lecture or presentation from lecturer/tutor ☐ In-class discussion or debate with lecturer/tutor and students ☐ Tutorials ☐ Group or team based activities ☐ Practical activities, e.g. laboratory, workshop, or project work ☐ Preparing and making a presentation to the class ☐ Personal reading and research ☐ Field trips and activities outside the classroom or workshop

11	Which of these did you find enjoyable? (Tick all that apply and tick both boxes next to the **most** enjoyable)	☐ ☐ Completing book or worksheet based exercises and problems ☐ ☐ Lecture or presentation from lecturer/tutor ☐ ☐ In-class discussion or debate with lecturer/tutor and students ☐ ☐ Tutorials ☐ ☐ Group or team based activities ☐ ☐ Practical activities, e.g. laboratory, workshop, or project work ☐ ☐ Preparing and making a presentation to the class ☐ ☐ Personal reading and research ☐ ☐ Field trips and activities outside the classroom or workshop

12	Which of these helped you to understand what you were studying? (Tick all that apply and tick both boxes next to the **most** helpful)	☐ ☐ Completing book or worksheet based exercises and problems ☐ ☐ Lecture or presentation from lecturer/tutor ☐ ☐ In-class discussion or debate with lecturer/tutor and students ☐ ☐ Tutorials ☐ ☐ Group or team based activities ☐ ☐ Practical activities, e.g. laboratory, workshop, or project work ☐ ☐ Preparing and making a presentation to the class ☐ ☐ Personal reading and research ☐ ☐ Field trips and activities outside the classroom or workshop
13	Where do you go for help with your studies? (Tick all that apply and tick both boxes next to the source of help that you have used **most** often.)	☐ ☐ Lecturer/tutor of the course ☐ ☐ Family/whanau and friends ☐ ☐ The Internet ☐ ☐ Library or other books ☐ ☐ Tutorials ☐ ☐ Your institution's student support services ☐ ☐ Classmates doing the same course/paper

In the next set of questions, please circle one of the following, Strongly agree, Agree, Neutral, Disagree, or Strongly disagree, to indicate how you feel about the statement.

14 I have found subject content at tertiary level more difficult to understand than the subject content I studied at secondary school (high school).

Strongly agree Agree Neutral Disagree Strongly disagree

15 I have had a lot of free time during my programme of study.

Strongly agree Agree Neutral Disagree Strongly disagree

16 When preparing for tests or exams I prefer to study on my own rather than with a friend or group.

Strongly agree Agree Neutral Disagree Strongly disagree

17 I have been involved in my tertiary institution's sport clubs and activities while studying here.

Strongly agree Agree Neutral Disagree Strongly disagree

18 I have been involved in my tertiary institution's cultural clubs and activities while studying here.

Strongly agree Agree Neutral Disagree Strongly disagree

19 I have socialized most with new friends I have made while studying here.

Strongly agree Agree Neutral Disagree Strongly disagree

20 I have found the subject content of my studies to be progressively more difficult in each year of my studies.

Strongly agree Agree Neutral Disagree Strongly disagree

21 I feel I have benefited from being in contact with active researchers/professionals in my field of study.

Strongly agree Agree Neutral Disagree Strongly disagree

22 During my programme of study, course information and resources have been available on the Web/Internet.

Strongly agree Agree Neutral Disagree Strongly disagree

23 I have received helpful and timely feedback on my progress from my lecturers/tutors.

Strongly agree Agree Neutral Disagree Strongly disagree

24 I have had to learn lots of facts in order to pass tests/assessments/exams.

Strongly agree Agree Neutral Disagree Strongly disagree

25 I have learned practical problem-solving skills.

Strongly agree Agree Neutral Disagree Strongly disagree

26 I have been involved in online learning activities as part of my programme of study.

Strongly agree Agree Neutral Disagree Strongly disagree

27 I expect the qualification I will get to help me get a job.

Strongly agree Agree Neutral Disagree Strongly disagree

28 Lecturers/tutors have been readily available to answer my questions.

Strongly agree Agree Neutral Disagree Strongly disagree

29 I have got to know my lecturers/tutors on a personal level.

Strongly agree Agree Neutral Disagree Strongly disagree

30 In my opinion, students with well developed computer-based skills do better in my programme of study.

Strongly agree Agree Neutral Disagree Strongly disagree

31 I have found the theoretical parts of my studies hard to understand.

Strongly agree Agree Neutral Disagree Strongly disagree

32 During my programme of study, I have had a heavy academic workload.

Strongly agree Agree Neutral Disagree Strongly disagree

33 I have always been clear about what was expected of me in my programme of study.

Strongly agree Agree Neutral Disagree Strongly disagree

34 So far, I have enjoyed my time as a tertiary student.

Strongly agree Agree Neutral Disagree Strongly disagree

35 My lecturers/tutors expect me to produce work of a high standard.

Strongly agree Agree Neutral Disagree Strongly disagree

36 I feel I am more part of the learning community of this institution than when I first started here.

Strongly agree Agree Neutral Disagree Strongly disagree

37 I have found the practical parts of my studies hard to understand.

Strongly agree Agree Neutral Disagree Strongly disagree

38 I have been tested on my ability to solve practical problems.

Strongly agree Agree Neutral Disagree Strongly disagree

39 I expect to go on to further study after I complete this qualification.

Strongly agree Agree Neutral Disagree Strongly disagree

40 I have been tested on my ability to solve theoretical problems.

Strongly agree Agree Neutral Disagree Strongly disagree

41 I feel that what I have learned will be directly relevant to my later intended employment.

Strongly agree Agree Neutral Disagree Strongly disagree

42 I have found lectures to be interesting and enjoyable.

Strongly agree Agree Neutral Disagree Strongly disagree

43 I have found practical teaching sessions, e.g. laboratory or workshop sessions, to be interesting and enjoyable.

Strongly agree Agree Neutral Disagree Strongly disagree

Thank you for taking the time to complete this survey.

Please return the completed survey to the appropriate collection box.

Appendix D: Interview protocols

Interview Outline for Lecturers

Explanation of research aims and nature of this interview.

Signing of interview consent form.

Question Guidelines

What is the interviewee's position, subjects taught and responsibilities?

Main issues involved in the transition from school to university study:

- What are some of the transition issues for students coming to tertiary study?
- Do you have any strategies for helping new students adjust to tertiary study?
- About how long does it take new students to settle into the new environment?
- What are the main enablers and barriers?

Teaching/learning style and relationship with students:

- Is it important to you to get to know your students personally?
- How well do you feel you get to know the learning needs of your students?
- What aspects of your paper(s) do you feel are most effective in helping your students understand the course content?
- Do you have any formal teaching qualification?
- How important are labs and practical workshops in the paper(s) you teach?
- Do you make course related material available online?
- How would you feel about lectures being replaced by putting course content and lecture material online?

Course Materials - Course Outline/Study Guide/Lab Manual

- Can you tell me what the purpose of this document is?
- Why do you use it?
- How do you use it in your class?
- How do you hope students would use it?
- How do you think students do actually use it?
- Can you tell me what you hope it conveys to your students about your expectations of what they will learn from your course?

Do your expectations vary depending on the academic level [e.g., 2nd/3rd years] of your students?

What do you do in classes/labs to help students achieve these learning outcomes?

Does this vary depending on the academic level [e.g., 2nd/3rd years] of your students?

Would you prefer to use other learning tools that you are currently not using? Why? Is anything preventing you from doing so?

Institutional expectations and culture:

Are you expected to do research as part of your job?

For you, how relatively important is teaching compared to research?

Within your institution, how relatively important is teaching compared to research?

Has the advent of PBRF influenced expectations within your institution? If so, how?

Is your effectiveness as a lecturer/tutor formally evaluated? If so, how?

Does your institution provide teaching support or training for lecturers/tutors?

If you could change anything you want, what would be the main change you would make in your papers to improve teaching and learning?

Any other points you would like to make?

Interview Outline for Student Focus Groups

Explanation of research aims and nature of this interview.

Signing of interview consent form.

Question Guidelines

What are interviewees' backgrounds and subjects?

What are your reasons for choosing to do science/engineering? (subject interest, job prospects)

Reasons for choosing this institution?

What were your expectations about tertiary study?

To what extent has the actual experience been different/similar from what you expected?

Main issues involved in the transition from school to university study:

What are the main differences? (intellectual, social, organizational, degree of support, teaching style, …)

Are you clear about what is expected of you in your papers?

How long does it take to settle into the new environment?

What are the main enablers and barriers?

Teaching/learning style and relationship with lecturers/tutors:

What kind of teaching style do you encounter most commonly?

What aspects of your papers do you find most effective in helping you understand the content?

Do you get to know your lecturers/tutors on a personal level?

Do your lecturers/tutors get to know you as an individual?

What are the characteristics of a good lecturer/tutor?

Where do you go for help with your studies? (classmates, lecturer/tutor, institutional support services, …)

Does your institution have support services for students?

Do many students make use of these services? Why? Why not?

How important are labs and practical workshops in helping you understand the content of your paper?

Are you clear about the purpose and what is expected of you in labs and workshops?

How would you feel about lectures being replaced by putting course content and lecture material online?

Do you feel any sense of commitment or loyalty to this institution? Why? Why not?

Course Materials - Course Outline/Study Guide/Lab Manual

Can you tell me what the purpose of this document is?

How and when do you use it?

How useful do you find it?

If you could change anything you want, what would be the main change you would make in your papers to improve your leaning?

Any other points you would like to make?

Appendix E: Observations

Scale for Overall Interaction:

1. hardly any interactions observed;

2. a few interactions observed;

3. some interactions observed,;

4. interactive lesson, both teachers and student initiated the interactions;

5. very interactive lesson, lots of conversations between teacher and students.

CPIT 01 / year 3 - Lecture / 5 students [third hour of three-hour lesson]	
Notes	The class was behind schedule so that the teacher needed to rush to finish the curriculum.
Teaching style	In the first 20 minutes, there was seldom conversation between teacher and students. Teachers talk mainly and sometimes wrote on the whiteboard and on a OHP film. He sometimes stopped to give time for students to take notes and copy graphs. Teacher proceeded to a new topic after 20 minutes. Teacher reviewed some knowledge taught in the previous year and began to develop a new model based on an old model taught. Teacher changed his teaching style and used more short questions to check with students' understanding. Students were more involved in the second part of the lesson. Teachers walked close to students to talk to them a few times.
Student engagement	Students were a bit rushed to follow the teacher and were focused on copying notes and drawing graphs in the first 20 minutes. In the second part, students felt more relaxed. Some students raised questions and make feedback to teachers' questions.
Interactions	Minimal interactions during the first part. More conversations, questions and responses were observed in the second part. Teacher sometimes used name to address students especially during the second part.
Atmosphere	Atmosphere changed a lot in the second part. In the first 20 minutes, the atmosphere was a bit stressed. When a new topic started, the mood was more relaxing. Students were more participatory.
Overall interaction scale (1-5)	3

CPIT 02 / year 2	Lecture / 8 students
Notes	The class was in a lab and most students sat at the back of the room. The teacher had clear and loud voice so that he could keep the attention of class. This lecture would be followed by a lab session later.
Teaching style	The lecture was supported with clear Powerpoint slides to indicate the progress all the way through. Teacher always stopped to use questions to check with students' understanding, especially during the first 30 minutes. When students failed to answer or they could not have appropriate answers, teacher often asked the question in different approaches or used short and direct questions to encourage students to think. Teacher engaged students to involve in conversations by inviting different students to give response to.
Student engagement	Most students appeared engaged (although one student felt asleep during the whole lesson) and usually felt free to make responses. Students usually asked relevant questions and made relevant responses. In some cases, the students' responses led to a little discussion in the classroom.
Interactions	Teacher walked close to the students and had a little chat with students before the lesson started. Teacher always walked close to students when asking questions. Teacher made good use of eye contact and body language to invite students to make responses.
Atmosphere	Students appeared focused. Most students participated in the lesson well.
Overall interaction scale (1-5)	4

CPIT 03 / year 2	Lab work / 7 students
Notes	This is a lab session. Each group had a specific task to finish (to control operation of different machines). The observed session is the second hour of a two-hour session.
Teaching style	Students were given worksheet of instruction and requirement of experiments. Groups worked on different projects. The teacher always walk around the classroom and monitored their progress. When teachers noticed that students had difficulties, teachers went to a group to discuss with them. Teacher often used guiding questions to encourage students to explore their issues. He usually gave clear instructions and support to them.
Student engagement	Students were in groups (2-3 students) work. Students appeared concentrated on their work. When they encountered problems, they usually tried to fix the problems themselves rather than to ask help from the teacher. There were lots of discussions within groups.
Interactions	Plenty of interactions (students-students, teacher-students) throughout the session observed. Students usually paid attention to the teacher' instructions and explanation. They had good responses to the teachers' questions. The teachers usually addressed students in name. Teachers seemed to have good personal relationship with students.
Atmosphere	The atmosphere was usually relaxed. However, at the end of the session, some student seemed to feel stressed and rush to finish their experiments. The teachers sometimes used humours to make the atmosphere relaxing especially when students encountered problems with their experiments. The teachers gave plenty of personal attention to each group.
Overall interaction scale (1-5)	5

CPIT 04 / year 2	Lab work / 5 students
Notes	This is a lab session. Students had to finish 2 experiments individually.
Teaching style	Students were given worksheet and parts to students before the lesson started. Teacher spent some time to explain the purpose and result of the experiment. Teacher drew these experiments to their pervious learning (A-level knowledge and year one). During the experiment, teacher often walked around the classroom to monitor the student's progress. When teacher found that some students encountered problems, he gave personal support to them. In some cases, teacher drew the class' attention to some issues encountered by individual students so as to highlight those issues. Teachers often praised students when they made some progress.
Student engagement	Students usually appeared engaged in their work. Although the experiment was individual work, discussions between students were frequent.
Interactions	Personal interactions (teacher-students and students-students) were frequent. In some cases, the teachers gathered all students to give further instructions and comments. The teachers usually addressed students in name. Teachers seemed to have very good personal relationship with students. Students often asked help from teachers when they had problems.
Atmosphere	Atmosphere was free and relaxing as students usually felt free to ask questions and made responses to the teachers' questions.
Overall interaction scale (1-5)	5

Wintec 01 / year 2	Lecture / <20 students
Notes	The class is about to develop a new model.
Teaching style	Before the lesson started, the teachers gave the class an overview of the lesson. Teacher also had a brief summary at the end of each section. Teacher used blackboard frequently as to explain and illustrate concepts (drawing and calaulation). Teacher made links to previous learning so as to develop new concepts, i.e. high school maths and previous assignments. Students were asked to do some calculation in class. Teachers asked students to check his calculation on the blackboard. Teacher demonstrated high passion in the subject. Teacher engaged students strongly, for example, guiding them to relate their previous learning to new concepts, inviting different students to give responses and comments. The teachers praised students when they gave good responses to questions.
Student engagement	Although a few students talked to each other occasionally, most students appeared engaged. They usually felt free to ask questions and make comments. However, at the last 10 minutes, a few students seemed to be distracted. Some students left early.
Interactions	The teachers usually addressed students in name. Teacher had good use of eye contact especially when teacher wanted to catch the students' attention. In some cases, the teachers walk to a group of students to request their attention. Some students stayed with the teachers during break.
Atmosphere	The lesson was interactive. Plenty of teacher and students interactions
Overall interaction scale (1-5)	4

Wintec 02 / year 2	Lecture / 12 students
Notes	Most students were adult students and they seemed to have good personal relationship among themselves.
Teaching style	The teachers gave a clear outline of the lesson when the lesson began and then provided good signpost throughout the lesson. Teacher tried to link the lesson to the students' prior knowledge and previous lessons. Teacher used questions in worksheet to guide students. Teacher used questioning technique to check with students' understanding. Teachers used group discussion. Teachers gave detail information about discussions. During group discussion, teacher walked around groups and stayed with each group for a while. Teacher demonstrated a good facilitating role. Teachers usually assigned a group to present their discussion and made use this opportunity to lead the class to discuss together.
Student engagement	Students were engaged to answer set questions on worksheets. In the second part of the lesson, students were highly engaged in group discussion. Students were request to make summary to their group discussion.
Interactions	Students chatted in the room before the class. Students were responsive to the teachers' talking and questions. In the second part, teachers requested students to fall into groups and gave clear instruction about grouping and location of groups. Students helped rearrange the room. Teachers usually addressed students in name. Teacher used good eye contact and used humour efficiently. The class performed good collaboration. Students were asked to check the accuracy of the teachers' work in the class.
Atmosphere	Atmosphere was very interactive and comfortable.
Overall interaction scale (1-5)	5

Wintec 03 / year ? Lecture / 18 students (To be finalised)	
Notes	The lesson was a curious mixture of a rather bored-sounding teacher drifting through the prepared notes providing examples of reactions on the whiteboard, and placing most emphasis on what needs to be known for tests or exams, and yet students appeared well engaged and attentive. Good rapport between teacher and students.
Teaching style	Teachers had the classroom setup before lesson and gave a welcome to students who were back from holiday. The lesson flew smoothly with good signposts. At the beginning of the lesson, the teachers posed some questions on the broad as revision. Teacher mainly highlighted the notes in handouts but gave lots of information. Teacher used the board to pose question, problem and illustrate examples. She provided time for students to do problems. Didn't cover everything in notes in detail, expected students to learn more deeply at home.
Student engagement	Students usually listened to the teacher carefully and focused. As they had been given handout, they add notes to handout occasionally. They were willing to respond to the teachers questions.
Interactions	Teachers walked around the class to help students. Teacher knows students names. Students respect teacher. Teacher sometimes used inclusive language, i.e. "we".
Atmosphere	Teacher in control, students were attentive and relaxed.
Overall interaction scale (1-5)	3-4

UOW 01 / year 3 Lecture / 12 students	
Notes	The lesson was the last session before examination. It was a preparation for examinations. It focused on showing students how to solve problems, that was thought similar to one in exam.
Teaching style	The lesson was well prepared. Teachers gave very clear and detail explanation on each steps to solve the problem. Teacher used lots of questions to check the students' understanding. Teacher used some rhetorical questions to guide students. Teacher provide good signpost to students and stopped a few times to ask students' comments before going on.
Student engagement	Students usually appeared very engaged and listened carefully to the teacher. However, they appeared stressed to follow and copy notes. Students were usually responsive and willing to answer questions.
Interactions	Although the classroom has 6 rows of seat, most students sat at the last three rows. However, teacher used good eye contact to indicate somebody to answer his questions. Teacher engaged students by asking them to check his calculation on the board.
Atmosphere	The atmosphere is a bit tense especially during the last 15 minutes of the lesson. Students were anxious to take notes (also the process of calculation).
Overall interaction scale (1-5)	3

AUT 01 / year 1 Lecture / >20 students	
Notes	It was basically a "teacher talk only" lecture
Teaching style	The lesson was well prepared. Powerpoint slides were well arranged with clear notes, and lots of pictures and tables. Handout of slides was given to students. Teacher's voice was clear and explanation was in detail. Teacher showed passion in this topic. Teacher often linked the topic to related stories, current research, current incidents and personal experiences.
Student engagement	Students were usually focused although a few students appeared bored and distracted. Students added notes to handout occasionally. They had some responses to the teacher, such as nodding but not frequently. Most students appeared interested in the pictures shown.
Interactions	There are seldom teacher and students interactions during the lesson. As teachers often kept eyes on the screen, teacher had little direct eye contact with the class. However, at the end of the lesson, teacher approached the students to ask for their comment of the lesson.
Atmosphere	The classroom was usually very "quiet"
Overall interaction scale (1-5)	2

AUT 02 / year 3	Lecture / 30 students
Notes	This was the first hour of a two-hour session.
Teaching style	Handouts were prepared for students. Teacher started with a revision of the previous lesson. Teachers used short questions to check with the students' understanding frequently. Teaching and explanation was clear and in detail. Teacher provided good examples and illustration. Teacher use whiteboard frequently together with a few OHP slides. Teachers usually provide clear signpost to students.
Student engagement	Basically, students were focused and listened to teacher carefully. Students were usually willing to answer teacher's questions. They often copied notes from the board. However, there were some students were slighted distracted, i.e. they have little chat during teacher talking.
Interactions	Interactions were mainly teacher initiated (i.e. questioning). There were some conversations between students who seemed to talk about the lesson (helping each other).
Atmosphere	Students were usually willing to participate and respond to teacher's questions.
Overall interaction scale (1-5)	3

AUT 03 / year2 Lecture / 20 students [second hour of two hours lesson]	
Notes	A break after 10 minutes. A new topic started afterward. The teacher' PC was broken down so that teacher had to use old OHP slide instead.
Teaching style	Teachers stopped to read notes quite frequently. However, teachers had some eye contact with the class. Although the teachers spoke and explained clearly, his voice was weak and tempo of speaking was slow. Teachers seldom initiated interactions or asked questions. As students had questions or comments, his responses were usually positive and explanation was usually clear and useful. Throughout the lesson, teachers had good use of the whiteboard for illustrating and explaining concepts, i.e. process of building models. Had good signpost.
Student engagement	Before the break, students were usually concentrated. After a short break, some students seemed to be distracted. A few students raised questions/feedback after the break.
Interactions	There was basically no teacher-students interaction before the break. Some after the break.
Atmosphere	The atmosphere was a bit bored before the break but it was better afterward. The tempo of teaching was slow. It made the atmosphere a bit bored.
Overall interaction scale (1-5)	2

Some issues observed

- **Classroom interactions** are usually frequent when
    - students were engaged in some kinds of class activities (e.g. calculation, experiment, group discussion)
    - teachers physically approached students frequently or showed that they were approachable, for example, CPIT 02, 03, 04, Wintec 02.
    - teachers and students had good personal relationship, e.g. teachers addressed students in name frequently
    - class size was small
    - teachers used questioning technique frequently
    - students were invited to answer questions and made feedback
- **Teacher/students relationship** seemed to be closer in the two polytechnics than the two universities, the classroom atmosphere of the two polytechnic is usually more relaxing
- **Teaching styles** affected classroom atmosphere, e.g. questioning and inviting feedback. They were significant in enhancing interactions and conversation in the classroom. Teacher-students interaction increase when teachers use questioning technique more often. When students are involved in some kinds of classroom activity, such as lab experiment, group discussion and calculation, there is likely to produce more opportunities for teachers-students or students-students conversations. Teachers tend to ask more questions to guide students and students seem to be more willing to make responses and raise questions.
- Most teachers used **questioning technique** as a way to initiate classroom interaction.
- Students usually appeared focused in all lessons (only a few cases of distraction observed).

Appendix F: Ethical consent forms

Lecturer Consent Form

This is an invitation to take part in interviews about your ideas, expectations, experiences, and feelings about tertiary teaching and learning in science and engineering. These interviews will take no longer than an

These interviews and observations are part of the following Ministry of Education funded research project.

Project title

Understanding and Enhancing Learning Communities in Tertiary Education in Science and Engineering

About the research

This research is part of the Ministry of Education's Teaching and Learning Research Initiative (TLRI) and more detailed information about this initiative can be found on the TLRI website http://www.tlri.org.nz.

This particular part of the TLRI is aimed at enhancing the quality of teaching and learning experiences in tertiary science and engineering education. The study addresses the nature of tertiary learning communities and seeks to understand, from the perspective of the participants, what it means to teach and learn in tertiary science and engineering

Declaration

Before agreeing to take part in this research, please read the following declaration and then, if you agree with the terms listed below, please tick the appropriate box(es) sign and date the form in the spaces provided below.

I understand and agree that:

1 My participation in this research is voluntary.

2 I will be involved in a study on Understanding and Enhancing Learning Communities in Tertiary Education in Science and Engineering.

3 Data gathered for this project will not be made available to any third party and will be subject to the provisions of the New Zealand Privacy Act (1993).

4 I will not be identified in any way other than a code number or pseudonym in data records or reports of the research findings.

5 My participation in this project will not in any way affect my professional progress.

6 I may withdraw from parts of this study at any stage, and if I wish I may withdraw from the project completely.

7 If I have any concerns about my participation in this research project I can contact the director of the research project Dr Michael Forret – phone: (07)8384481, email mforret@waikato.ac.nz

☐ I am willing to be interviewed as part of this research.

☐ I am willing to have my teaching observed at a time or times agreed by me.

Signed _____ **Date** _____

Interview Consent

This is an invitation to take part in interviews about your ideas, expectations, experiences, and feelings about tertiary teaching and learning in science and engineering. These interviews will take no longer than an hour and will take place at a time and place to suit you. In addition, please indicate if you would be willing to have a researcher observe your teaching as part of this research project.

These interviews and observations are part of the following Ministry of Education funded research project.

Project title

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About the research

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3 Data gathered for this project will not be made available to any third party and will be subject to the provisions of the New Zealand Privacy Act (1993).

4 I will not be identified in any way other than a code number or pseudonym in data records or reports of the research findings.

5 My participation in this project will not in any way affect my academic progress.

6 I may withdraw from parts of this study at any stage, and if I wish I may withdraw from the project completely.

7 If I have any concerns about my participation in this research project I can contact the director of the research project Dr Michael Forret – phone: (07)8384481, email mforret@waikato.ac.nz

☐ I am willing to be interviewed as part of this research.

Signed _____ **Date** _____

Survey Consent Form

Introduction

The following survey is about your ideas, expectations, experiences, and feelings about tertiary learning in science and engineering, and should take no more than half an hour to complete. This survey is part of the following Ministry of Education funded research project.

Project title

Understanding and Enhancing Learning Communities in Tertiary Education in Science and Engineering

About the research

This research is part of the Ministry of Education's Teaching and Learning Research Initiative (TLRI) and more detailed information about this initiative can be found on the TLRI website http://www.tlri.org.nz.

This particular part of the TLRI is aimed at enhancing the quality of teaching and learning experiences in tertiary science and engineering education. The study addresses the nature of tertiary learning communities and seeks to understand, from the perspective of the participants, what it means to teach and learn in tertiary science and engineering.

Declaration

Please read the following declaration and then, if you agree with the terms listed below, proceed to completing the survey.

By completing this survey, I understand and agree that:

1 My participation in this research is voluntary.

2 I will be involved in a study on Understanding and Enhancing Learning Communities in Tertiary Education in Science and Engineering.

3 Data gathered for this project will not be made available to any third party and will be subject to the provisions of the New Zealand Privacy Act (1993).

4 I will not be identified in any way other than a code number or pseudonym in data records or reports of the research findings.

I do not need to put my name anywhere on the survey.

5 I will be invited to take part in a similar follow-up survey next year.

6 My participation in this project will not in any way affect my academic progress.

7 I may withdraw from parts of this study at any stage, and if I wish I may withdraw from the project completely.

8 If I have any concerns about my participation in this research project I can contact the director of the research project,

Dr Michael Forret – phone: (07)8384481, email mforret@waikato.ac.nz

Appendix G: Case study: Auckland University of Technology (AUT)

Understanding and enhancing learning communities in tertiary education in science and engineering

Case study: Auckland University of Technology

Michael Forret, David Dodd, Heather Stonyer, and Jim Clark

1. Introduction

The case study presented in this report is one of four studies carried out as part of the Teaching and Learning Research Initiative (TLRI) funded project "Understanding and Enhancing Learning Communities in Tertiary Education in Science and Engineering". The project examines the nature of tertiary learning communities and seeks to understand, from the perspective of the participants, what it means to teach and learn in tertiary science and engineering.

The report begins by describing the tertiary institution, school of study, and the general context within which the research took place. This is followed by a discussion of the rationale and purposes of the project along with a description of the project's design and the methods used to collect data. Next, the findings and conclusions drawn are presented and the report finishes with a summary and discussion of this case study's findings and implications.

Context of the case study

The Auckland University of Technology (AUT) evolved from the largest polytechnic in the tertiary education sector of New Zealand. On 1 January 2000, the Auckland Institute of Technology, as it was formerly known, was granted university status, becoming the Auckland University of Technology. New Zealand's youngest and fourth largest university has a unique profile reflecting its history and its contemporary approaches to teaching, learning, and research. The mission of the new university is "to foster excellence, equity and ethics in learning, teaching, research and scholarship, and in doing so serve our regional, national and international communities" (Auckland University of Technology, 2003, p. 8).

With a goal of stimulating lifelong learning, AUT offers a wide range of postgraduate and undergraduate degrees, diplomas, and certificates via its major faculties of Design and Creative Technologies, Health and Environmental Science, Applied Humanities, Business, and Te Ara Poutama (The Pathway of Learning). AUT now offers 36 bachelors degrees as well as postgraduate diplomas, masters and doctoral degrees. AUT still offers bridging programmes such as certificate and diploma courses which may help "staircase" students into further study. AUT's research and practice-informed teaching, combined with its engagement with business, industry, and the community, results in employment-ready graduates—92 percent of the 2002 graduates were employed within six months of leaving AUT. The School of Engineering offers two undergraduate degrees, the Bachelor of Engineering and the Bachelor of Engineering Technology with mechanical and electrical/electronic majors. The School of Applied Science offers a Bachelor of Medical Laboratory Science and a Bachelor of Applied Science (BAppSci) which has nine majors such as applied chemistry, food technology, and environmental science.

AUT has two campuses, a city campus located on Wellesley Street in the CBD and the Akoranga campus situated on Auckland's North Shore. The School of Applied Science and the School of Engineering are located on the Wellesley Campus. Both these groups were, until 2005, joined

with the School of Applied Mathematics, comprising what was then the Faculty of Science and Engineering.

The former Faculty of Science and Engineering at AUT enrolled 1,300 equivalent full-time students (EFTS) annually across a range of pre-, undergraduate, and postgraduate degrees. A key feature of this faculty, which has continued in both science and engineering, was its commitment to an integrated articulation model that ensured students and graduates at all programme levels had the opportunity to maintain and/or [re]develop their vocational and professional practice throughout their working life. The success of this approach can be identified in the staircasing statistics for AUT as a whole (Institution Research Unit, 2002):

- Almost a quarter (23.1 percent) of diploma enrolments in 2002 comprised students who have staircased from an AUT certificate.
- Slightly more than a quarter (26.0 percent) of enrolments in bachelor programmes at AUT comprise students who have staircased from either a certificate (16.1 percent) or a diploma (9.9 percent) at AUT.
- The School of Engineering, the Department of Electrotechnology and the Department of Mechanical Engineering enrol around 300 EFTS annually in the Bachelor of Engineering programme. The School of Applied Science enrols around 400 EFTS annually in undergraduate degrees.

In the four years to 2003, for the BAppSc programme, more than 35 percent of students who had enrolled for the first-time in this programme had been enrolled in tertiary study in the previous year. The majority of this group of first-time enrolled students had completed the foundation programme at Levels 2 and 3 and been awarded the Certificate in Applied Science.

Many other students, up to 70 percent of first-time enrolled students in the BAppSc, took advantage of the flexibility available in the modularised approach to programme structure and took papers at a range of levels lower than the bachelor's programme.

Staff in the science and engineering schools are active in teaching, research, and programme development, and gain significant grants for "innovation in teaching", "resources to enhance teaching and learning", and Blackboard online paper development. Since the inception of AUT Teaching Excellence Awards in 2000, two senior lecturers in the Department of Electrotechnology and one in the School of Applied Science have gained these awards.

Universities have responsibilities to advance knowledge through research, maintain and disseminate this knowledge through effective teaching, and foster intellectual independence. Moving from polytechnic to university status has seen a major change in the nature of science and engineering education at AUT in terms of goals, content, and methods. Both science and engineering have been successful in attracting significant external research funding and recognition of high quality research outcomes, particularly through the efforts of the engineering research centres—the Engineering Research Institute and the Earth and Oceanic Science Institute.

These research institutes are a leading example of how to effectively integrate research and practice across undergraduate and postgraduate engineering degree programmes.

As degree-level curricula were developed there was strong emphasis placed on lifelong learning and professional capability development particularly through the requirements of professional accreditation bodies.

The demographics of the student cohort are also a key change in AUT's profile. In recent years, immigration into New Zealand has grown considerably and has expanded beyond its traditional base (United Kingdom, the Netherlands, and the Pacific Islands) to include significant numbers from Eastern Europe, the Middle East, India, Thailand, China, and Korea. Consequently, English is not the first or the preferred language of many of these "new" permanent resident students. This situation is compounded by relaxation of study visa requirements that currently sees students (largely from Asian and Middle Eastern backgrounds) studying in AUT's School of Science and School of Engineering (in 2002, 9 percent; in 2003 10 percent). Necessarily, approaches to teaching and learning have had to change to accommodate students for whom English is a second language (ESOL).

Students in years one, two, three, and four from a range of papers in the Bachelor of Engineering, Bachelor of Medical and Laboratory Science, and Bachelor of Applied Science degrees were involved in student surveys and focus group interviews. The lecturers who were interviewed were those who had demonstrated some interest in the issues or concerns around learning.

Purposes of the research

This project aims to enhance the quality of teaching and learning experiences in tertiary science and engineering education. The study seeks to develop a better understanding of how existing systems, processes, and practices influence both students' and lecturers' perceptions of, and attitudes towards, science and engineering, and science and engineering education. The study addresses the nature of tertiary learning communities and seeks to understand, from the perspective of the participants, what it means to teach and learn tertiary science and engineering.

The main thrust of the Teaching and Learning Research Initiative is to build knowledge through partnership research about teaching and learning; to use this knowledge to create improved outcomes for learners; and to create partnerships between practitioners and researchers to maximise the value and usefulness of research.

The main aims of the research are to:

- contribute to an understanding of the nature of learning communities in tertiary science and engineering and how they work to enhance teaching and student achievement
- understand how the nature of the learning community might change for teachers and learners over time of participation in that community

- build capability in educational research for tertiary science and engineering lecturers by involving them in the research process
- investigate the use of a sociocultural view of learning to understand teaching and learning in higher education.

The purposes of the research are embodied in the following objectives:

- research student perceptions of learning in tertiary science and engineering—this will involve examining students' ideas about the purposes of learning events, how they learn, who they learn from, and how the nature of the learning environment affects their learning
- research teacher perceptions of teaching in tertiary science and engineering—this will involve examining their purposes in teaching, their perceptions of student learning, and how the nature of the learning environment affects their teaching
- research interactions between teachers and students to understand how the nature of their relationship might influence learning—this will involve gathering data on teacher and student views about these relationships, observations of the relationships, and their development over time.
- research the changes in learning experiences for students as they progress through their undergraduate degrees and into graduate study—this will involve following the progress of a group of students through two years of study, and asking lecturers about their perceptions of teaching students at different levels.
- work alongside lecturers to scaffold research-informed development of their teaching programmes—this will involve the lecturers in planning and carrying out the research, analysing the data and reflecting on how the data may inform their practice.

Many of the academic staff in both science and engineering come from a professional background, rather than a purely academic one, and therefore bring their work and life experiences to the classroom. In general, their purpose in teaching has been to prepare students for specific vocational careers.

Some of the issues raised covered the following areas:

- the student's transition to tertiary study
- the varying approaches taken by lecturers to teaching
- student's progression over the years
- the institutional culture and related issues.

2. Project plan

Over the two years of the project, data were collected regarding the learning and teaching expectations and experiences of students and lecturers in each of the four partner institutions. In the first year of the project, a cohort of first-year and a cohort of third-year students were invited to respond to surveys and take part in focus group interviews. These students were followed into their successive years of study (i.e., second and fourth year). Lecturers involved in teaching and administering relevant courses were interviewed over the two-year period.

Research design

Student data were gathered in a number of ways. For Phase One of the study, first- and third-year science and engineering students were surveyed during the first semester of 2005, using a questionnaire they completed during either lectures or laboratory classes.

Phase Two, part way through the first year of the study, involved convening focus groups of first- and third-year students for interviews that probed the students' expectations and experiences.

In Phase Three, in 2006, students who were continuing on to their second year of study were surveyed again. This survey focused on gathering data on the students' current and previous learning experiences as well as their expectations for the year ahead.

In Phase Four, in the second semester of 2006, a group of second-year and a group of fourth-year students were invited to join focus groups which again looked at the nature of the learning relationships the students had developed and their thoughts on the whole learning and teaching experience at AUT, and explored the process of the students' enculturation into the tertiary engineering community.

Thus, data about students' learning experiences were gathered across four years of study within a two-year research programme. Although some of the same students took part in the research in successive years, the composition of the cohorts varied. The number of students in each cohort is given in Table 1.

Data were also sought from lecturing staff. In each year of the study, a group of science and engineering lecturers was interviewed individually by a researcher not employed at AUT about their perceptions and experiences of teaching and learning at the levels of study in focus for that year.

In addition to the above, data were also gathered from observations of lectures and laboratory classes, and by analysis of programme related documents such as course outlines, laboratory manuals, study guides, and assessment items.

Table 1. Data collection and participant numbers

Data method	Participants	2005	2006
Questionnaire	Students	Years 1: n = 52 (59.6% male, 40.6% female) Year 3: n = 23 (47.8% male, 52.2% female)	Year 2: n = 91 (52.7% male, 47.3% female)
Interviews	Students and staff	Focus groups: Year 1: one group of fifteen students Year 3: one group of eight students Six staff interviews	Focus groups: Years 2: one group of six students Year 4: one group of three students Three staff interviews
Class observation	Staff and students	-	Three classes
Document analysis	-	-	Course outlines, study guides, lecture notes, assessment items

The AUT authors of this report were involved in the study as practitioner-researchers. They are all research-active teaching staff at AUT, and were involved in the planning of the research, the collection, analysis, and interpretation of the student data, the interpretation of lecturer data and document data, the drawing of conclusions, and dissemination of findings.

The multiple methods used in this research project enhanced the validity and reliability of the data presented and analysed here. The AUT case study also followed the University of Waikato Human Research Ethics Regulations 2000 and the ethical guidelines of the New Zealand Association for Research in Education (NZARE), including the principles of informed consent, privacy, and confidentiality.

3. Research results

Student perceptions

Data on students' perceptions were gathered from questionnaires and from focus group interviews. Questionnaire data is presented first, followed by focus group interview data. Questionnaire data provide demographic details about the respondent group as well as a broad overview of the students' perceptions and experiences. The interview data then provide a more detailed view of students' experiences, opinions and expectations that complements and extends the questionnaire data.

Questionnaire findings

First-year students

The questionnaire was completed by 52 first-year students studying science or engineering, of whom 60 percent were male and 40 percent female. Thirty-one percent of the group identified themselves as New Zealand European; 25 percent were Asian and 15.4 percent Polynesian (Appendix 1). The remainder were identified as Māori, European, or "other". This last category was used by 17.3 percent of respondents. Only 33 percent of the cohort indicated that they were at secondary school before beginning their first-year studies; 17 percent had been in paid employment but 46 percent had been in previous tertiary study. This last group probably represents students enrolled in bridging courses, such as Foundation Science/Foundation Engineering.

Asked about their reasons for taking the course, students most commonly indicated that they needed it for their chosen career (48 percent) or that they expected to enjoy the subject (35 percent). Data from focus groups support this, with students stating that they had chosen a particular course of study on the basis of personal interest. Eighteen percent of respondents had enjoyed the subject at school. Perhaps surprisingly, careers advisors—and family and friends—were reported as having minimal effect on students' tertiary study choices.

All students reported that they had experienced a wide range of learning opportunities during their previous education: completing workbook exercises, listening to teacher presentations, engaging in in-class discussion and debate, doing practical activities, making presentations to the class, doing reading and research, and going on activities outside the classroom.

Of these, the most enjoyable were practical activities such as laboratory classes (selected by 45 percent of students), and this option was considered the most important by 16 percent. Field trips and other "away" educational activities were also popular (37 percent), and were considered important by 14 percent. In-class discussion was chosen by 45 percent (considered important by only 6 percent) but only 12 percent indicated that they found making a presentation an enjoyable

activity. These findings should be considered by tertiary teachers in determining the mix of learning activities offered to their students. Students may need more education and support in learning how to make a successful in-class presentation, for example, and the reasons for particular activities may need to be explained.

Seventy percent of these first-year students did not consider that preparing and making a presentation to the class, or going on field trips or other activities outside the classroom were a help to understanding what they were studying. Twenty-five percent felt that field trips and activities outside school helped them understand what they were studying, and 21 percent of students felt that making a presentation helped them to understand the subject they were studying.

Asked what they expected in terms of learning experiences during their tertiary studies, more than half (55 percent) expected that university study would involve them in hearing lectures and completing book or worksheet based exercises and problems. Slightly fewer (51 percent) anticipated practical activities (laboratory, workshop, and so on) or doing personal reading and research. Some 49 percent felt that their learning activities would involve in-class discussion or debate, 41 percent felt that they would be expected to prepare and make a presentation to the class but only 29 percent expected to have field trips and other activities outside the classroom.

In terms of learning support while at school, 63 percent of students reported asking the course teacher for help with their studies, and 51 percent would have asked their classmates. Students regarded family and friends as less significant (43 percent), while the Internet and the library were regarded as least useful (41 percent). In comparison, they expected that at university they would expect to make more use of the library (60 percent) and Internet (58 percent), while relying slightly less on the course teachers (56 percent). Peers still rated highly at 56 percent, while the proportion expecting to seek help from family dropped to 27 percent, despite the fact that 50 percent of students were living at home. These expectations are borne out by the results of the survey of second-year students (see below), and may reflect the fact that subjects are becoming more specialised, thus restricting the amount of assistance that family members can give.

Students were asked to indicate their agreement/disagreement with a number of statements about their expectations of university study, ranking responses on a 5-point Likert scale (1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree), and a summary of the results follows.

Predictably, they did not expect to have much free time while studying. Likewise, they did not anticipate being involved in sports clubs and cultural activities, and this may reflect that if the students were living at home, they may not see the educational institution as a venue for either their sporting or cultural interests.

Respondents agreed that they expected to feel part of the institution's learning community, although fewer expected to get to know their teachers on a personal level. They agreed that lectures and—more strongly—practical classes would be interesting and enjoyable. In terms of their learning experiences, students agreed that the subject content would be more difficult than it

had been at secondary school. They expected to have to learn lots of facts, but also practical and problem-solving skills. They thought assessment would include testing their ability both to memorise material and to apply practical skills—and they would have rapid and useful feedback on their progress. They also agreed that they expected a heavy workload, and that they would be required to produce a high standard of work. Previous studies have identified workload as an issue for some students (Leach et al., 2006), with some avoiding particular papers if the course workload was perceived to be particularly heavy. Related to this was the strong expectation that students would have a clear idea of what was expected of them in their courses, and that course information would be readily available from sources such as the Internet. Students strongly agreed that they expected to use a computer, and computer skills, during their studies.

Second-year students

There were 91 responses from students in their second year of study in the faculty: 53 percent male and 47 percent female. Asians made up 41.1 percent of the total; New Zealand Europeans were 17.8 percent and 7.8 percent were Polynesian. The remainder were identified as Māori, European, or "other" (see Appendix 1). Asked about their reasons for taking the course, 69 percent indicated they needed the course for their chosen careers, 55 percent felt they would enjoy the subject, and 32 percent enjoyed the subject at secondary school. The single most influential reason, selected by 58 percent of students, was the subject's relevance to their chosen career. The increased focus on a course's relevance to career options may reflect the fact that students are now focusing on their majors.

In terms of help with their studies, 83 percent relied on their teachers to the same, or greater, degree than in their first year.

In addition, 92 percent reported using the Internet the same or more; 93 percent made the same, or greater, use of the library; and 90 percent indicated the same or greater reliance on working with their classmates. While 75 percent reported finding tutorials helpful to the same or a greater degree, 25 percent reported using them less—this probably reflects the fact that in most disciplines tutorials are not offered past the first year. Family and friends became even less significant (28 percent using them less) as a source of help with studies; again, reflecting students' increasing specialisation. These findings match with the expectations held by first-year students in regard to likely sources of help with their studies.

Students were again asked to indicate their agreement/disagreement with a number of statements about their expectations of university study, ranking responses on a 5-point Likert scale. The results of this section of the questionnaire are summarised below.

Student workload seemed to have had a marked effect on students' extracurricular activities, compared to their experiences in their first year of study. Those surveyed agreed that they had less free time than in the previous year, and also felt that they were less involved with both sporting and cultural activities. As might be expected, they felt themselves to be more organised in their study habits than in the past.

There was some agreement that students felt more a part of the university's learning community and that during their second year they had got to know their lecturers better on the personal level. They were neutral on the question of whether lectures were less interesting than in the previous year, but tended to agree that practical classes were more interesting, and that they were expected to work more independently during these classes. They also felt that they were expected to produce work of a higher standard than had been the case in their first-year papers.

Second-year students disagreed that their workload was lighter than in their first year, and also disagreed that they had to remember less factual information for tests and exams than previously. They agreed that both theoretical and practical parts of their studies were harder to understand, but were neutral as to whether lecturer feedback, and readiness to answer questions, was more or less helpful. There was slight disagreement with the proposition that they were less clear than in their first year about what was expected of them in their programme of study. Very few recalled having been involved in on-line learning activities in the previous year.

Third-year students

Twenty-three students (52 percent female and 48 percent male) completed the third-year questionnaire. Thirty-two percent identified themselves as New Zealand European, and 23 percent as Polynesian; with 27 percent identified as "other". The remainder described themselves as Asian (14 percent), or European (4.5 percent).

The most common reason given for taking their particular programme of study was a feeling that they would enjoy the subject (43 percent). Some 39 percent needed it for their chosen career. Advice from the school careers advisor was significant for only 5 percent of the sample. It is interesting that enjoyment ranks above career value for these students, given the current marketing emphasis on promoting the link between degree study and consequent careers.

The students reported that they had experienced a wide range of learning opportunities during their programme of study: listening to teacher presentations, engaging in in-class discussion and debate, group or team-based activities, doing practical activities, making presentations to the class, and doing reading and research. Tutorials and field trips were the least common, both 57 percent. The most enjoyable were practical activities such as laboratory classes (87 percent), lectures or other teacher presentations (61 percent), and personal reading and research (52 percent) and in-class discussions (52 percent). Preparing and delivering a presentation to their classmates was selected by only 26 percent of the respondents as was completing book or worksheet exercises. This, along with in-class discussion or debate was not well regarded by students as helping to understand what they were studying (only 48 percent for each). This suggests a need to explain the purpose of these activities to students, given that they teach a different set of skills (including team work and public speaking). Those activities considered least useful were field trips (30 percent) and preparing and making a presentation to the class (35 percent).

Asked where they would go for help with their studies, these third-year students regarded their lecturers as the most important (selected by 96 percent). The Internet and classmates (both 65 percent) were highly valued, but 74 percent indicated that they would use the library or other reference books. Only 22 percent would choose family and friends. Student support services were selected by only 17 percent of the cohort.

Students were also asked to review their learning experiences over the previous three years. Because it is instructive to compare these with the expectations of first-year students at the beginning of their university study, these data are discussed later.

Focus group interview findings

Transition to tertiary study

Students in the focus groups had come to AUT from a variety of backgrounds. Some had come from school, some had been working before coming to university, and others had already been in tertiary study. All of the groups indicated that the main reason for choosing their course of study was a combination of interest in science or engineering and vocational choice.

For most students, the transition to tertiary study was characterised by the need to be much more independent and self-reliant in managing their time and studies. This was particularly true for students who had come to AUT straight from school. As one student put it, "From school, you can have subjects and everything we do is managed in time and sorted out by someone else so it's really that, the transition to running your own life, which from school is fairly shocking". Even for students who had not come directly form high school, the change was still one of adjusting to being self-reliant: "I had a year off just working and then came to university, in comparison to school, I was kind of thrown in the deep end. Just, rocking up, getting my timetable and having to do everything myself".

While all students found it took some time to adjust to tertiary study, with the time and degree of adjustment varying from student to student, the second-year focus group agreed that: "It takes, definitely like a semester … to get settled".

All agreed that a major part of this change was meeting new people and making new friends. At university, students found that they were "socialising more with people who have the same interests as me", and this was linked to the subject-oriented nature of tertiary study: "At school you probably get a mix of classes, here most of the people you know are always in the same lectures so you tend to make friends with them I guess".

Teaching/learning situations and approaches

Students' learning experiences varied from course to course but generally students attended a range of lectures, tutorials, and laboratory sessions as part of their science or engineering programmes. While students reported that their lectures (and lecturers) were generally helpful,

they also said they varied in quality from interesting, well organised and contextualised through to boring, hard to follow, and too theoretical. Students' perceptions of lecturers and lecturing style had a strong effect on students' interest in particular papers. As one student said, "The paper itself could be really interesting but the lecturer could be really bad".

Students tended to dislike lectures that lacked interaction and consisted mainly of copying down notes: "It's just the fact that there is so much stuff that is written down, all we have time for is copying it down, we're not actually, half the time I'm not actually listening". Other approaches were considered more helpful:

> Whereas some of them they'll introduce the topic to you first, tell you what it's all about and then they'll go with examples and notes and students take notes from that and I think we understand much better that way rather than just coming in and just writing it … just write the notes down there's no point if you don't understand it.

Because of the vocational focus of most of the courses the students were taking, interviewees appreciated lectures in which the course content was related to everyday practical examples. One student commented: "It's always nice to have the context to look at things in rather than having ideas thrown at you that you don't know what to do with". Most students had a strong sense that practical examples improved their understanding and that their studies needed to prepare them for their future careers.

> It's kind of the whole apprenticeship, like old style of apprenticeship type learning versus just learning the text book, and a lecturer that can bring in that apprenticeship type discussion for learning practicalness does help because, ultimately you learn the most when you're working. I mean, you know the theory but, I started working in a lab the day I started my course and the stuff that I've learnt at work is so valuable to help me, I need the theory as well, but as [other student] said, the clinical side, so the lecturers that can help you bring that in is definitely [better].

When asked about what they considered to be the qualities of a good lecturer, students responded that along with the ability to relate to students and communicate well, lecturers also needed "Lots of experience in different areas so then they can tell you about why you use this in that area and why you use that". One third year student reflected on the importance of lecturers being able to show how ideas were applied in practice and seemed to summarise the group's views: "Yeah, I suppose that differentiates the quality of the lecturers in terms of moving from purely imparting information to actually moving on to interpreting and applying it".

The vocational nature of their programmes also underpinned students' perceptions of the importance of laboratory sessions in preparing them for the workplace.

> I've got feedback from a few people that when they sort of left, they go into the workplace, they say the labs and things are just so invaluable because skills you pick up there just … familiarise you with all the equipment and things that you learn and just, that sort of stuff is really helpful for getting into the real world, whereas if you leave university with a totally academic theoretical degree with no practical application, just be totally useless for someone, you're actually more of a burden than a person as an employee for the first year.

As well as their vocational importance, students found laboratory work helpful for clarifying and consolidating what they had covered in lectures. “The labs do make it heaps easier to understand what you do in the lecture”, and “Like it’s a sort of, instead of being told this is what will happen, you will actually see what will happen”.

An organisational aspect raised by some students was the need for lectures and laboratory work to be co-ordinated. Students sometimes found the connection between lectures and laboratory work difficult to make if laboratory sessions were timetabled a long time after or before the related lectures, making it difficult to relate the two parts of their programme. However, they found this connection very useful when appropriately timed.

> …. you could miss the lab and be fine, but I think if you really want to learn the information, if you learnt something and go and practice it, you’ll learn a lot quicker and therefore I think the labs are beneficial when they are directly linked with what you’ve learned that day or that week.

When asked about the relative importance of lectures and laboratory work and how they would feel about having either removed from their programmes, students clearly felt that they needed both. Laboratory sessions were highly valued for the reasons discussed above and lectures were seen as necessary to help deal with the large amounts of information that needed to be learned.

> It’s a good way to cut down a text book that’s two inches thick to notes that are actually useful to understand because you can read pages and pages of the text book and not mean anything but then a lecturer in our lectures tend to follow our texts quite well which is … just highlight main points which gives you a good understanding of what we are trying to read.

A number of students supported the notion of having lecture notes, or even whole lectures, made available online but did not support the idea of replacing face-to-face lectures with online equivalents. Students valued the personal interactions afforded by lectures as well as the immediacy of response available in a face-to-face situation.

> The added benefit of having a lecture is that, for us anyway, we have small classes and good lectures, you get instant feedback of your problems like I can ask the lecturer straight away what are you talking about and come straight back to you whereas on line for instance, I’ll have to send an email or go and see them sort of thing, so that could be a couple of days.

Most students who attended tutorials as part of their programme of study found these helpful because the generally smaller groupings of tutorials afforded better opportunities to ask questions and clarify problems.

Course-related materials

All courses issued students with course outlines and laboratory sessions where accompanied with laboratory manuals. Course outlines provided students with information such as course aims and objectives, course content, assessment methods and weightings, timetable, regulations, and expectations. Generally students looked at the course outline at the beginning of a paper and only

referred to occasionally thereafter: “I have a look at the beginning when I get it and um, yeah but I don’t really, don’t really follow it too closely. I sort of believe if you get notes in the lecture, a lot of the course content should be involved in that …”. Students did, however, appreciate the purposes of course outlines and thought that “it’s always good to have it in the background you know, sort of know where you’re at …”.

Laboratory manuals contained details of the procedures and experiments that were to be carried out in laboratory sessions and often had supplementary notes providing further explanations and theoretical background. Students found laboratory manuals helpful and essential parts of their studies: “They’re very helpful I think. They have supplementary notes with them. Just every lecture you can like, refer to the lab manual and you can read up on what you’ve just learnt in the lecture”.

Some students mentioned that they liked having their lecture notes made available either as handouts or online so that they could read the notes in preparation for the lecture and did not have to spend so much time copying down notes: “And also lecture notes, I think it’s really helpful when it’s already, when they’re already provided a lot of the notes and then you just take down … anything extra, things to add, to help you understand”. Students who wanted to have lecture notes made available also acknowledged that this could, and had, reduced attendance at lectures but also acknowledged that “… even if they’re giving you notes, [it] doesn’t mean you’re going to understand them, you’re still going to need someone to go through it with you” and “But then on the other side, it’s also very helpful if you know, someone’s sick and they can get the notes quite easily”. These students also recognised advantages for international students: “Like [copying] off the slide or something and they put it away too fast, then you don’t get everything copied down and also, I think if you’re the international students, they don’t speak English so well, they find it hard to copy down some of the stuff”.

Relationships

The degree to which students felt they got to know their lecturers (and visa versa) was an important factor influencing students’ experiences. In larger, particularly first-year, classes, it could be difficult to get to know some lecturers and required the students to make an effort: “You have to make an effort in order to get recognised. You have to approach the lecturer and tell them you are interested, you want to do really well. I want you to help me out.” One student felt that whether or not lecturers made an effort to get to know students was simply a case of “Some lecturers care about you, some don’t” while another student recognised the problems lecturers face getting to know large numbers of students: “So lecturers say, might not get to know everyone, and you can see that some do make an effort”.

Some students used lecturing style to judge what sort of person the lecturer was and whether the lecturer would be helpful and approachable.

> Depends on the lecturer because [if] the lecturer just gives you the facts and doesn't really involve everyday things into the class and that's the type of lecturer I wouldn't be able to approach whereas someone who gives examples and tells me how I can use this information I can say, what about this, and then they'll explain it to me …

One student commented: "It would create a very comfortable environment to study, having your lecturer as somebody you know, somebody [you're] comfortable with". Another commented on the positive influence of personal relationships:

> If you know people over here, like your lecturers and stuff, you'd be able to pay more attention to the lecturer than if you don't know anyone. So like, I know the person, it's easier to approach them, I can go up to them anytime and ask them questions, he won't put me down or anything or he won't think that I am a loser or something.

While students did not feel they had developed any particular sense of loyalty or belonging to the institution itself, they did feel a sense of loyalty to individuals such as their classmates and to some lecturers: "I feel a loyalty to some lecturers that go out of their way to help you. When I move on, I will be friends with these people. I know I can email them if I need help".

Students often formed, particularly in their later years, informal study and support groups comprising members doing the same paper or papers and experiencing similar problems. These groups formed in an ad hoc manner and could provide strong support: "Within that group, you'd probably take on board if one of them has failed, maybe one of the others would straight away get behind and pick them up". These loosely formed, informal groups seem to be an important part of the students' learning culture.

Class size

Interviewees often indicated their preference for smaller classes, with this being the reason for some students choosing to come to AUT.

> I think that the reason as to why I choose AUT over any other university is that, like some of my mates they, even my cousin, he is a former student of Auckland uni and they've got lectures that have a roll of around 400, 500, 600, 700 students whereas at AUT you've got smaller roll and it's sort of like, having a smaller group, it helps you understand better because over there I think lecturers just come, they talk and go. Whereas over here you are able to ask questions, but not in all lectures. Some of the lecturers they'll just come in, start talking, ends the lecture and move on.

Class size appeared to be one of the most significant factors influencing students' experiences because the degree to which students were able to engage with their learning situations through personal interactions with peers and lecturers seemed, to a large extent, to be determined by class size. In smaller classes, students felt more inclined and able to ask questions and get to know their lecturers and classmates. Second- and third-year classes, tutorials, and most laboratory sessions tended to be smaller classes and students reported these as being the situations in which they were better able to become involved and learn effectively.

Teachers' perceptions

Students' transition to tertiary study

All lecturers agreed that it took some time for students to adjust to a tertiary study environment: "I think it's a whole new ball game for them". Lecturers observed that the main changes for students were the lack of supervision (additional freedom) and the need to be more independent and self-reliant. One lecturer commented that "a lot of students don't know how to take lecture notes if you are indeed in a lecture. A lot of them have very little idea of study skills, particularly when it comes to examinations and things like that". While the time needed to settle in varied from student to student, interviewees generally agreed that school leavers took longer to adjust compared to more mature students with previous work experience.

> Having said that, we do have older students that come into the course and start at those lower levels in some places, who have had work experience and who know that you have to come in and put in a days work here just like you're working for a company.

In thinking about how long it took students to settle in to university study, one lecturer commented:

> Probably takes them the best part of at least a semester. And I think some students it's actually longer than that because some of them fail and have to repeat and I think that's an indication in some cases that they haven't quite got to grips with what they're supposed to be doing. So it is difficult, especially for first year.

Aware that students need help in adjusting to tertiary study, most lecturers said that they spent time at the beginning of their papers explaining what was expected and providing guidelines on how to tackle the paper. One lecturer devoted his first lecture to study skills and in one paper a general study guide covering such things as learning styles, study skills, and information on plagiarism and referencing was made available to students. However, this support material was not always used appropriately by students: "I find that even though you give students that material initially, a lot of it doesn't sink in, they don't read a thing, they maybe have a quick look and file it away". For some students, it was not until they encountered a problem with an assignment or other assessment that they began to make use of the support materials they were given earlier.

> We're a little bit luckier here because we do have really good [bridging] courses for people like, you know, are catching up so we can actually do some of the training there as well so when they actually do start a full degree properly, they have them [the study skill].

Teaching/learning situations and approaches

While lecturers employed a variety of teaching approaches and these varied depending on the lecturer and the programme of study, most courses were based around lectures, tutorials, and laboratory sessions.

Most interviewees reported that they tried to encourage students to participate and ask questions in lectures. For example:

> I do try and make the atmosphere relaxed enough that if somebody asks a question, even it's a really stupid question and I just say that's really good I'm so pleased you've asked that because obviously I didn't explain enough. Or somebody else needed to know and I try and make sure they'll keep asking questions, you know.

Another lecturer commented:

> Definitely and I find, especially the first year students, I try and make a point of learning their names. I find that, as I get older it's hard to try and remember them. But I find that's really good, because they'll say 'you know my name' as like wow, and immediately that sort of helps…
>
> Yeah, the interaction and they're kind of a bit more, well if he knows my name he's interested in me, I want to learn. That helps a lot I find.

However, particularly in large, first-year classes, only a few students tended to ask questions during a lecture with perhaps a few approaching the lecturer personally at the end of the session.

Lectures were seen as useful for helping students organise and understand the factual and theoretical content of their courses while tutorials and laboratory or practical sessions were regarded as important for dealing with problems and learning how to apply the appropriate content.

Lecturers had differing views on the value of students copying down notes during lectures. One view was that the taking and/or copying of notes helped the students' learning.

> I think there is some benefit to … in fact the old hand, brain, eye co-ordination whatever the notes are like. And I suggest they write things down with great gaps so they can go back and fill them in later, because you know I'm giving an outline.

This lecturer acknowledged that many of his students did not have English as their first language but felt that

> even though you've got that problem, I still think its better that you just write down headings. If you only write down headings for each PowerPoint rather than try and get a lot of the points down. Write down the headings and listen to me and listen to explanations and ask at the time.

Another lecturer preferred that students were not copying down notes during his lectures and he explained why:

> So that I can lecture at reasonable speed and the students have something to fall back on. I actually don't like students writing a whole lot of notes while I'm talking. I actually, my best teaching situation is when I know the students are comfortable with the fact that they have a set of notes to fall back on what I'm talking about and they can listen to me and engage with me and that's why I really like to have a solid text book.

The same lecturer accepted that there were learning situations and subjects that were more suited to a note-taking approach but felt that his subject was not one of them.

> Yes, yes absolutely, and I know that there's some lecturers that feel that writing things down puts it into people's heads, and there is, there are some things that are very good like that but not a lot in engineering. It's less memorising and more using and developing of the algorithms themselves.

Some lecturers made lecture notes available to students either during the lecture or online. Online lecture notes were usually made available after the lecture rather than before as one lecturer had experienced a dramatic drop in attendance when he tried putting the lecture notes online prior to the lecture.

When asked about the effectiveness of lectures as a teaching method, one lecturer replied:

> I think it's a shocking way of teaching. I don't think it's a good way of learning but it's a good way of disseminating information and I think, I try and combine teaching with the dissemination of information. I personally feel that you have to do a certain amount of teaching, you can't just deliver a lecture and hope for the best, so there is a good deal of explanation in quite a lot of my lectures, particularly on problem solving.

The need to cover large amounts of course content in a relatively short time was one reason why lectures were a chosen delivery method. One lecturer who had completed his institution's Certificate of Adult Teaching felt that the course had been very helpful in suggesting a range of teaching approaches but felt that

> to translate them into a sort of, practical classroom situation was quite difficult especially when you're got all this course material where you've got to get through, it's lovely to have, lets have group sessions and lets do this, you know, you just don't have time to do it all.

All lecturers felt that laboratory and practical sessions were an essential part of their programmes. One lecturer, when asked how he would feel about the removal of laboratory sessions from the programme, went as far as to say: "I would resist it as far as I could. I'd move heaven and earth to not remove labs at all". Laboratory sessions were seen as important because lecturers felt that some aspects of professional practice and practical problem-solving could only be learned successfully in a practical, hands-on context. Also, many courses were vocationally aimed and required proficiency in practical techniques.

Course-related materials

As mentioned earlier, all courses provided students with course outlines and laboratory sessions were accompanied by laboratory manuals. Course outlines were viewed as a sort of contract between the students and the university and designed to "keep both the student and the staff honest". From a programme leader's point of view a course outline

> tells me that the lecturers' know what they are doing, that I know what the lecturers are doing and that the students know where they are going, what is expected of them and how and when they will be tested and assessed.

Laboratory manuals were intended to prepare students for laboratory sessions by providing explanations of practical activities and procedures to be used, and they often included additional explanatory notes that helped to relate practical activities to the more theoretical parts of the paper. Lecturers found that students did not always arrive at laboratory sessions having read the manual and one lecturer gave students a test on the manual in order to ensure that students arrived prepared. He commented that the test was "reasonably trivial but it forces them to read the lab and have some vague idea about what they're coming in to do".

Relationships

Staff generally felt that they got to know students better as they progressed through their years of study.

> Oh, I think you get more friendly with them. They sort of get to know you and some of them, you know more able to make that, bridge that gap than others. Whereas, you know, in year one it's all very strange for them and they don't know you and they're sort of more reserved, you know, certainly by the end of semester two that sort of process is starting, is well under way with most of them and I think that's something that you know, that at AUT always had a culture in that.

Most lecturers felt that they wanted to get to know their students and that this helped encourage students to ask questions and be more relaxed in their learning. One lecturer commented, however, that it was quite some time before he got to know his students by name.

> Yes. Well I personally, I have a very bad memory for names, I'm really, really bad. I mean it's contrary to the normal lecturer. So in first year, I actually mostly don't know their names unless they're particularly bad students that give me a lot of trouble or the really good ones who are there asking questions all the time.
>
> The ones in the middle sadly the ones that I should know, so in fact, I only start learning their names by the time they get to the end of the second year and that also connects up, by the time we get to third year we're supervising pairs of students and by fourth year, we're supervising individual students, it gets a lot closer.

While most interviewees were comfortable with becoming friendly with their students, this lecturer felt there could be problems with staff becoming too familiar with students.

> I think some lecturers actually have a problem with it, they don't understand that they're having a problem, they do get, they get twisted around some particular student's fingers and they end up not being consistent with the students.

He allowed students to become more familiar with him as they became more senior but was careful not to let this happen too early.

> Early on I won't allow it, I won't actually allow that to happen. I don't want the first years to think I'm their buddy because they have some very strange ideas about how they can get maximum marks and they need to first understand that they're now at university not at school anymore.

Generally lecturers felt that large classes were a barrier to getting to know students whereas tutorials and laboratory sessions, which were usually smaller groups, provided for greater, more personal interaction and allowed staff to develop closer relationships with their students. The usually smaller classes in the more senior years, coupled with extended contact over a number of years, enabled lecturers to get to know most of their students quite well and their third and fourth year students very well.

Class size

Class size repeatedly emerged as an issue affecting teaching and learning. Large classes were viewed as problematic as they increased workload and reduced lecturers' ability to form good working relationships with students. One staff member reflected on his experience of teaching a paper in which he had only large lecture classes and no practical sessions in which to get to know his students.

> I was rostered to do the lecturing, but I didn't do any practical classes for that, totally unsatisfactory. Going into a class lecturing to 110 and never, a sea of faces, only those who actually came up at the end, was totally unsatisfactory.

He further reflected on the situation in other institutions where classes were considerably bigger than at AUT and commented: "So there's my colleagues, for God's sake, repeating a lecture, I can't imagine repeating a lecture threes times involving the same content to a whole sea of faces of 200 at a time. That would be hell".

In thinking about how to improve teaching and learning in the institution, another lecturer said "I think if I was able to, I would actually like to have a lot more smaller group teaching. Small group teaching would be my main objective".

Lecturers valued the smaller classes generally afforded by laboratory sessions and tutorials as being situations in which they were better able to interact with students, provide more personalised help and teach more effectively. For the same reasons, the smaller classes of the more senior years were also seen as better teaching/learning environments.

Institutional environment

Lecturers felt that AUT traditionally had a culture that focused on teaching and learning.

> I think it's probably more of an emphasis on the learning than in traditional universities because we have a history of being a teaching institution so we are concerned about our

> students, we are concerned about their learning and so on, and I'm guessing, but I guess that that probably is true more so than in a traditional university.

While there was a strong feeling among interviewees that teaching was their first priority, AUT's recent change to university status had brought with it expectations that staff would also be involved in research. Within the new environment, staff were concerned that teaching, "has kind of taken a back seat".

> I think so, I think, I mean, I think unfortunately for AUT there's such a desire to stand up and be counted as a university, that they're saying lets really focus on research and push research dah dah dah, and it feels sometimes to us at the coal face, like aren't you guys valuing teaching, isn't that what we're all about?

One lecturer commented that, as part of the push for more research, it had been claimed that being involved in research would improve teaching but he questioned whether this was so. "It has been said, if you do research you become a better teacher, I'm not sure if I agree with that because there are lots of people doing research but not good teaching".

Another change brought about by the institution's new university status and focus on research was that AUT was now recruiting more staff with higher academic qualifications such as PhDs and this was a source of some tension between the perceived value of practical professional experience versus theoretically based qualifications. One senior member of staff summed up the tension when he said: "Yes, its clear that were all our jobs up for grabs now, I would not stand a chance of being employed at AUT".

Lecturers felt that the institution's culture was still one in which providing a quality learning experience for their students was a high priority but they generally expressed a degree of concern about the effect their recent institutional changes were having upon this culture.

Student progression through the years of study

Questionnaire findings

Students entering tertiary study had clear expectations of what this would involve. When third-year students reflected on their experiences, it was clear that many of these expectations had, in fact, been met (see Appendix 1). For example, workloads were indeed heavier than at school; students did make new friends; a high standard of work was required; and students' expectation of enjoying their time at university became a reality.

However, there were some areas where expectations did not measure up. For example, new students tended to agree with the statement that they would be involved in sports clubs and activities during their time at university; overall, the third-year students did not agree that this had been the case. They were stronger in their disagreement with the statement that they had been involved with cultural groups and activities over this time. They were also less likely to agree that

they had learned practical problem-solving skills. And again, students in their third year of university agreed less strongly that they had been tested on their ability to solve practical problems, whereas new students had quite a strong expectation that this would happen.

While the first-year cohort expected that they would receive appropriate and timely feedback on their progress from teaching staff, the third-year students were less likely to agree that this had been the case. Similarly, while first-year students expected to have a clear idea of what was expected of them in their various papers, third-year students were less likely to agree that they had always been clear about this. This bears out the findings of earlier work by Leach et al., (2006), who report that students can be confused by lack of clear expectations, or by being in a situation where different lecturers have different expectations. These authors also noted that unclear assessment questions, lack of effective feedback, and over-assessment can affect students' decisions to continue with a paper:

Focus group interview findings

Feedback from focus groups makes it clear that a major issue for students entering tertiary education is developing the skills and self-discipline necessary to become an independent learner and one who knows how to be successful with a tertiary environment. Students reported that, over their years of study, their skills in this regard improved. One third-year student commented: "You've got to learn how the game is played and you've got to get smart at doing that". Another went on to say: "Yeah, I think a lot of the time at university we're still undergrad, it doesn't bring out intelligence, it's just a way of understanding the system, knowing the way that you have to study or get to know the lecturers etc".

Students anticipated that, as they progressed through their programme of study, their work would become progressively more detailed, difficult, and applied. As one student put it, "More practical, one year doing practical and basic ideas and second, third and fourth we put it into use", and the more senior students agreed that, generally, this had been true over the years.

A similar progression was evident in the types of assessment that students encountered from years one to three. In their first year, students felt there was a lot of new information to learn and that much of their assessment was based on remembering this information: "I think that your ability to recall is a big thing. Most of my exams the tests are definitions and just things like that". Another student reflected:

> I'd never see a question on an exam that would say a person has this condition, what would happen if they did this, I'd never have to put two ideas together and explain something very thoroughly. I find myself in my tests, it's just all facts …

At the senior end of their programme, however, engineering students commented that project design papers "can probably be the most challenging papers" and that

> … in terms of actually learning to be an engineer, the project design papers has been very important. Sort of, it's probably closest the course comes to the real work in terms of, the other papers are very much, here's the theory here's how it's applied, very much like a formula, recognize a problem, attach the book to it, here's the answer, whereas design is very much open.

Although challenging, students found these papers enjoyable ("Yeah, I get a lot of satisfaction out of them") due to the creative and independent work involved: "You come from nothing to something that you totally have done yourself and you modelled it basically entirely by your own knowledge and sourced the information yourself".

Another change over the years is the closer relationships that are formed between students and lecturers. While first-year students can sometimes find it hard to get to know lecturers because they are new to the institution and classes can be relatively large, over the years, class sizes tend to decrease and they get to know their lecturers better and vice versa: "Yeah we have, both my major papers I'm doing this year we have ten people in one class and eight in another and we've had those lecturers right through, and that's pretty good" and "… so by the time you get to a third year, lecturers sort of care about how you are going and stuff a bit more and it's that idea that you're obviously here to stick it out whereas in first year, we'll just see whose here in third year sort of … "

Teacher interview findings

As students progressed through their years of study, lecturers expected them to become more capable and independent in their learning, and lecturers' expectations increased as did the intellectual pace of their work.

> In terms of pace. The pace moves up, my expectation of the students change. In first year, I expect them to piece together some small things and to solve problems but the limit of their abilities, I understand, is first year, and starting on this journey. My job, I see within the Bachelor of Engineering, is to get them at the graduate level when they graduate, to be able to solve almost any problem they've never seen before.

The path to this goal was one which began with lecturers providing a relatively large amount of support and guidance in first year and progressively removing this support to challenge students to become more independently capable. When asked if he felt this approach was successful, one lecturer replied:

> I think it works reasonably well, but it doesn't happen in the first year, or a second year or a third year, it happens over those years and so I find that by the time I take these guys in year four … I get to the point where they don't get anywhere near as much from me as they would have back in Year 1 and its more a case of pointing them in the right direction and saying here's some basic information I want you to go away and do this or expand on this, or look at how this affects whatever, and they actually handle that reasonably well, they do learn.

As reported in the earlier section on relationships, lecturers report that they progressively got to know their students better over the years, forming closer personal relationships as students progressed to the senior years of study. So, in their early years of study, although lecturers tended not to know their students very well, students were provided with quite a lot of learning and problem-solving support. As time went on, the personal lecturer–student relationship strengthened while the learning support provided earlier was progressively reduced.

Another developmental aim reported by lecturers was to help students develop a sense of professional responsibility and honesty towards their work and this was seen as particularly important in the medical science-related courses.

4. Summary and implications

This case study is based on data collected from staff and students in AUT's School of Science and School of Engineering over a two-year period. These experiences have been elicited through the use of questionnaires, interviews, classroom observations, and document analysis. Students completed questionnaires and, in some cases, took part in focus group interviews, while teaching staff were involved in interviews only.

Questionnaire respondents identified with a wide range of ethnic backgrounds that reflected AUT's changing student population with the largest groups being New Zealand European and Asian. Student respondents were evenly divided between male and female, with slightly fewer (46 percent) female. A large number (46.2 percent) of first-year respondents had already been in tertiary study before starting their current study programme. It may be that these students had taken part in bridging or transition courses before entering a degree programme but data were not available to confirm this. A large majority of students (87 to 96.3 percent) were studying full-time with half or more of the students living at home. Most students cited interest and career choices as their main reasons for selecting their programme of study, with careers advisors and family and friends seeming to have minimal effect on students' tertiary study choices.

While students indicated that they had expected a large workload at university, they still found that they tended to underestimate the amount of work required. Workload pressures may be one reason that students reported not being as fully involved in extracurricular activities at AUT as they initially expected. This may also be attributed to the increased financial burdens students face in modern universities with the majority of students reporting that they were working part time while studying. Another factor may be the number of students living at home with established sporting and social networks in their communities.

Students' learning experiences at university included lectures, tutorials, and laboratory and workshop sessions. Of these, the practically-based (laboratory and workshop) sessions were the most highly valued by both students and staff. Both groups agreed that practical sessions were particularly important for contextualising and consolidating the understanding of course content and, in most cases, were crucial for learning the practical techniques and problem-solving skills needed by students in their future careers. While lectures were seen as a useful way to organise and disseminate large amounts of course content in a relatively short time, students and staff had mixed feelings about how effective lectures, particularly those with large numbers of students, were in helping students understand the presented material. Students found it helpful to have a combination of theoretical and practical teaching sessions particularly when these were integrated and related in a timely way but much less helpful if they were disconnected of disjointed.

Relationship building seems to be an important aspect shaping the quality of learning and teaching experiences. Students and lecturers valued situations that afforded opportunities for personal interactions between staff and students and between students. From the lecturers' perspective, opportunities to interact with and get to know students allowed them to better

understand and attend to the students' learning needs. From the students' point of view, getting to know their lecturers and classmates helped them to feel more relaxed and confident, and be more inclined to ask questions and become involved in classes. Interactive and practical learning situations were seen by students as more enjoyable and effective ways of learning.

A significant factor influencing opportunities for personal interaction and relationship building was class size with staff and students alike preferring smaller classes in which more interaction took place. Usually, tutorials and laboratory/workshop sessions were organised in smaller groups and this was another reason these learning situations were preferred to large lectures in which interaction tended to be minimal. Smaller classes was also cited by some students as a reason for coming to AUT rather than a larger university such as Auckland.

Students anticipated that, as they progressed through their programme of study, their work would become progressively more detailed, difficult, and applied, and senior students agreed that, generally, this had been true. Lecturers aimed at helping students become progressively more independent in their learning and problem-solving and worked towards this goal by providing a relatively large amount of support and guidance in first year and progressively removing this support over the years to challenge students to become more independently capable. Student–staff and student–student relationships grew and deepened over the years and senior students had a much closer and more personal relationship with their lecturers than in earlier years. An important factor influencing this deepening relationship was the progressively smaller class sizes in each more senior year and, the extended time over which the relationships were formed.

While students did not feel they had developed any particular sense of loyalty or belonging to the institution itself, they did feel a sense of loyalty to individuals such as their classmates and to some lecturers. Students often, particularly in their later years, formed informal study and support groups comprising members doing the same paper or papers and who experienced similar problems. These loosely formed, informal groups seem to be an important part of the students' learning culture and provide students with important academic and emotional support.

Lecturers felt that AUT traditionally had a culture that focused on teaching and learning and while they felt that this was still true, they generally expressed a degree of concern about the effect the institution's recent change to university status was having upon this culture. Lecturers were concerned that a greater emphasis on research within the institution may have a negative impact on the time and emphasis placed on teaching.

These findings have the following implications for tertiary learning in science and engineering:

- facilitate the development of strong teacher–student and student–student relationships as early as possible in a student's time at the institute
- help students become more involved in the wider cultural and sporting activities of the institute
- create and maintain small class sizes to maximise learning opportunities through personal interaction and relationship-building

- help teachers develop methods to deliver high levels of subject content in student-centred ways
- deliver science and engineering courses so that theoretical knowledge and practical applications complement each other in a timely fashion
- ensure that teaching, learning and research are equally valued within the culture of the institute.

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Appendix H: Case study: Christchurch Polytechnic Institute of Technology (CPIT)

Understanding and enhancing learning communities in tertiary education in science and engineering

Case study: Christchurch Polytechnic Institute of Technology (CPIT)

Thomas F. Cronjé, Crispin Maclean, and Michael Forret

1. Introduction

The case study presented in this report is one of four studies carried out as part of the Teaching and Learning Research Initiative (TLRI) funded project "Understanding and Enhancing Learning Communities in Tertiary Education in Science and Engineering". The project examines the nature of tertiary learning communities and seeks to understand, from the perspective of the participants, what it means to teach and learn in tertiary science and engineering.

The report begins by describing the tertiary institution, school of study and the general context within which the research took place. This is followed by a discussion of the rationale and purposes of the project along with a description of the project's design and the methods used to collect data. Next, the findings and conclusions drawn are presented and the report finishes with a summary and discussion of this case study's findings and implications.

Context of the case study

This case study focused on students and staff involved in the Bachelor of Engineering Technology in Electrotechnology—BEngTech (Electrotechnology)—offered by the School of Engineering at Christchurch Polytechnic Institute of Technology (CPIT). CPIT is the largest polytechnic in the South Island and is located in Christchurch, which is generally considered as the centre of the electronic manufacturing industry sector of New Zealand.

The BEngTech programme of study has been designed with special emphasis on a professional career in terms of the Institution of Professional Engineers New Zealand (IPENZ) profile for engineering technologists, as prescribed by the Sydney Accord for three-year engineering degree qualifications. This programme started delivery in 2000 and has produced graduates since 2002, with excellent uptake of graduates into the local workforce. This qualification is currently only offered with one true specialisation, that of electrotechnology. However, it offers students a choice of strands in the final (third) year. Students select two of five specialisations: control systems engineering, electronic engineering, electrical engineering, computer engineering, and (tele-)communications engineering. Since early 2006, this programme has been granted full international accreditation to the above-mentioned Sydney Accord.

The School of Engineering at CPIT has principal responsibility for four sections, notably:

- Electrical and Computer Engineering, incorporating the programmes:
  - Bachelor of Engineering Technology in Electrotechnology (three years, level 7)
  - Diploma in Advanced Computer Networking (one year, level 7, starts 2006)
  - Diploma in Electrotechnology (two years, level 6)
  - Diploma in Computer Networking (two years, level 6)
  - Certificate in Electrotechnology (one year, level 5)
  - Computer Technicians Certificate (one semester, level 5)
  - Certificate for Technician Engineers (two year part time, level 6, starts 2006)

- Computer-Aided Design, incorporating:
  - Diploma in Advanced Computer Aided Design (one year, level 7, starts 2006)
  - Diploma in Computer Aided Design (one year, level 6)
  - Certificate in Computer Aided Design (one year, level 4)
- Civil Engineering, offering:
  - Diploma in Civil Engineering (two years, level 6)
- Mechanical Engineering, offering:
  - Diploma in Mechanical Engineering (two years, level 6)

The School accounts for approximately 220 equivalent full-time students (EFTS) with the BEngTech attracting 39 EFTS, including full-time (majority) and part-time students, representing nearly 18 percent of School EFTS. CPIT has a full roll of approximately 6,100 EFTS (2006), so the BEngTech represents a meagre 0.64 percent of EFTS at CPIT.

The demographics of the BEngTech students vary from cohort to cohort, but typically include school-leavers, previously employed (mature) people, international students, and those who have matriculated from a university, either with a base degree such as a BSc. or those who struggled with the competitive study regime at the local university. Females, Māori and Pacific Island people are very poorly represented, despite attempts to attract more. The typical student is a New Zealand European (64 percent to 75 percent of students) with the remainder mostly Asian. Approximately 50 percent of students have Christchurch as their home "town". Between 40 percent and 70 percent of all students expect to be, or are, in part-time employment while studying.

The aim of the BEngTech programme is to provide graduates for all of the electrical/electronic engineering industry—that is, to provide a comprehensive foundation coupled with specialist skills within a particular field. This will enable the graduate engineering technologist to follow a career path, ultimately to professional engineer level if desired. This is achieved by providing students with engineering skills and self-directed learning abilities that meet the needs of industry and encourages graduates to update their skills throughout their working lives. Students are encouraged to develop engineering design and applied research skills during their design projects and final year papers, enabling them to continue to postgraduate study.

Student cohorts in all three years of the BEngTech were surveyed. Representative groups of students from all three years and a substantial majority of teaching staff (tutors) were interviewed separately; observations were also made in classrooms and in practical laboratories. Enrolled numbers in the cohorts per year were:

2005	Yr1: 15	Yr2: 16	Yr3: 9	Total: 40
2006	Yr1: 13	Yr2: 12	Yr3: 14	Total: 39

The tutors involved in this programme comprise four core staff members, who primarily teach on this degree. They teach across all three years, with more emphasis on the last two years. These core tutors are research active, while the others are mostly not. The others are made up from slightly less than one full time equivalent (FTE) staff, spread between 10 tutors from other faculties and other teaching programmes. At CPIT there is a policy that all teaching staff should be appropriately qualified—the expectation is that staff should be qualified with at least an adult teaching certificate (CAT).

The weekly structure of a course in the BEngTech differs for each of the three years. In the first year, a course would typically consist of four hours of lectures (often broken up into separate hour sessions or at worst in two-hour blocks), one hour of tutorial (where problems are given to students to work) and a four-hour practical every fortnight. This translates to an average weekly contact of seven hours. In the second year, this total is reduced to six hours and it is reduced again to five hours for the third year. The reduction in time is applied to the lecturing, with all other aspects remaining the same. This structure is in line with a policy that students should become more independent as they progress. More self-study is required from a student in order to progress satisfactorily. The structure described above applies to core courses, while non-core courses such as management would not include a practical (laboratory) element, but the rest is the same. In a certain way, this structure is also reflected in the weighting ratio between course work and examinations—in the first two years, the ratio is usually 50/50 (respectively), while in third year, it is normally 60/40.

Purposes of the research

This project aims at enhancing the quality of teaching and learning experiences in tertiary science and engineering education. The study seeks to develop a better understanding of how existing systems, processes, and practices influence both students' and lecturers' perceptions of, and attitudes towards, science and engineering, and to science and engineering education. The study addresses the nature of tertiary learning communities and seeks to understand, from the perspective of the participants, what it means to teach and learn tertiary science and engineering.

The main thrust of the Teaching and Learning Research Initiative is to build knowledge through partnership research about teaching and learning; to use this knowledge to create improved outcomes for learners; and to create partnerships between practitioners and researchers to maximise the value and usefulness of research.

The main aims of the research are to:

- contribute to an understanding of the nature of learning communities in tertiary science and engineering and how they work to enhance teaching and student achievement
- understand how the nature of the learning community might change for teachers and learners over time of participation in that community

- build capability in educational research for tertiary science and engineering lecturers by involving them in the research process
- investigate the use of a sociocultural view of learning to understand teaching and learning in higher education.

The purposes of the research are embodied in the following objectives:

- research student perceptions of learning in tertiary science and engineering—this will involve examining students' ideas about the purposes of learning events, how they learn, who they learn from, and how the nature of the learning environment impacts on their learning
- research teacher perceptions of teaching in tertiary science and engineering—this will involve examining their purposes in teaching, their perceptions of student learning, and how the nature of the learning environment impacts on their teaching
- research interactions between teachers and students to understand how the nature of their relationship might influence learning—this will involve gathering data on teacher and student views about these relationships, observations of the relationships, and their development over time.
- research the changes in learning experiences for students as they progress through their undergraduate degrees and into graduate study—this will involve following the progress of a group of students through two years of study, and asking lecturers about their perceptions of teaching students at different levels.
- work alongside lecturers to scaffold research-informed development of their teaching programmes—this will involve the lecturers in planning and carrying out the research, analysing the data and reflecting on how the data may inform their practice.

2. Research design

This case study primarily involved students and staff associated with the BEngTech degree at CPIT, and was conducted over a two-year period, starting in 2005. One of the surveys of 2005 (the first year survey) captured a larger audience than just this degree, as it also included the first-year students from the Diploma in Electrotechnology who have a very similar background, including demographics and profile, to those of the degree students.

It should be noted that these figures describe small classes. The samples included a substantial majority of each class, representing the core of attendees for that particular class. This was especially so for the surveys, but not necessarily so for the group interviews. Although not every student and staff member was surveyed or interviewed, we believe that a substantial and representative sample was taken from this relatively small population.

In the first semester of 2005, the first year and third year cohorts were surveyed by the use of pre-designed anonymous questionnaires. Later that year, three of the four core tutors for the degree were interviewed in a group.

In 2006, only the second-year students were surveyed, in order to gauge that particular cohort's perceptions of the transition and changes between their first two years of study. Also, representative focus groups of all three cohorts were interviewed, separately, for about one hour each. Several tutors were then privately and separately interviewed, for about 15 to 30 minutes each.

Also in 2006, classroom observations were carried out on two different classes, covering one hour each as part of a two-hour lecturing session. Finally, observations were made on two different laboratory experiments, each also covering only part (one hour) of that particular laboratory session, which typically lasted for three to four hours.

Data from the questionnaires were collated, tape recordings from all interviews were transcribed, and classroom and laboratory observations were also recorded, all performed by members of the research team not employed at CPIT. Observations were conducted against a pre-released list of expected activities indicating frequency—all tutors involved had been given a copy of this list before being observed. This collection of data provides variety and a rich mix.

In addition to the above, data were also gathered by analysis of programme-related documents such as course outlines, laboratory manuals, study guides, and assessment items.

It should be noted that, at all times, informed ethical consent was obtained from all individuals in writing, before any data were collected. All involved persons were satisfied with arrangements, did not object to their participation, and appeared to be keen to contribute.

A summary of data gathering methods and numbers of participants is given in Table 1.

Table 1. Data collection and participant numbers

Data method	Participants	2005	2006
Questionnaire	Students	Year 1; n = 39 (100% male) Year 3: n = 10 (70% male, 30% female)	Year 2: n = 13 (100% male)
Interviews	Students and staff	Three staff interviews	Year 1: one group of four students Year 2: one group of six students Year 3: one group of four students Three staff interviews
Class observation	Staff and students	-	Four classes
Document analysis	-	-	Course outlines, study guides, lecture notes, assessment items

3. Research results

Student perceptions of the teaching and learning

Data on students' perceptions were gathered through questionnaires and focus group interviews and each of these groups of data is reported in turn within student year groups.

First-year students

Questionnaire findings

Forty students, all male, responded to the questionnaire. Of these, 64.1 percent identified themselves as New Zealand European and 23.1 percent as Asian. Forty percent of students had come from secondary school with 32.5 percent having been working before starting their studies and 25 percent had already been in some form of tertiary study. The majority of these students (55 percent) were living in rented accommodation while another 35 percent were living at home. About half of the students were from Christchurch (46.2 percent).

Students were asked to indicate their agreement/disagreement with a number of statements about their expectations of university study, ranking responses on a 5-point Likert scale (1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree).

In reporting the data, we have concentrated on responses that are deviations from a neutral response. Large deviations are presented with their average score.

The key findings regarding first-year students' expectations of tertiary study are as follows:

- The expected to find laboratories interesting and enjoyable (score 1.4).
- The ultimate qualification would help find work (score 1.4).
- Problem-solving would be learnt (score 1.5).
- Substantial opportunities for laboratory work would be available.
- Students would have reasonably access to tutors.
- Tertiary studies would be more difficult than school.
- Feedback would be provided.
- A lot will be learnt.
- Students would use computers a lot.
- Students would experience academic pressure.
- Students would have a clear idea of what they were expected to do and at what standard.
- Students would be expected to produce work of a high standard.
- Students would find lectures interesting and enjoyable.
- An increased amount of independent study would be required.

Interview findings

The key findings regarding first-year students' perceptions of their first year of tertiary study were as follows:

- A lot more work and independent study was required than at school.
- "We're expected to do a lot more out of school hours so work on your own time, that's a lot harder. It's quite difficult too, when you're doing eight hour days to go home and then do some more work. . . . "
- The teaching programme had a strong vocational focus.
- An incorrectly booked classroom (double-booked) proved to be a big annoyance to this group. This aspect was emphasised several times during the interview.
- Practical (laboratory and workshop) sessions were a very important and useful aspect of their studies—one student reported that "(he)'d be gutted" if this part was taken away and was replaced with a virtual or simulated practical:

  > Labs are good, they give you something to, that's not just theory talk. It's something practical, where you can actually be like, oh I understand how it works now because of that, that and that because when it doesn't work and you have to troubleshoot it, find out why it doesn't work then you cover stuff that you might not have learnt from a book ….

- The exams required more of an application of theory than proof, and regurgitation of pure theory.
- A good tutor was defined as someone who:
  - was well organised
  - had a positive attitude
  - used several media in teaching at a time
  - was easy to access when help was sought.
- Students found tutorials helpful in learning as they were able to work through exercises and problems with their tutor.

  > Just having someone to work through the questions you're getting stuck on, that's a big help ah, like doing the tutorials and stuff. Without the tutorials, it would be a lot harder, without having time to work through questions and stuff with the tutor.

- Assignments were very helpful for learning.
- Laboratory reports were a good tool to assist in learning and formal writing.
- Students got to know their tutors reasonably well.
- Students did not particularly like studying subjects of a very general nature; that is, they preferred to study more focused and applied topics.
- They found the small classes very helpful in learning—as opposed to the university's large classes.
- They had not yet developed any real loyalty or sense of belonging towards CPIT.
- They very much enjoyed the practical workshop course.

- They were aware of special assistance available within CPIT if serious problems with learning arose.
- The major reason(s) for doing this course were that they believed it was needed for their chosen career, or they felt they would enjoy it.

Students from the first year reported high expectations and appeared to look forward to an interesting and enjoyable programme. The transition from school to tertiary was not too arduous (nor from work back to study) and they enjoyed the highly focused career-oriented training they received with a lot of practical work.

Second-year students

Questionnaire findings

Thirteen male, second-year students responded to the questionnaire. Of these, 75 percent identified themselves as New Zealand European and 25 percent as Asian. There were 53.8 percent of respondents living at home and 46.2 percent living in rented accommodation, with 84.6 percent studying full time and 38.5 percent working while they were studying.

The key findings regarding second year students' expectations of tertiary study are as follows:

- workload heavier this year (score 1.4)
- less free time this year (score 1.6)
- more factual information required to pass tests/exams than last year (score 1.8)
- used tutor more for help this year
- have to remember and process more information
- tutors expect work of higher standard
- lectures more interesting
- practicals/laboratories more interesting
- higher participation or more active involvement in classes
- expected to work more independently.

Interview findings

The key findings regarding second-year students' perceptions of their tertiary study were as follows:

- Compared to school, the students enjoyed a climate of more like-minded individuals working towards a common goal. "It makes it easier because everyone who is here wants to learn in the first place so that's why they're here. So there's no one buggering around, pissing you off so you can't get stuff done."
- CPIT was a better link with real life and more practical than university.
- CPIT was very focused from the first year, with a practical aspect and links from theory to practice.

- It was more difficult than the first year; however the communication with tutors was better.
- Students had free and open access to tutors—they felt comfortable approaching tutors—"We can just wander into their offices and say we need help with this and get help straight away".
- There was a dislike of working with different staff on a subject, rather than with one person.

  > In the first year, we actually had a case of one person teaching [lecturing] us, a different person writing the lab, a different person taking the lab which really didn't work that well.
  >
  > But most of our courses the person teaching us was the person taking the lab.
  >
  > And it runs a lot smoother.

- Laboratories were important, but complementary to the theory which was needed first; for example:

  > The labs help but you also need to know how it works in the first place, that's why you have the lectures.
  >
  > They're complementary.
  >
  > You need some theory and then the lab then to prove the point really.

- Students felt they learned a lot of additional things in laboratories that were not otherwise taught, for example, troubleshooting circuits until they worked well.
- Students felt the best way to learn was by doing. The theoretical parts of the course "are necessary but they are only in your mind, I mean, they're just sterile theories but we do it, it sort of became yours and you know, you really know it instead just like reading and remembering".
- Personal relationships with the tutor were important for good and easy learning.
- The problems they were asked to do were more open-ended.
- Students become more adept at acquiring the information required to solve problems.
- Students felt the class contract (a document that students must sign at the beginning of that particular course) kept them on "the straight and narrow" by making clear what was expected.
- Laboratory manuals were seen as helpful guides and considered to generally work well.
- Students had mixed feelings about the value of examinations and considered them to be a very restrictive mechanism of assessing actual understanding. "You could learn everything by heart and just do it in the exam, but to do the project you've got to understand".
- Some responses were supportive of examinations in that they forced students to revise subject content.
- Assignments were better for deep learning as more time was available to work on the material.
- Students felt that CPIT courses were extremely compact and covered a lot in a short time.
- Respondents reported that there was not really a social side to CPIT compared to the local university's engineering social club.
- Students reported having some sense of belonging towards CPIT.

Second-year students experienced a clear shift in workload and level of work, and more open-ended assignments. This was balanced by the perception of more interesting and enjoyable material, and by experiencing better connection with their tutors and class mates.

Third-year students

Questionnaire findings

Ten students completed the questionnaire, seven male and three female. Seven students identified themselves as New Zealand European and three as Asian. Fifty percent of respondents were living in rented accommodation with 30 percent living at home and the remaining 20 percent were boarding or had made some other arrangements. Seventy percent of students were from Christchurch, 80 percent were studying full-time, and 70 percent had been working part-time during their studies.

The key findings regarding third year students' experiences of tertiary study were as follows:

- tutors were readily and available to help (score 1.5)
- tutors expected work of high standard (score 1.6)
- students found laboratories interesting and enjoyable (score 1.6)
- in the students' opinion, those with well-developed computer skills did better in their studies (score 1.7)
- in-class discussions and field trips were most enjoyable and interesting
- lectures, discussions, and laboratories were most helpful for learning
- students found subjects progressively more difficult in each year
- they received timely feedback on progress
- they had learnt practical problem-solving skills
- they expected the qualification to help them get a job
- they found most teaching information available on-line. Having material electronically available was very helpful for learning as it was transportable and could be used together on the computer
- they preferred to study on own for tests/exams
- they had been tested on theoretical and problem-solving skills
- tutors had been clear on what to expect
- students enjoyed their studies
- computer skills were very important
- there was a lack of organised social activities; however, they did feel a sense of belonging at CPIT—familiarity with tutors, classmates, and junior students.

Interview findings

The key findings regarding third year students' perceptions of their tertiary study were as follows:

- Interviewees reported that they had a lot of site visits and found these interesting and relevant.

> Everything that we learn, well pretty much everything that we learn here is related to what we're going to be doing in the workforce. And we do lots of site visits and things like that which backs everything up and kind of supports it all so when, we're really confident about when we go out and get jobs after we've graduated, that we're going to be at a level where we can just start doing things, we can just start working and you know, we're going to be there and doing it, whereas at university it was a lot more theoretical, it's all, a lot of research and things like that, whereas actually doing things, it's not really focused that way.

- Students felt the most valuable learning was through "hands on" experiences.
- A student reported his satisfaction with the training at CPIT as opposed to his attempt at university studies.

> I really struggled at university, probably because I'd taken five years off from studying and was working and then came back to it, and of course you step straight back into doing maths 105, where you're literally in a lecture theatre with 500 people and one lecturer talking at you and you get tutorials which you do once a week with like, third year students and it was just so much to do, you're struggling to keep up, you've got everything else which is the same and it was, I really struggled, I was scraping through getting Cs and things and basically just wasn't into it, wasn't motivated. There was nothing really of value that I was doing at intermediate year that I could have taken with me or you know, used out in the industry or anything like that, so to me it was pointless doing it.

- Four of the six students in the focus group had previously been to university and they all agreed that, had they known about the course at CPIT, they would have preferred to come to this course straight from high school. "In hindsight I wish that I had of started this straight out of high school and just done it, and I would have been working for six years by now with a, you know, a degree." The students also commented: "I mean, it's not as though it's a second best or anything, it's just different styles."
- Clear integration of lectures, tutorials and laboratories was seen as a big help to learning. This was fostered by having the same tutor for all parts of the paper.
- Students reported a clear progression of work and depth from the first to the third year: "You're sort of spoon fed in first year and then they expect you to feed yourself in second year and by third year, cooking it".
- The third year was seen as much more enjoyable because students could focus on what they wanted to do and this was seen as a large motivator.
- Interviewees felt that the second year workload needed to be spread more evenly. Nevertheless, students felt that this forced them to learn better time-management and it was considered "good training".
- Assignments were much more open-ended and challenging but this led to extended and deeper learning.

> Well with, I work for an electronics company in town part time just assembling things and doing bits and pieces but the guys that I'm working with are very, very, very intelligent, they're kind of industry gurus I suppose if you will, and when I have assignments and I've got things bouncing around inside my head, I'll ask them and ask questions and get ideas and they're obviously more than happy to sort of, contribute and discuss and I'll talk to

> other people and there's this big process you go through and you understand and it gets built upon and you know, you do some more research and then you find out more and then you find out how much you don't know, and then it just all opens up.

- Examinations were seen as useful for revising subject content but not so good for deep learning.
- Weightings for examinations dropped progressively through the years, from 50 or 60 percent down to 40 percent, with the consequential weighting/emphasis of coursework/assignments increasing. Students felt this was a good system.
- Students reported that the general organisation of the course was that they were taught theory and it was then quickly related to the real world in a clear logical progression.
- Students appreciated staff providing appropriate and timely feedback.
- On being asked to define a good tutor, students agreed that he/she was tough, fair, passionate about teaching, and had industry experience.

Third-year students enjoyed the freedom of choice of electives, found the lectures, in-class discussions, laboratories, and field trips interesting and stimulating, and found very open-ended assignments daunting yet very satisfying after completion. These students also enjoyed better social connection with their peers, tutors, and other more junior students on campus.

Teacher perceptions

The key perceptions of core tutors are listed below:

- The number of students in the programme was relatively small and the range of students varied considerably from year to year: " … sometimes we have more school leavers, sometimes we have quite a large number of internationals, sometimes we don't. We get a tremendous mix, a different mix every year, varies a lot from year to year".
- Staff felt that students took some time to adjust to tertiary study:

> … because the culture and the environment is totally different from school. Here they are treated as adults and are supposed to be responsible for themselves, they obviously have to go through an adaptation stage which, according to my understanding, is taking three to four months to change.…

- Small class sizes (15–20 or smaller) made it possible to get to know students very well and staff felt this was very important.

> I think its extremely important. The students feel they are understood. You understand them better so you obviously appeal to them much better and you can help them much better. If you don't have the power of knowledge of personal knowledge you cant really appeal to them, you don't know what they understand and what they don't understand, what they're expecting, what they're not expecting …

- A high level of interaction in classes helped to engage students and get to know them as individuals.

- Usually all aspects of a particular course (lectures, laboratories) were run by the same lecturer and this enhanced the tutor's ability to get to know the students, as well maintaining a close integration of theory and practice.
- Laboratories and the practical side of courses were seen as essential because of the real-world, practical capability goals of the courses, particularly practical problem-solving which could not be taught except by hands-on experience:

> Given the culture of the polytech that its hands on practical nature, its teaching practical nature studies, it would go totally against the grain of our philosophy of teaching and so it [removing practical sessions] wouldn't make any sense. It wouldn't be tolerated. It wouldn't happen.

- One suggestion was that it would be good to teach via a problems-based approach in which aspects of subject were addressed as and when they arose as part of solving the problem. This was already done to some extent but it was somewhat problematic to approach a whole course this way.
- Senior students were required to work more independently, often in teams, and to adopt a progressively more professional attitude towards their studies. "We also expect a mature attitude to the course, time lines, deadlines, more sort of approaching it professionally to it because we are hopeful that they have the right attitude when they go and apply for jobs."

> [Senior students were expected to be] "reliable responsible, ethical, and with a good 'can do' attitude and flexible attitude as well and also that they can work well, work independently, work together and also work with tremendous, sort of tremendous confidence …

- Students were sometimes assessed as a group and peer assessment within the group was sometimes used.
- Institutional pressure to be more research active was seen as a source of tension because of competing demands on tutors' time. "There's a, there's mounting pressures from management that we produce research".
- Long teaching hours and making themselves available to students took most of the tutors' time.

> It's not always easy to get things done or to get started or to do anything because of our long teaching hours and amount of access to students and so on, at the same time I suppose it's, it's up to us to make more time available and to sometimes shut us off from students but it's not easy for us to shut us off from students.

- Students were encouraged to approach staff and tutors would not want to change this: "Yes it [contact with staff] is highly encouraged and [we're] quite proud that we have that access as opposed to perhaps the university."

Student progression through the years of study

On student progression through the years, core tutors reported that:

- students became progressively more independent over the years
- tutor support and need to spell out what needed to be done decreased over time
- students gradually developed the ability to handle more complex and real-world problems as well as project management skills
- it was important that students developed a sense of professional responsibility.

Taken together with previously reported data, there is a clear path of progression from school to tertiary and from one year to another within the programme. Students perceived and experienced a clear message that they must learn to help themselves more and more as they progressed. Students progressively tackled more complex and more open-ended problems. Studies became more industry-focused towards their final year and this in itself acted as a strong motivator. Students became more mature, confident and independent, preparing themselves for their future careers.

From a social point of view, students gradually developed a sense of belonging to CPIT, and enjoyed growing relations with their peers, tutors, and also with different cohorts. This is a very small group of students in a relatively small institution, compared with the local university which offers a social club for engineering students, and these students indicated a need for a more social side to CPIT.

Course-related materials

The usefulness and merits of various handouts, documents, and assessments were discussed with both students and staff. Class contracts, laboratory manuals, assignments, tutorials, and examinations were explored. Course contracts were used at the School of Engineering at CPIT as a standard contract between the tutor and students, spelling out the regulations and expected behaviour related to that particular course or subject. Added to this contract was a teaching schedule that provided some guide on the rate of teaching the topics, an assessment schedule with dates and weightings, and often also the learning outcomes for that course. Students were required to sign these contracts. It is policy that the tutors get this done during the first contact with the students. Students reported that they seldom referred to the contract after this session. However, the schedules were found to be useful and regularly consulted.

The policy of providing most materials to students on-line was reported by students as being very helpful for transportability and for access on a computer while they had other documents open, especially when doing laboratories or writing reports.

Laboratories were consistently regarded as the most useful vehicle for linking the theory to practice and aiding deep understanding. It was also reported that these activities developed skills beyond what could be taught in textbooks and lectures, the most notable of which was trouble-shooting skills—learning to get the circuit to work, in the presence of a lot of degrees of freedom

and opportunities to build the circuits incorrectly. The accompanying manuals or briefs were found to be very useful, as they “told them exactly what to do and how”.

4. Summary, implications, and recommendations

This case study is based on data collected over a two-year period from staff and students involved in CPIT's School of Engineering's Bachelor of Engineering Technology in Electrotechnology. These experiences have been elicited through the use of questionnaires, interviews, classroom observations, and document analysis. Students completed questionnaires and, in some cases, took part in focus group interviews, while teaching staff were involved in interviews only.

Students from the first year had high expectations and looked forward to an interesting and enjoyable programme. The transition from school to tertiary study was characterised by students needing to adjust to being more independent and self-reliant in their study habits. Second-year students experienced a clear upwards shift in workload and level of work, and in being given more open-ended assignments. The more challenging and difficult work was offset by more interesting and enjoyable material, and by experiencing better connection with their tutors and with their peers. Third-year students enjoyed the freedom of choice of electives, found the lectures, in-class discussions, laboratories, and field trips interesting and stimulating, and found open-ended assignments challenging yet satisfying once completed. Third-year studies became more industry-focused and this was a strong motivator for students as they experienced more contact with their future careers. Tutors felt that students became more mature, confident, and independent in preparing themselves for their careers.

Closer teacher–student relationships developed with time, so the more senior students enjoyed a much better connection with tutors and engaged readily in discussion in and out of class. These relationships were fostered by staff making themselves available to students and adopting an open and supportive approach to student contact. Senior students also enjoyed better social connection with their peers and other more junior students in the degree programme.

First-year students described an ideal tutor as someone who was positive, used media well, and was very accessible. Third-year students asked for someone who was tough, fair, passionate about teaching, and with industry experience. This difference suggests that the inexperienced junior students require a more supportive environment while the senior students require someone who helps motivate them and articulate them into the workplace.

Laboratories were consistently regarded by students as a useful vehicle for linking theory to practice and assisting their learning. Laboratory activities developed skills beyond what could be taught in textbooks and lectures. Students reported that they enjoyed assignments, particularly open-ended assignments, and found these to be the best way to achieve deep learning because they encouraged them to work and research widely and independently. Close integration of lectures and practical sessions—enabled by both parts of the programme being run by the same tutor—was seen by students and staff as important for a successful programme. Tutorials were considered useful but often not enjoyable and sometimes boring. Examinations elicited mixed feelings that ranged from being a useful tool to force students to revise content to being a dubious

method for assessing a student's understanding. Students felt that examinations were a somewhat hit or miss approach to assessment that was very stressful.

Students and staff generally reported their satisfaction with small classes. Students appreciated the informal and interactive teaching culture and better access to tutors compared to the local university, and staff valued the opportunities afforded by small classes to get to know their students and thereby provide more individually tailored support and teaching.

Tutors felt that CPIT traditionally had a strong teaching culture but expressed concerns that a greater emphasis on research within the institution might have a negative impact on the time and emphasis placed on teaching.

These findings have the following implications for tertiary learning in science and engineering in general:

- The development of strong teacher–student and student–student relationships is very supportive of student learning.
- Small class sizes promote opportunities for personal interaction and relationship-building and enhance students' involvement, motivation and enjoyment.
- A close and timely integration of the theoretical and practical aspects of a programme is very supportive of students' learning and this is greatly enhanced by all aspects of a programme (lectures, tutorials, and laboratory sessions) being taken by the same teacher.

Recommendations for CPIT include:

- Staff should be open to feedback from students and to suggestions that might aid them in their learning. The reported student definitions of a good tutor are important to note. It is recommended that feedback from this case study, in general terms, should be circulated to all staff involved in this degree. This report should be circulated, together with some more specific information available in the case of further interest. Names and references should be removed.
- There must be careful planning to avoid unnecessary repetition of materials, unless it serves to reinforce learning. We should attempt to appoint one staff member per course who, ideally, does all the activities.
- Our school should exploit our advantage of small classes and the flexible learning environment we have to offer. CPIT should assist the school in marketing its strong advantage to the local community and attempt to attract more students, particularly more females, Māori and Pacific Island people.
- We should consider starting a social club for our students, other than the student association.

Appendix I: Case study: University of Waikato

Understanding and enhancing learning communities in tertiary education in science and engineering

Case study: School of Science and Engineering, the University of Waikato

Alison Campbell, Rainer Kunnemeyer, Michèle Prinsep, and Michael Forret

1. Introduction

The case study presented in this report is one of four studies carried out as part of the Teaching and Learning Research Initiative (TLRI) funded project "Understanding and Enhancing Learning Communities in Tertiary Education in Science and Engineering". The project examines the nature of tertiary learning communities and seeks to understand, from the perspective of the participants, what it means to teach and learn in tertiary science and engineering.

The report begins by describing the tertiary institution, school of study, and the general context within which the research took place. This is followed by a discussion of the rationale and purposes of the project along with a description of the project's design and the methods used to collect data. Next, the findings and conclusions drawn are presented and the report finishes with a summary and discussion of this case study's findings and implications.

Context of the case study

The University of Waikato is a relatively new tertiary institution, established in Hamilton 40 years ago. It has a student body of approximately 10,000 equivalent full-time students (EFTS). Around 2,000 of these are international students, and there are also substantial numbers of Māori students. Mature ("second-chance") students make up 40 percent of the total student body. Within this setting, the School of Science and Engineering has a total student enrolment of around 900 EFTS (domestic plus international students, who make up 10 percent of the total), with 25 percent of these being graduate and postgraduate students. These students are enrolled in one of three undergraduate degrees (Batchelor of Science, Batchelor of Science (Technology), and Batchelor of Engineering), or in Master of Science, Master of Engineering, Master of Philosophy, Postgraduate Diploma, or Doctor of Philosophy studies, in a wide range of papers across all the science and engineering disciplines. The intention of the school is "to contribute effectively to the attainment of the university's strategic goals, recruit academically able and suitably qualified students, increase total enrolments, maintain a high level of postgraduate enrolments (>25%), and deliver teaching and research programmes of the highest internationally benchmarked standards in a safe, caring, and stimulating environment" (School of Science and Engineering, 2006a).

The students who participated in this study were enrolled in first-, second-, and third-year papers offered by the departments of Biological Sciences, Chemistry, and Engineering. However, not all students in any one cohort chose to participate in the study. Most papers are taught by a team of three to five lecturers, with laboratory classes typically supervised by an academic, supported by a group of senior students who act as demonstrators. Laboratory classes are compulsory and attendance at lectures is expected, but students may choose not to attend the tutorial classes also offered at first-year level in many subjects. In general, students enrolled in first-year papers are expected to attend one three-hour laboratory class and three one-hour lectures a week, as well as the tutorial sessions. The course structure becomes more variable at second year and beyond, depending on the discipline. For example, a second-year biology paper would involve three one-

hour lectures and a three-hour laboratory class each week; in chemistry the requirement for one paper is three lectures, two laboratory sessions (over a six-week block) and a tutorial; and in engineering, one or two lectures and a laboratory class.

Purposes of the research

This project aims at enhancing the quality of teaching and learning experiences in tertiary science and engineering education. The study seeks to develop a better understanding of how existing systems, processes, and practices influence both students' and lecturers' perceptions of, and attitudes towards, science and engineering, and science and engineering education. The study addresses the nature of tertiary learning communities and seeks to understand, from the perspective of the participants, what it means to teach and learn tertiary science and engineering.

The main thrust of the Teaching and Learning Research Initiative is to build knowledge through partnership research about teaching and learning; to use this knowledge to create improved outcomes for learners, and to create partnerships between practitioners and researchers to maximize the value and usefulness of research.

The main aims of the research are to:

- contribute to an understanding of the nature of learning communities in tertiary science and engineering and how they work to enhance teaching and student achievement
- understand how the nature of the learning community might change for teachers and learners over time of participation in that community
- build capability in educational research for tertiary science and engineering lecturers by involving them in the research process
    - investigate the use of a sociocultural view of learning to understand teaching and learning in higher education.

The purposes of the research are embodied in the following objectives:

- research student perceptions of learning in tertiary science and engineering—this will involve examining students' ideas about the purposes of learning events, how they learn, who they learn from, and how the nature of the learning environment impacts on their learning
- research teacher perceptions of teaching in tertiary science and engineering—this will involve examining their purposes in teaching, their perceptions of student learning, and how the nature of the learning environment impacts on their teaching
- research interactions between teachers and students to understand how the nature of their relationship might influence learning—this will involve gathering data on teacher and student views about these relationships, observations of the relationships, and their development over time.

- research the changes in learning experiences for students as they progress through their undergraduate degrees and into graduate study—this will involve following the progress of a group of students through two years of study, and asking lecturers about their perceptions of teaching students at different levels
- work alongside lecturers to scaffold research-informed development of their teaching programmes—this will involve the lecturers in planning and carrying out the research, analysing the data and reflecting on how the data may inform their practice.

2. Research design

For Phase One of the study, first-year science and engineering students were surveyed during the first semester of 2005 using a questionnaire they completed during laboratory classes. The questions explored the social and cultural nature of their learning at school and their expectations of their tertiary study. Later in the semester, third-year students in science and engineering were also surveyed about their learning experiences and relationships to date.

Phase Two, part way through the first year of the study, involved convening focus groups of first- and third-year students for interviews that probed the students' learning experiences. These interviews focused on the nature of the learning relationships the students had developed, and the social and cultural influences within the community that had affected their learning.

In Phase Three, in 2006, students who were continuing on to their second year of study in the school were surveyed again. This survey focused on gathering quantitative data on the students' learning experiences in their previous year of study and their expectations for the year ahead.

Phase Four, part way through 2006, involved convening focus groups of second-year students for interviews exploring the process of the students' enculturation into the tertiary science and engineering communities. Thus, data about students' learning experiences were gathered across three years of study within a two-year research programme.

Data were also sought from lecturing staff. A cohort of science and engineering lecturers was interviewed individually by the researchers in each year of the study about their ideas on teaching, learning, and assessment at the levels of study in focus for that year.

In addition to the above, data were also gathered from observations of lectures and laboratory classes, and by analysis of programme-related documents such as course outlines, laboratory manuals, study guides, and assessment items.

The School of Science and Engineering authors of this report were involved in the study as practitioner-researchers. They are all research-active teaching staff at the University of Waikato, and were involved in the planning of the research, the collection, analysis, and interpretation of the student data, the interpretation of lecturer data and documental data, the drawing of conclusions, and dissemination of findings.

The multiple methods used in this research project enhanced the validity and reliability of the data presented and analysed here. The project followed the University of Waikato Human Research Ethics Regulations 2000 and the ethical guidelines of the New Zealand Association for Research in Education (NZARE), including the principles of informed consent, privacy, and confidentiality.

A summary of data gathering methods and numbers of participants is given in Table 1.

Table 1 Data collection and participant numbers

Data method	Participants	2005	2006
Questionnaire	Students	Year 1: n = 192 (69% male, 31% female) Year 3: n = 51 (27.5%male, 72.5% female)	Year 2: n = 62 (69.4% male, 30.6% female)
Interviews	Students and staff	Student focus groups: Year 1: two groups of five students Year 3: one group of four students Three staff interviews	Student focus groups: Year 2: one group of four students Two staff interviews
Class observation	Staff and students	-	One class
Document analysis	-	-	Course outlines, study guides, lecture notes, assessment items

3. Research results

Student perceptions

First-year students

The questionnaire was completed by 192 first-year students studying chemistry, biology, and engineering, of whom 69 percent were male and 31 percent female. As for the other cohorts, this is not representative of the school's student population, where the genders are more evenly balanced. Seventy percent of the group identified themselves as New Zealand European; 7.8 percent were Asian, and 5.2 percent Maori (see Appendix 1). The remainder were identified as Polynesian, European, or "other". Only 60 percent of the cohort indicated that they were at secondary school before beginning their first-year studies; 15 percent had been in paid employment; and 19 percent in tertiary study. This last group probably represents students enrolled in bridging courses, such as Foundation Science and the Certificate in University Preparation. Forty-four percent of the respondents were studying in their home city, while 56 percent identified themselves as from out of Hamilton, and 97 percent were studying full time.

Asked about their reasons for taking the course, students most commonly indicated that they needed it for their chosen career (37 percent) or that they expected to enjoy the subject (also 37 percent; students could select more than one option). Data from focus groups support this, with students stating that they had chosen a particular course of study on the basis of personal interest. Twenty-eight percent of respondents had enjoyed the subject at school. Perhaps surprisingly, careers advisors—and family and friends—were reported as having minimal effect on students' tertiary study choices. This is an interesting finding given the amount of effort spent by the university in trying to influence parents and careers advisors. It also suggests that the perception of many adults, that young people are strongly influenced by their peer group, may not be true for important decisions that affect future lives and careers.

All students reported that they had experienced a wide range of learning opportunities during their previous education: completing workbook exercises, listening to teacher presentations, engaging in in-class discussion and debate, doing practical activities, making presentations to the class, doing reading and research, and going on activities outside the classroom. Of these, the most enjoyable were practical activities such as laboratory classes (selected by 41 percent of students), though field trips and other "away" educational activities were also popular (33 percent). In-class discussion was chosen by 29 percent but only 7.5 percent indicated that they found making a presentation an enjoyable activity. These findings should be considered by tertiary teachers in determining the mix of learning activities offered to their students. Students may need more education and support in learning how to make a successful in-class presentation, for example, and the reasons for particular activities may need to be explained. For example, few students (13 percent) felt that making a presentation helped them to understand the subject they were studying,

while all the other activities were thought to be helpful by a large proportion (≥33%) of the respondents.

Asked what they expected in terms of learning experiences during their tertiary studies, a large minority (46 percent) expected that university study would involve them in hearing lectures and doing personal reading and research. Slightly fewer (41 percent) anticipated completing book and worksheet exercises and problems. Between 20 and 30 percent felt that their learning activities would involve in-class discussion or field trips, and only 18 percent expected to make presentations to the class.

In terms of learning support while at secondary school, 45 percent of students reported asking the course teacher for help with their studies, and 43 percent would have asked their classmates. The Internet and the library were regarded as less significant (33 to 34 percent), while students regarded family and friends as least useful (21 percent). In comparison, they expected that at university they would make more use of the library (43 percent) and Internet (38 percent), while relying slightly less on the course teachers (42 percent). Peers still rated highly at 41 percent, while the proportion expecting to seek help from family dropped to 13 percent (understandably, since the majority of first-years indicated that they were living away from home). These expectations are borne out by the results of the survey of second-year students, and may reflect the fact that subjects are becoming more specialised, thus restricting the amount of assistance that family members can give.

Students were asked to indicate their agreement/disagreement with a number of statements about their expectations of university study, ranking responses on a 5-point Likert scale (1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree), and a summary of the results follows here.

Predictably, students did not expect to have much free time while studying. However, a majority still anticipated being involved in sports clubs and activities, and socialising with new and existing friends. Respondents agreed that they expected to feel part of the institution's learning community, although fewer expected to get to know their teachers on a personal level. They agreed that lectures and—more strongly—practical classes would be interesting and enjoyable. One focus group member remarked: "I feel like I've been waiting all my life to go to uni".

In terms of their learning experiences, students agreed that the subject content would be more difficult than it had been at secondary school, and that they would benefit from being in contact with research staff. They expected to have to learn lots of facts, but also practical and problem-solving skills. Assessment would include testing their ability both to memorise material and to apply practical skills—and they would have rapid and useful feedback on their progress. They also agreed that they expected a heavy workload, and that they would be required to produce a high standard of work. Previous studies have identified workload as an issue for some students (Leach et al. 2005), with some avoiding particular papers if the course workload was perceived to be particularly heavy. Related to this was the strong expectation that students would have a clear idea of what was expected of them in their courses, and that course information would be readily

available from sources such as the Internet. Students strongly agreed that they expected to use a computer, and computer skills, during their studies.

Second-year students

There were 95 responses from students in their second year of study in the School: 63 percent male and 37 percent female. New Zealand Europeans made up 56.4 percent of the total; 23.4 percent were Asian and 3.2 percent Māori. The remainder were identified as Polynesian, European, or "other" (see Appendix 1). The proportion in full-time study had increased slightly compared to the first-year group, to 98 percent. Asked about their reasons for taking the course, 73 percent indicated they needed the course for their chosen careers, 67 percent felt they would enjoy the subject, and 66 percent enjoyed the subject at secondary school. The single most influential reason, selected by 52 percent of students, was the subject's relevance to their chosen career. The increased focus on a course's relevance to career options may reflect the fact that students are now focusing on their majors.

In terms of help with their studies, 88 percent relied on their teachers to the same, or greater, degree than in their first year, and this support was obviously valued: "Well, the tutors and the lecturers are fantastic, if you don't understand something you can ask and they have a multiple of ways of explaining the same thing differently". In addition, 77 percent reported using the Internet the same or more; 93 percent made the same, or greater, use of the library; and 88 percent indicated the same or greater reliance on working with their classmates. While 67 percent reported finding tutorials helpful to the same or a greater degree, 33 percent reported using them less—this probably reflects the fact that in most disciplines tutorials are not offered past the first year. Family and friends became even less significant as a source of help with studies; again, reflecting students' increasing specialisation. These findings match with the expectations held by first-year students with regard to likely sources of help with their studies.

Students were again asked to indicate their agreement/disagreement with a number of statements about their expectations of university study, ranking responses on a 5-point Likert scale. The results of this section of the questionnaire are summarised below.

Student workload seemed to have had a marked effect on students' extracurricular activities, compared to their experiences in their first year of study. Those surveyed agreed that they had less free time than in the previous year, and also felt that they were less involved with both sporting and cultural activities. As might be expected, they felt themselves to be more organised in their study habits than in the past.

There was some agreement that students felt more a part of the university's learning community, and that during their second year they had got to know their lecturers better on the personal level. They were neutral on the question of whether lectures were less interesting than in the previous year, but tended to agree that practical classes were more interesting, and that they were expected

to work more independently during these classes. They also felt that they were expected to produce work of a higher standard than had been the case in their first-year papers.

Second-year students disagreed that their workload was lighter than in their first year, and also disagreed that they had to remember less factual information for tests and examinations than previously. They agreed that both theoretical and practical parts of their studies were harder to understand, but were neutral as to whether lecturer feedback, and readiness to answer questions, was more or less helpful. There was slight agreement with the proposition that they were less clear than in their first year about what was expected of them in their programme of study. Very few recalled having been involved in online learning activities in the previous year; this is somewhat surprising given that biology, at least, strongly encourages use of the online ClassForum system. Those few were neutral on whether they used this form of learning less than in the past.

Third-year students

Fifty-one students, nearly three-quarters of them women, completed the third-year questionnaire. (Again, this is not representative of the gender balance in the School as a whole.) Seventy-one percent identified themselves as New Zealand European, and 10 percent as Asian; only 4 percent identified as Māori. The remainder described themselves as Polynesian, European, or "other" (see Appendix 1). Ninety-six percent were in full-time study.

The most common reason given for taking their particular programme of study was a feeling that they would enjoy the subject (29 percent). Eighteen percent had enjoyed the subject at school and 22 percent needed it for their chosen career: members of one third-year focus group gave the existence of work placements, as part of the degree, as a reason for choosing their particular course of study at this university. Advice from the school careers advisor was significant for only 5 percent of the sample. It is interesting that enjoyment ranks above career value for these students, given the current marketing emphasis on promoting the link between degree study and consequent careers.

The students reported that they had experienced a wide range of learning opportunities during their programme of study: completing workbook exercises, listening to teacher presentations, engaging in in-class discussion and debate, doing practical activities, making presentations to the class, doing reading and research, and going on activities outside the classroom. In-class discussions and making presentations were the least common, at 37 percent and 35 percent respectively. The most enjoyable were practical activities such as laboratory classes (51.5 percent), lectures or other teacher presentations (49.5 percent), and personal reading and research (46.5 percent). In-class discussions (35 percent), group activities (38 percent), and field trips (37 percent) were also popular. Preparing and delivering a presentation to their classmates was selected by only 19 percent of the respondents and, along with group work, was least likely to be regarded as helping students to understand what they were studying (only 26 percent for each).

This suggests a need to explain the purpose of these activities to students, given that they teach a different set of skills (including team work and public speaking).

Asked where they would go for help with their studies, these third-year students regarded their lecturers and the institution's library as almost equally important (selected by 30 percent and 28 percent respectively). The Internet (22 percent) and tutorials (25 percent) were almost as highly valued, but 19 percent indicated that they would ask classmates and 12 percent chose family and friends. Student support services were selected by only 2 percent of the cohort. This last finding could be fruitful ground for future research.

Students were also asked to review their learning experiences over the previous three years. Because it is instructive to compare these with the expectations of first-year students at the beginning of their university study, these data are presented in the next section.

Student progression through the years of study

Students entering tertiary study had clear expectations of what this would involve. When third-year students reflected on their experiences, it was clear that many of these expectations had been met: for example, workloads were indeed heavier than at school; students did make new friends; a high standard of work was required; and students' expectation of enjoying their time at university became a reality. However, there were some areas where expectations did not measure up.

For example, new students tended to agree with the statement that they would be involved in sports clubs and activities during their time at university; overall, the third-year students did not agree that this had been the case. They were stronger in their disagreement with the statement that they had been involved with cultural groups and activities over this time. They were also less likely to agree that they had learned practical problem-solving skills. And again, students in their third year of university agreed less strongly that they had been tested on their ability to solve practical problems, whereas new students had quite a strong expectation that this would happen.

While the first-year cohort expected that they would receive appropriate and timely feedback on their progress from teaching staff, the third-year students were less likely to agree that this had been the case. Similarly, while first-year students expected to have a clear idea of what was expected of them in their various papers, third-year students were less likely to agree that they had always been clear about this. This bears out the findings of an earlier study by Leach et al. (2005), which found that students can be confused by lack of clear expectations, or by being in a situation where different lecturers have different expectations. These authors also noted that unclear assessment questions, lack of effective feedback, and over-assessment can affect students' decisions to continue with a paper.

Feedback from both first- and third-year focus groups makes it clear that a major issue for students entering tertiary education is developing the skills and self-discipline necessary to become an independent learner. This is reinforced by another study of the issues influencing

students' decisions to continue with their studies (Otrel-Cass et al., 2006). The students in the present study compared the school system, with its regimented days and teacher pressure to get work done and on time, with the far looser university system with its varied distractions:

> Because everyone's always wandering in and wanting you to go somewhere and it's always busy and it's really, really social … [it can be hard to stay focused], to sit down and do your assignments.

Student comments also made it clear that things such as class size—where their comments showed a preference for small classes—make a considerable difference to their participation in learning and their sense of being a part of a learning community:

> But sort of like, the friends we have now, like in classes and stuff, if you can't be bothered going to class and you think, I better go [because] everyone else will be. Especially in third year, they'll really notice if you're not there [because] you're one of eight in the class. (Third-year student)

Teacher perceptions of teaching and learning

Purposes of teaching

Lecturing staff felt that their classes had a number of purposes, in addition to the transmission of knowledge. They felt it important to bring students "up to standard"—this is most likely to be seen as an important function of teaching by staff involved in first-year classes, where students have a wide range of educational backgrounds and prior learning experiences (e.g. Buntting et al., 2004). At the same time they saw a need to build a rapport with students, something which students also view as important (e.g. Leach et al., 2006). While there is a substantial body of content knowledge in all university courses, lecturers also highlighted the need for students to learn process skills, such as the technical skills used in laboratory work, and to develop skills needed in the "real world", such as working in groups (School of Science and Engineering, 2006b).

Perceptions of student learning

Lecturers felt that students were not well-prepared for the tertiary teaching environment. They characterised students as expecting handouts of lecture material, rather than taking their own notes. (One staff member remarked that even then, students did not read the material provided before coming to lectures.) Many were used to teacher direction, requiring spoon-feeding rather than having independent learning skills, and in addition seemed to have little background in other, related topics (e.g. chemistry is useful for biology students, but many have not studied it at Year 13).

> Yeah, they then come to university and expect to be fed everything, they expect handouts, they expect everything on a plate and then they expect to know that everything that could possibly be in the exam is in the handouts …

Asked more specifically about learning in the university environment, staff commented that students seemed to focus on rote learning of facts, and that many tended to put little effort into their learning. They felt that students relied heavily on lectures, and needed to put more time into course readings. At the same time, students could find it difficult to cope with the sheer quantity of teaching material, especially where this was conceptually difficult. One lecturer commented that student learning would be enhanced by students participating more actively in learning experiences.

> Yeah, well I suppose I mean that students are coming to university and not really appreciating what is expected of them and not putting any work in. I mean, university education is quite an important thing for a lot of people to take part in but there seems to be a lack of participation from students in their education.

There was general agreement on the importance of laboratory classes for student learning: this is where students develop practical techniques and build relationships. In addition, laboratory classes often illustrate or expand on material covered in lectures.

Nature of learning environment

Staff commented directly on their perceptions of the learning environment, but also on issues affecting their teaching (and hence with the potential to have an effect on student learning). Chief of these were the effect of the Performance-based Research Fund (PBRF), with its focus on research:

> Well I guess people are, well when you talk to people they do feel there is a lot of emphasis on PBRF in which case that is tending to favour the emphasis on research and not teaching. So if things go that way I guess the emphasis will continue to be about research.

The PBRF and the administrative load carried by many staff members place considerable demands on staff time: "We'd all be better at everything given more time but when you've got lots of administration and lots of teaching and lots of research it's really hard to get that balance".

Student attendance at lectures was seen to be an issue affecting the learning environment, with one staff member noting that in some cases only two-thirds of the class might actually appear in lectures: "I was pretty shocked with the quality of the students and about the lack of attendance at lectures". This can affect staff attitudes; for example, there may be reluctance to provide study materials in advance if this will act as a disincentive for students to attend lectures. There was little staff–student or student–student interaction in lectures, despite the fact that many lecturers made an effort to elicit this. However, the value of tutorials and field trips in the learning environment was highlighted: they provide the opportunity to break down barriers between staff and students, and to encourage active student involvement in the learning process. Similarly,

laboratory classes offered the chance for one-on-one teaching, particularly at advanced levels where the student: teacher ratio was lower.

> I guess that key thing of one to one contact which is a luxury of working in labs or going on field trips with students and sort of, seeing the differences in students, and getting into discussions with students about how they learn.

Staff members were positive about the physical learning environment and about the support offered to both staff and students. The university has excellent teaching facilities, in terms of both the rooms and the technology available. Some lecturers used online learning in support of their classroom teaching. The Teaching and Learning Development Unit was described as providing very helpful workshops on teaching; it also offers considerable learning support to students. One staff member felt that senior colleagues had not been very supportive to new teaching staff, and also perceived younger staff to be more interested in teaching than senior team members.

Teacher–student interactions

Students value many attributes in their teachers—including the ability to develop a good rapport and positive working relationships with students (Leach et al., 2005). These relationships develop over time, and perceptions of the learning environment, in terms of teacher quality and student–teacher relationships, were varied. Asked about the effectiveness of their learning experiences, one first-year student commented:

> It varies a lot from lecturer to lecturer. Like, some lecturers you connect with and others you don't and the ones that you do connect with are great, you just want them to keep lecturing but I'd say the majority of them are mediocre and you get bored.

Like others, this student valued lecturers who were passionate about their subject, describing his favourite teachers as

> energetic, you know, likes what they are lecturing, if they enjoy what they are lecturing it comes out in the lecture, it's definitely visible … You know, the ones that you like, they're absolutely on to it, all their lecture slides are perfect, really easy to understand. And about the lecturers that I like, the ones that connect with me, they, I think a good way of putting it would be to say that they make it easy for you. Like they teach it to you and they make it seem easy whereas the ones that, the other ones that aren't so good they teach it to you and you're like, you don't get it, what's going on. Whereas the other ones they teach it and you get it straight away, they make it easier for you. That's probably the best way of saying it.

The rest of the focus group agreed with this assessment. However, this student also commented that, much as he enjoyed being taught by enthusiastic, passionate lecturers, if in need of help he would approach the course tutor, rather than the lecturer. This particular focus group agreed that lecturers were there to present information to the whole class, but students needed to use textbooks and practical exercises, ask friends, and go to the tutors for assistance in mastering difficult concepts and skills. They seemed to regard lecturers as too busy to approach after

lectures and also, to some degree, unapproachable. (This is an interesting perception, given that 42 percent of first-year students, and 30 percent of third-year students, regard the lecturing staff as an important source of help with their learning.)

However, as students go on to more advanced study, they can gain a feeling that staff are interested in them as individuals, and value this. Asked if he perceived his lecturers to be interested in his progress, one second-year student agreed, saying that he liked "not being lost in the crowd … instead of just being another student, and I like it because I like the interaction between the [students and] lecturer". This positive relationship with his teachers, and the feeling of being treated like an adult, encouraged him to want to do better in his courses. Like the first-year students, he also valued passion, enthusiasm, and approachability in his teachers:

> Because often you can have like a real relatively minor problem in terms of academically … if you don't understand that concept then you've got other concepts that build on that. So the [lecturers] that you can really just approach and … are actually happy to talk, will explain the whole concept and it helps, they are passionate about what they do and they generally want you to understand.

This can have a significant effect on students' decisions to continue with a particular paper:

> I pulled out of a paper in A semester of this year part way through it and just pulled out because he [the lecturer] just would not explain things to you, like he just wouldn't. Even if he tried a little bit, and it just wouldn't help and he just wasn't prepared to do anything else.

Implications for teaching

The material presented above suggests that there is a mismatch between teacher perceptions of the teaching and learning environment and those of students. In their comments, the latter group focused far more strongly on the quality of teachers and of teaching, as they perceived it. For example, teachers commented that students were often ill-prepared for the university environment and might lack a strong background in their main or supporting subjects. It could be suggested that the tertiary teaching system needs to meet students half-way, given that the New Zealand school system is not focused on preparing students for university study. In addition, the increasing diversity of the university student body brings with it the need to recognise other learning styles (something touched on by a member of one of the student focus groups), and to adjust teaching methods to deal with these perceived problems. Zepke et al. (2005) also comment on the need for tertiary institutes to adjust to meet student diversity.

Student attitudes to learning can have an effect on the attitudes of staff. For example, staff identified student attendance (or the lack of it) at lectures as something that affects the learning environment. Whatever its cause, this student behaviour can affect staff attitudes; for example, staff commented that they were sometimes loath to supply course handouts in advance of lectures as they believed that this would adversely affect student attendance. Yet students reported that they valued such materials and did not regard having them as a reason for skipping class, and

there is good evidence that provision of these materials in advance enhances the lecture learning experience for students (e.g. Ryan 2000).

The results of the student questionnaire also highlight those educational activities that students enjoy and which they find helpful in developing an understanding of the subjects they are studying; for example, few first-year students (7.5 percent) enjoyed making a presentation to the class, and only 13 percent regarded this as helpful to their learning. Even though third-year students could be expected to have more experience with this particular activity, only 19 percent of them reported enjoying it and just 26 percent thought it a valuable learning exercise. These findings should be considered by tertiary teachers in determining the mix of learning activities for their students. There may need to be more education/support for students in learning how to make a successful in-class presentation. It may also be necessary to ensure that students are aware why they are doing particular things; for example, presentation skills, and other tools for communication, may be useful in future employment, even if they do not aid learning of content.

In addition, class size can make a difference to students' perceptions of teaching and learning. Third-year students agreed that small classes were preferable, partly because these fostered development of good relationships with teaching staff, and partly because the students felt they received more individual attention in such classes. While it may not be possible to move away completely from the traditional lecture mode, teaching staff may wish to investigate teaching techniques that encourage small-group work within the lecture setting. This can also have positive outcomes on development of desirable learning skills; for example, supporting acquisition of a "deep" learning approach (Watters & Watters, 2007).

4. Summary and implications

This study identifies a number of key themes that influence student learning in the tertiary education environment:

- Students entering tertiary study generally have positive expectations of their experiences, and feedback from later cohorts suggests these expectations are usually, but not always, met.
- Students' perceptions of teaching staff, and their relationships with staff, are important: students see staff as an important source of learning assistance.
- There are gaps between student and teacher perceptions of the learning environment.
- Teachers enjoy teaching but face considerable competing demands on their time.
- There is a need for more support for student learning.
- Students attach considerable value to small class sizes, and to practical classes.

Expectations that are not always borne out by subsequent experiences include things such as involvement in sports and cultural clubs and activities (possibly related to workload); learning—and being tested on—practical skills and problem-solving techniques; receiving appropriate and timely feedback on academic progress; and having a clear idea of lecturer expectations. These factors can affect overall satisfaction with their tertiary experience, but also—and more specifically—affect learning outcomes for students. Where feedback and lecturer expectations are concerned, these issues can be remedied through improving lines of communication between teaching staff and students; which could also contribute to enhanced relationships between the two groups and a stronger sense of belonging to a community of learning. Students place a high value on the development of one-to-one relationships with teaching staff.

Gaps between student and teacher perceptions of the learning environment exist: teaching staff perceive many first-year students as ill-prepared for university study, and are concerned about attendance and participation. Students focus far more strongly on the perceived quality of teaching, and their comments suggest that this perceived quality can affect enjoyment, learning, and retention. These gaps can be difficult to bridge; one way to begin would be for teaching staff to become more familiar with the varied educational backgrounds of their first-year students—a time-consuming exercise and one which would require a change at departmental, school, or institutional level. Other approaches could involve changes in teaching approach: for example, both lecturers and students find smaller class sizes helpful in learning, but the primary teaching mode is in lectures with large class sizes, particularly at first-year level. This is despite evidence that smaller classes have a positive effect on student outcomes and on their development of desirable learning approaches (see, for example Watters & Watters, 2007). However, there are teaching approaches that can give students the small-group experience, even in a large group of students in a lecture theatre.

Responsibility for student learning extends beyond the classroom and the student–teacher relationship. Students must take responsibility for their own learning, and may need to be supported in this as they make the jump from the highly-controlled world of secondary school to

the university system. However, there is also a case for making institutional student learning-support services both more visible and more accessible to students, and for staff to be more consistent in encouraging students to make use of them. This may require some education of staff as to what services are available and how students can access them. It may also require more investment in these services by the university, an issue with considerable budgetary implications.

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Appendix J: Case study: Waikato Institute of Technology (Wintec)

Understanding and enhancing learning communities in tertiary education in science and engineering

Case study: Waikato Institute of Technology (Wintec)

Chris Eames and Kevin Stewart

1. Introduction

The case study presented in this report is one of four studies carried out as part of the Teaching and Learning Research Initiative (TLRI) funded project "Understanding and Enhancing Learning Communities in Tertiary Education in Science and Engineering". The project examines the nature of tertiary learning communities and seeks to understand, from the perspective of the participants, what it means to teach and learn in tertiary science and engineering.

The report begins by describing the tertiary institution, school of study, and the general context within which the research took place. This is followed by a discussion of the rationale and purposes of the project along with a description of the project's design and the methods used to collect data. Next, the findings and conclusions drawn are presented and the report finishes with a summary this case study's findings and implications.

Context of the case study

Wintec is the fifth largest institute of technology/polytechnic in New Zealand and the third largest tertiary education institute in the Waikato, Bay of Plenty, and Taranaki region. The institute was founded in 1924 and originally called the Hamilton Technical College. The name was changed to the Waikato Technical Institute in 1968 and to the Waikato Polytechnic in 1987, to reflect the increasing scope of its educational activities. During the 1990s, the organisation developed a range of degrees in nursing, midwifery, business, sport and exercise science, information technology, and media arts. The strong practical focus of these degrees was designed to support the long-standing reputation of the organisation for successful trade and technology training. The name was changed to the Waikato Institute of Technology in 2001 with the "Wintec" brand adopted in 2003.

Wintec has three campuses in Hamilton. The main city site is situated overlooking the city centre and accommodates programmes from the Schools of Information Technology, Business and Administration, Health, Communication, Education and Social Development, Science and Primary Industries, Te Toi-a-Kiwa: Māori, Pasifika and Indigenous Studies, English Language, and Media Arts, as well as most of the central administrative services. The community-serving philosophy of the institute is articulated in the mission statement: "To build a stronger community through education, research and career development".

The Avalon campus on the northern outskirts of the city houses the Schools of Trades, Engineering and Construction, Sport and Exercise Science, and Retail and Service Industries. The third Hamilton campus, the Horticultural Educational Centre, is situated at the Hamilton Gardens.

Wintec enrolls more than 8,000 EFTS students in two faculties—the Faculty of Business and Technology and the Faculty of Health, Arts, and Social Sciences. These faculties comprise 12 schools of study with more than 300 full-time equivalent staff members. The institute offers programmes ranging from certificate to postgraduate degrees, including seven undergraduate

degrees. Most of the programmes are at certificate and diploma level, with a practical career-based focus.

This study compares the experience of students at Wintec with those at three other tertiary institutions in New Zealand. These are the University of Waikato (UoW), Auckland University of Technology (AUT), and the Christchurch Polytechnic Institute of Technology (CPIT). There is a strong Tainui community in the Waikato region and around 17 percent of students enrolled at Wintec are Māori.

The cohort of students that took part in this study was drawn from the School of Science and Primary Industries and the School of Trades, Construction and Engineering. The science students were all enrolled in the two year Diploma in Technology. This is a full-time course designed to prepare students for employment in local science-based industries. There were 25 first-year students enrolled in this course in 2005, and in 2006 there were 12 second-year students.

The engineering students were enrolled in a Diploma in Technology or Diploma in Engineering, majoring in civil, mechanical, or electrical engineering. There were approximately 100 first-year students enrolled in this course in 2005, and in 2006 there were 50 second-year students enrolled.

Therefore the population in this study of science and engineering students was 125 in 2005 and 62 in 2006.

Purposes of the research

This project aims at enhancing the quality of teaching and learning experiences in tertiary science and engineering education. The study seeks to develop a better understanding of how existing systems, processes, and practices influence both students' and lecturers' perceptions of, and attitudes towards, science and engineering, and science and engineering education. The study addresses the nature of tertiary learning communities and seeks to understand, from the perspective of the participants, what it means to teach and learn tertiary science and engineering.

The main thrust of the Teaching and Learning Research Initiative is to build knowledge through partnership research about teaching and learning, to use this knowledge to create improved outcomes for learners, and to create partnerships between practitioners and researchers to maximise the value and usefulness of research.

The main aims of the research are to:

- contribute to an understanding of the nature of learning communities in tertiary science and engineering and how they work to enhance teaching and student achievement
- understand how the nature of the learning community might change for teachers and learners over time of participation in that community
- build capability in educational research for tertiary science and engineering lecturers by involving them in the research process

- investigate the use of a sociocultural view of learning to understand teaching and learning in higher education.

The purposes of the research are embodied in the following objectives:

- research student perceptions of learning in tertiary science and engineering—this will involve examining students' ideas about the purposes of learning events, how they learn, who they learn from, and how the nature of the learning environment impacts on their learning
- research teacher perceptions of teaching in tertiary science and engineering—this will involve examining their purposes in teaching, their perceptions of student learning, and how the nature of the learning environment impacts on their teaching
- research interactions between teachers and students to understand how the nature of their relationship might influence learning—this would involve gathering data on teacher and student views about these relationships, observations of the relationships, and their development over time
- research the changes in learning experiences for students as they progress through their undergraduate degrees and into graduate study—this will involve following the progress of a group of students through two years of study, and asking lecturers about their perceptions of teaching students at different levels
- work alongside lecturers to scaffold research informed development of their teaching programmes—this will involve the lecturers in planning and carrying out the research, analysing the data and reflecting on how the data may inform their practice.

2. Research design

This report constitutes a case study of the data collected from the Schools of Science and Primary Industries, and Trades, Engineering and Construction at Wintec. It represents one case among four that were based at different institutions, all focused on teaching and learning in tertiary science and engineering. The focus of this case study was teaching and learning in the two-year programmes, Diploma in Technology and Diploma in Engineering. A case study design (Bassey, 1999; Merriam, 1998) was used to provide a process that enabled researchers to gain an in-depth understanding of the issues and to explore meaning from a number of angles (Merriam, 1998). Using a number of data sources and collection methods allowed triangulation of the findings, leading to improved validity and reliability. Conclusions on the case could then be drawn, which when situated in the context of the case, would permit the reader to decide on the generalisability of the findings to another contexts. Ethical approval for the research to be carried out by the researchers was obtained from the University of Waikato and Wintec and informed consent was gained from all participants before the data were collected.

Data were collected over two years to investigate learners' and teachers' experiences of the tertiary learning community over time. In this study, data were collected by the means of questionnaire, interview, observation, and document analysis (see Table 1).

Questionnaires containing closed questions were used to gain a breadth of data from students in their first year in 2005 and their second year in 2006 of the diploma programmes. The questionnaires were administered by the Wintec researcher and statistically analysed by a research assistant. The findings were then co-analysed by the research partnership. The findings of the questionnaires were used to inform development of interview questions for student focus groups.

Interviews were used to probe staff and student views more deeply. In this study, semi-structured interviews were carried out with staff and students by a researcher not employed at Wintec. One-to-one interviews were conducted with staff and focus groups of two to five people were conducted with students. Interviews were audio-taped and transcribed into written form, and the content analysed by the researcher. Individual staff interview transcripts were returned to the participant for validation. In 2005, three staff were interviewed about their perceptions of teaching and learning, and in 2006, three staff were interviewed about their teaching and assessment practices in one of their papers. In 2006, focus groups of students were interviewed from three diploma classes.

A third method of data collection used was observation. As our interest was in the socioculturally-determined learning community, a view of what was happening in this community could be gained by non-participant observation. Three lecture classes, taught by the staff members who were interviewed, were observed over a two-hour period. Data were collected on student and teacher behaviour, and student–teacher interaction. A mixture of quantitative and qualitative data were obtained. Data were analysed and triangulated with staff and student interview data and the document analysis. These data were collected by a researcher not employed at Wintec and

analysed by a research assistant. Outcomes not attributable to any particular participant were then co-analysed by the research partnership.

Finally, data were also collected through document analysis. In 2006, teacher documents were analysed. These documents were a course outline containing class schedules, rules and learning objectives which were examined for indications of how the teacher shaped the learning situation; a set of lecture notes which were examined for an understanding of what the teacher felt constituted knowledge in the community and how that was portrayed; and a piece of assessment pertaining to the course being taught, which was examined for an understanding of what and how it communicated to the students the nature of the learning community they were in. In each case, the documents allowed for triangulation of the expectations and experiences of the teacher and students in each class.

Table 1: Participants and data methods

Data method	Participants	2005	2006
Questionnaire	students	Year 1: n= 85 (89.4% male, 10.6% female)	Year 2: n=14 (35.7% male, 64.3% female)
Interviews	students	N/A	three focus groups
Interviews	staff	three staff	three staff*
Observation	Staff and students	N/A	three classes
Document analysis	N/A	N/A	Course outlines, lecture notes, assessment items

* Two of the three staff were the same as in 2005.

The sum of the data were then co-analysed under themes allied to the objective of this research project. The findings are described below as a case, but also with cross-references to the overall findings of the four cases, where appropriate.

3. Research findings

This study has investigated the teaching and learning in a science and engineering tertiary learning community. The findings are now presented as student perceptions, teacher perceptions, student–teacher interactions, progression, and implications for teaching.

Student perceptions

Student background

The following contextual information was obtained from the first-year questionnaires. The overall gender mix of the first-year student cohort participating in this study consisted of 89 percent males and 11 percent females (n=85). The ratio of males to females in science was roughly equal, so the gender imbalance was because the engineering students were almost exclusively male. This imbalance was also observed at the other institutions with participants from UoW and AUT having more females than Wintec (31 and 39 percent respectively), and CPIT less (0 percent).

Most of the students at Wintec declared their ethnicity as New Zealand European (63 percent). This was similar at the other institutions, except AUT where this group was only 29 percent. The remainder of respondents from Wintec were fairly evenly scattered among the other ethnic groups (Maori, Polynesian, Asian, European, and other). There was a similar spread in the other institutions, except in the cases of AUT and CPIT, where there was a higher Asian proportion of around 25 percent.

About a third of students were in paid employment before beginning their study at Wintec. This was a slightly higher proportion than from CPIT, and considerably higher than the two universities (UoW 15 percent, AUT 18 percent). This suggests that more students were coming to Wintec from the workforce than as school-leavers compared to the university sector. This is further supported by the fact that there were more students studying part-time at Wintec (12 percent) than the other institutions (0–4 percent).

Hamilton was the home city for approximately half (53.5 percent) of the students at Wintec in the first year. A similar proportion of students were living with family. Consequently, a high proportion of students (39 percent) indicated that they had been living in this city for some time and had a group of friends studying at Wintec. In contrast, 26.2 percent of the students indicated that they were new to Hamilton and Wintec, but had a group of friends studying at Wintec, indicating that one of the reasons for their choice of Wintec may have been existing friendships.

The major reason Wintec students felt they chose their course of study was that they thought they needed it for their choice of career (81.4 percent of respondents); the advice of family and friends (25.6 percent) or to career advice at school (7 percent) were less significant reasons.

As with the other institutions, most of the students beginning at Wintec had experienced a range of learning activities in their past education. They had enjoyed practical activities (65 percent) and

field trips (55 percent) and many had enjoyed class discussion and debate (37 percent), but less enjoyed lectures or teacher presentations (21 percent) or giving presentations to the class (20 percent). They remembered practical activities, completing worksheet-based exercises and problems, and personal reading and research as helping most to understand what they were studying, and preparing and making a class presentation the least helpful. Their expectation was that they would be mostly learning from worksheet-based exercises and lectures, rather than from making class presentations and field trips or other activities outside the school.

At secondary school, the students had mostly gone to their course teacher (91 percent) for help with their studies, followed by their classmates (82 percent), rather than the Internet or library, and were least likely to seek help from family/whanau and friends. At Wintec they again expected to get most of their help from teachers (87 percent) and classmates (83 percent). Similar information was obtained from students at the other institutions.

The following student perceptions of the science and engineering learning community at Wintec were derived from the student interviews in 2006, the classroom observations, and student questionnaires:

Course outlines

The students in the three focus groups were in classes in which the tutor had provided a course outline at the beginning of the course. The course outlines showed the tutor's contact details, list of topics and lecture and laboratory class dates, expected learning outcomes (sometimes linked to assessments), and ground rules for behaviour. The tone of the documents ranged from welcoming to more formal. The learning outcomes were predominantly focused on technical knowledge or skills, with a small component on interactions of science/engineering with society.

When students were asked about how they used the course outline, there was a perceptible delay in response as the students recalled the document. Most noted that they remembered reading the outline at the beginning of the course, but seldom referred to it later. Two students checked topics for the laboratory work for the coming week so they could prepare for the class. One student looked at the learning outcomes before assessments such as tests to check how they were going against them, noting that "I usually review those prior to tests and exams to see whether, it's just as a measure to see whether I have attained that or not" (St1/6). However, most students said they did not look at the learning outcomes in the course outline after the start of the course. One student noted that it was useful to have the learning outcomes at the beginning of each set of lecture notes, commenting that "I find that handy because while I'm studying, I'm ticking that off instead of, in this case you know, it's here [in the course outline] so I can't be bothered". A number of students also said they looked at the course outline around assessment time to check the assessment weightings, as this would guide them about the effort they would put in to complete the assessment. However, one mature student offered a contrary view when he said,

"It's useful, but just for me, I did not put much attention on this because, like the weights or marks, maybe some people look after it but I think I should just do my best on everything".

Lectures and other teaching situations

Students commented on the volume of information that they were being asked to learn, with one saying that "it's just so much information that I have personally taken on board". The students described how it was hard to learn all the detail required, and that they tended to study up for the assessments and then forget the knowledge once the assessment was over.

In two courses where lecture notes were provided to the students, the students felt the lecture notes guided their learning. As one student said:

> I think it told me that we were expected to, not necessarily remember all the chemical equations but to have a grasp on what reactions are taking place throughout the soil, that you know, not everything is just sitting there in unison, that there are reactions going on all the time and things are being exchanged all the time.

One student offered the view that it was difficult to know exactly what had to be learnt from the notes and that a learning outcome associated with each section of the notes would be useful.

The students felt that having notes given to them enabled them to learn without the pressure of having to write in class. As one student said "It's much easier to learn having it all in front of you than having to copy it down off an OHP or something like that". Another student felt that having notes helped to focus on the key points: "I'm glad we do get lecture notes, I'm glad we don't just have to sit through a lecture while somebody just rambles on". The students described how some tutors left gaps in the lecture notes for them to fill in words, diagrams, or equations which helped them to participate in class. As one student explained, "I like how we fill in the bits because writing does help you kind of suck it in", and another elaborated that "you can't just sort of drift off and not really pay attention if you have to fill parts in all the time". However, it was felt that gaps in notes could disadvantage students who missed the class.

Participation

Students noted that they appreciated the chance to discuss ideas and share knowledge in groups. They noted that in many of their classes the tutors encouraged them to actively participate in the learning process. As one student commented:

> Quite often we come together as a class and then we'll discuss the reactions that are happening and whatever we're doing and [the tutor] will work through on the board with us and he'll get our input out well and everybody sort of, at the end of it, knows what's been going on and it's really good.

The students felt that participation was a key aspect of learning at Wintec; as one described, "the tutor there gets you to put your point of view across and what you think of it, and that generally happens in the majority of all the class work, that's basically the style of learning here at [this institution]". Some students highlighted the role that tutorials played in encouraging them to be active learners, with one noting that "it allows you that time to ask questions and because the class is even smaller so you don't feel self-conscious asking a stupid question". Students liked it when the main concepts in a lecture were highlighted and a summary was given of a lecture. As one student commented "What [the tutor] did today was really good though, about the summary of all the reactions, that was excellent".

Observations of the classes indicated coverage of a significant amount of technical knowledge, summarising of coverage, and student participation in answering questions, group discussion, and problem solving.

Assessments

Students felt generally that the assessments were fair tests of their learning. They felt the purpose of the assessment was to give feedback to their tutors on their learning. One student commented that "it's also a good gauge just to see where you are at personally". They felt there was a good link between the lecture notes and the assessments, although as noted earlier this was not directly related to the learning outcomes. In one case the students felt that the assessment was not so clearly related to their course, stating that it was not about science, and that the assessment belonged more in an arts paper. The students were quite clear that they felt other aspects involved in the assessment topic, such as their views on what happened with a particular scenario, had no place in a science course. One student commented that "scientists don't usually concern themselves with that because then they find themselves in trouble with any aspect, they like to keep themselves away from those issues". These comments hinted at a strong belief in the objectivity of scientists and a lack of interaction between scientists and society.

The Wintec community

Students commented that they were enjoying studying at Wintec and that they felt they had chosen the right course to study. A number of students commented on their less favourable experiences at university, feeling that the small class sizes and friendly atmosphere was a plus in a smaller institution. They felt small classes helped in forming relationships and sharing study. One student noted being put off at university, saying "it's the huge lecture theatres and you can't, you'll hesitate to ask questions just 'cause of the crowd". Another student felt that at university they focused more on theory, "whereas at [this institution] it's lots more hand-on, practical stuff that's more relevant to us when we get out there" .

The students liked the combination of lectures and laboratories and how the two components of the courses often seemed to be closely linked. This was seen to work well when only one paper was timetabled per day. However, if a student had two papers in one day (a possible total of 10 hours in the day) it was seen to be too much.

However, some students commented on the difficulty of doing certain papers, that they seemed to be harder than others. This was particularly so when the student had not done a perceived prerequisite paper. As one student commented, "I think that there should be a prerequisite that you have to do before you can actually do that paper because that paper is very, very intense and the information overload on that paper alone is incredible". This problem appeared to be linked to a perception expressed that there were insufficient study options, particularly for a part-time student who noted that papers had been changed regularly over the period of study and the options had become limited.

There were disparate views expressed on the merits or not of studying full-time or part-time. One student noted that

> If you're working already in the industry, it's a lot easier to do it part time because you're still working, you're still getting industry experience whereas full time, you literally have no experience and you're trying to build up all this experience and it makes it really hard to enter.

From a different perspective, a second student felt that full-time students had twice the workload in terms of assignments to complete.

Students felt their course was giving them a good base; as one student noted "I feel we're learning a good base, but with science and with jobs out there, often the jobs tend to be channelled to a specialised area, for instance you've got your microbiology, you've got your chemistry, we have a good base here but we don't have any specialising". Other students felt uncertain about the state of their knowledge and preparedness for work in science, with one commenting that "I don't think it will be until we actually get out there and get our jobs that we will know whether what we've learnt here has helped us or hasn't helped us, so you'd have to come back and ask us that, after we'd been in the workforce for a while .

As they began their study programmes at Wintec, 85 percent (n=86) of students felt unsure or did not expect to be involved in Wintec sports clubs and activities, and 91 percent felt unsure or did not expect to be involved in Wintec cultural clubs and activities whilst at Wintec. In their second year of study, on average, students at all of the institutions indicated that they were not more involved in the institution's sport clubs, sport activities, cultural clubs, and cultural activities than in the previous year.

Students at the other three institutions felt that they were more part of the learning community of the institute this year than last year; however, this was not the case at Wintec. This may reflect the high number of part-time students at Wintec in the second year, as these students may feel less part of the community.

Teacher perceptions

Students entering a learning community

The tutors were asked for their perceptions of the transitional issues that students faced when they began their programme at Wintec, thereby entering a new learning community. The tutors felt these issues varied between younger, school leaver-type students and older, mature students who are returning to study after a break. They felt that younger students faced the change to a more independent learning environment, where they needed to be self-motivated. As one tutor commented, "it's a big wide world and nobody's looking over their shoulder anymore. It is very exciting and we tend to see a lot of drop outs because they don't have to come to class". They also felt students experienced a change in the expectations of the amount they were to learn, and in the way they are assessed in their learning (from NCEA). As one tutor said, "I think probably coming straight from school one of the biggest issues is adapting to the way things are taught and what is expected of them, for example, I get the impression that students handle work at school in small packages".

On the other hand, the tutors described the mature students as generally well motivated, but that they had families to juggle, were often scared when returning to study, and were slow to start with but caught up fast. As one tutor noted, "those who are mature do better, generally very well, because they are more focused they know why they are doing it". The need to juggle family life at home was also seen to provide a focus for mature students but also a handicap when children became sick. Their return to study was often seen as difficult but able to be overcome, as one tutor commented:

> You get a lot of mature students that maybe come back to study after many years and sometimes are just a bit scared by what lies ahead and initially I find a lot of the mature students tend to be a bit slow but they catch up pretty quickly because they know what they need to learn.

Another tutor felt that for mature students, it was a lot easier to come back to study at a small polytechnic where the classes were small, and they could get to know their tutors and classmates better.

In terms of their movement into this new learning community, the tutors felt that it could take at least 4–6 weeks for students to settle in. The first assessment opportunity was seen as a pivotal point in their progress. As one tutor pointed out:

> That can be really scary for them and one of the things that I have done for my [subject] class is get them old test papers to have a look at and that kind of, and go through it with them, and it takes that whole scariness away to a certain extent.

Beliefs about teaching

When asked about their teaching, the tutors felt that it was important that their students should enjoy learning, and felt rewarded when they felt the students were learning. As one tutor noted, "when I teach students I want them to enjoy what they are learning", and another tutor spoke of the revelational nature of student learning when they said "I like seeing the students succeed and it is that 'oh that's what that means', and students finally clicking with something they have been struggling with". One tutor felt that good lesson delivery was important in their teaching, noting that "I feel very happy if whatever I am supposed to teach them has gone across to everybody in my class". While all the tutors spoke of the need to teach a high content load in science and engineering, there was also emphasis on working together and solving problems. As one tutor said, "it is about working together and then also tackling problems using your knowledge and skills that you have learnt to solve problems in science".

The issue of content and problem solving was also prominent in the tutors' views about their teaching approaches. All the tutors interviewed had undergone some training in tertiary teaching, either from their current institution or a previous one. They all spoke about their awareness of incorporating some of the teaching techniques they had learnt in this training into their classes. For example, one tutor said "I am aware that different students have different learning styles, as we call it, and nobody wishes to listen to blah, blah, blah if you carry on doing that, so you could change your style of teaching every so often within one hour or two hour class time", and another tutor noted "trying to make it as student-centred as possible where I can and using different methods of learning like we talk about visual, auditory, kinaesthetic sort of thing, trying to incorporate all those sorts of learning styles in the classroom". However, the tutors experienced some difficulty in trying to offer a range of teaching approaches and still cover a lot of content. As one said, "the one difficulty that I have found is that teaching in a, I would like to say a high content area, it can be difficult to implement a lot of it with some of the techniques that I've learned". The tutors appeared to have some understanding of pedagogy from their training, and it can be assumed that they had good knowledge of the content they were teaching, but they seemed to feel they were constrained in their opportunity to fully develop what is known as pedagogical content knowledge. This is the ability to teach particular content or subject material.

All the tutors mentioned that involving their students in solving problems was important in science and engineering. One described solving problems together with the class as "the most satisfying lectures of all because you know, we can then nut out the problem and I can help the students and I know they are learning".

Observation of the classes being taught by the tutors showed that the tutors used a mix of pedagogical approaches in their classes, all of which appeared effective in retaining student interest.

Course outlines

Module outlines were given out by all staff in the study. Staff viewed the outlines as providing an idea of topics that would be covered—"inform students of what will be taught in the course; details of assessments—"it tells them when their tests are, what the test will cover, any assignments, and gives all the weightings for the assessments as well"; expected learning outcomes—"it has a page or two with the learning outcomes, they can use this as a focus for their study"; and ground rules for behaviour —"just rules on use of cell phones and so on".

The purpose for the course outline appears to be to provide information regarding the norms for the paper. Analysis of the module outlines found the contents included the teacher's contact details, a list of topics to be covered and the dates for those classes, expected learning outcomes (sometimes linked to assessments), and ground rules for behaviour. The tone of the documents ranged from welcoming to more authoritarian. The learning outcomes were predominantly focused on technical skills or knowledge, with a small component based on the interaction of science/engineering and society.

Lectures and other teaching situations

The tutors believed that the purpose of lectures was for delivering knowledge and providing a structured learning programme. They noted that the lecture provided a framework for delivering the course content, and also served as a sort of motivation to participate in the learning process. As one tutor commented, students could be motivated by "just having somewhere to go every week, keeps you on track".

At the time of this research, the tutors indicated that they were not involved in online or e-learning. They had three view points on this issue. Firstly, they noted the time that would be involved to make lecture material available online, and the time required for teaching support. One tutor commented that "people view it as just additional work" on top of an already heavy workload. Secondly, they wondered about the feasibility of teaching hard concepts and practical work online. Thirdly, all tutors emphasised the importance of personal contact with their students. As one tutor said:

> I believe that the student – teacher contact is very important, in the learning process. Because if a student has some difficulty you cannot sort it out through phone lines, it has to be through dialogue, one to one sitting, you have to feel the pulse where the student comes from and then get down to that level and then sort out [their] difficulty.

This was echoed by a colleague who commented that:

> I guess it is just that personal contact, I know you can do stuff online and email it and all the rest of it, but I still think it is nice to have someone face to face, somebody that you can easily ask questions of right there on the spot, rather than trying to put a question into words that you can type in an email or over the phone.

The importance of personal contact between students and their teachers is considered in more detail in the section on teachers' perceptions.

Two of the three staff provided lecture notes to their class. Their reasons for doing so included the covering all the required science content which would otherwise be hard to cover in the class, providing the students with a record of what was covered in class for studying, collating information into one source when there was no suitable text book, forming a basis for questions and discussion, and preventing the students having to write all the time. One teacher commented:

> With a lot of what we do, with science being a really high content area, we usually have a lot to cover in a short space of time and there's not always a specific text book that covers everything that they need to cover so we tend to have our own, or do our own lecture notes that often come form different sources, we use the internet, texts books and stuff like that so that we cover exactly what's in the course outline. It means that the student's not frantically writing notes in the whole session and therefore hopefully has some time to process or you can kind of do other activities to help them process the information rather than just mad frantic writing, really not taking in much of what we want them to.

Analysis of the lecture note documents revealed a high level of content to be covered in a lecture. Additionally, teachers felt that the notes formed the basis of what the students should learn, but would not be everything that students needed to know. Students would also be encouraged to read further. As described in the discussion on teachers' perceptions, some teachers left gaps in their notes for students to fill in during class. They felt it encouraged participation in their class, with one noting that "what I have done through my diploma (in tertiary learning), the more you interact with the material, the easier it is to understand, and if they are not doing something, they tend to kind of switch off".

All the science and engineering tutors included laboratory classes in their courses. They felt the laboratory classes were important to students for reinforcing knowledge, learning practical skills, learning to work together, and applying knowledge and skills to solve problems. The tutors emphasised the practical nature of the programmes they were teaching and that "we are really trying to get our students out into the work force and without those practical skills they are a bit lost if they turn up at [work] and they don't seem prepared". Laboratory classes were seen as important in reinforcing the abstract concepts being taught, as one tutor commented:

> If you are going to simply just teach it on the board, writing out a lot of equations, it is almost meaningless, you have to do it in the lab, they have to be physically mixing the chemicals, making reagents, seeing changes and then it becomes more meaningful, so I would say for me and the [science] that I teach the lab is absolutely critical.

The tutors also saw the laboratory classes as important in helping them to establish a relationship with their students, and with the students getting to know each other, a point that is discussed in more detail in the section on teachers' perceptions.

The other teaching situation that occurs at this institution is the tutorial. One tutor talked about the importance of the tutorial in fostering revision, believing that the revision "helps cement it in their mind".

The tutors felt the teaching and learning could be improved by more use of computer-based technology such as data projection and in-class Internet access, which was a resource issue, and use of online environments for options such as student self-tests, which was a time issue.

Student participation

All staff felt that it was important for students to participate in class, through active note-taking as above, whole-class discussion, small group discussion, and problem-solving activities. One tutor felt it was important to establish an environment in class where students and the tutor could share knowledge. He commented that "I don't see myself as someone that has got all the knowledge and transferring that knowledge that's there, and that's why I always say to the students, look we can learn from each other".

It was noted that it was difficult to get students to participate because science and engineering students were not used to or keen to participate in class. One tutor related how he gave students items to read and then discuss in class in groups, as his experience was that it is "really difficult to get them to sit together and discuss things". Another commented that: "it's easy for me to stand up in class and talk or teach. It's not always easy to, you know, get the same process coming from their side".

The tutors felt it was important to engage students in class not only in getting knowledge but processing and revising knowledge, and discussing and practising through doing problems. Analysis of the lecture note documents revealed opportunities for participation through questions, discussion, and problem solving.

Observations of the classes indicated tutors appeared generally enthusiastic in their approach and concerned for student learning. They provided clear information about paper requirements. They provided opportunities for student involvement in group and class discussion and problem solving.

Assessment

Two assignments and one test were analysed and views on these assessments gained from the tutors and students.

The tutors felt the assessments helped students apply theory to practice—"We did the theory in class and that was a good opportunity for them to go and apply those theories"; helped students understand the nature of scientific knowledge and engage with ideas—"I wanted students to realise that even experts and scientists don't agree on certain things", and that they provided

feedback on student learning—"Have they learnt the information that we've been putting across and how well are they learning it".

They also felt assessment provided an indication to the students of what they were expected to learn in the course, as practice for the final summative assessment. As one tutor noted:

> I do think it does show them, particularly with, when they come up to the exam at the end of the year, gives them some practice at doing these types of questions and what kind of type of question they are going to get and you know, 'can I really learn this stuff and if I can't, how do I go about it'.

The tutors felt the assessments were fair and that there was a good link between the learning objectives and the assessment, with one tutor commenting "I usually base the handouts on the learning objectives so, making sure that anything that they need to know is in the handouts and then I go from the handouts to the test". In one case, however, the assessment was new and was linked to a movie that happened to be showing at that time in town. The tutor saw it as an opportunity to expose the students to a public debate about the course material and ask for their critical thoughts. But, as noted in the discussion on students' perceptions, students felt that the assessment belonged more to an arts course than a science course.

Analysis of the assessment documents showed mainly good synergy with the espoused learning outcomes and learning ideas indicated by the tutors. In one case the assessment reflected a combination of memory and understanding questions as discussed by the tutor, in another the assessment required the students to demonstrate their practical ability on set tasks that mirrored the learning objectives, and in the final case, the assessment required the students to apply their thinking in science to issues. It was this latter case that students found difficult to accept as relevant to science.

The tutors felt that as students have different learning styles, providing a variety of assessment types was important. One tutor felt that more flexible, student-friendly assessment options could be provided by computer-based systems. Another tutor noted that some students did not do well in tests and examinations and some form of oral interview may be better, but that time constraints for all students made that difficult.

Assistance and hindrances in teaching

The tutors were asked for their perceptions of what assisted and what hindered their teaching in the science and engineering community at Wintec. The tutors noted that the institution provided time and courses for professional development in teaching, which all participants had undertaken. One tutor said, "We get a couple of weeks' professional development, which isn't a lot of time". All tutors interviewed had attended courses and acknowledged their usefulness, however one commented that:

> I'd actually like to see more, if we could call it, practitioners on site presenting the way they do things so that you learn from people's experience. Sometimes I think it is good to know all the theories and all that sort of stuff, but also because it is a practically based education it's good to share practical knowledge with other people.

In terms of hindrances to their teaching, the tutors' comments focused on their high teaching and administration loads. All tutors felt they were teaching too much; for example, "people are teaching almost to their maximum [allowable weekly contact hours]". They felt there was too little time to prepare for teaching. As one tutor said, "That would be my biggest problem, is that I probably don't get the time that I would like to prepare and revamp courses as often as I would like". The amount of time involved in administration work was a frequent reason given for lack of time. For example, "sometimes I think I have spent the whole day on the administration, I really need to think about that lesson I am supposed to give next week, so administration does sometimes seem like a burden".

All tutors expressed an interest in doing research as part of their work. There did not seem to be an expectation that they were engaged in research, and time pressures were cited as reasons for less involvement than they would like. As one tutor noted, "It is not required as a part of my job, it comes as something extra because of my own interest". The time pressure meant that tutors felt they would have to get teaching relief which meant "I would have to find funding to replace me as a tutor to be able to do it".

Community relationships

The tutors all felt it was important to develop a relationship with their students. They felt they should develop a friendly atmosphere in class, to allow sharing of ideas and participation in discussions. They felt that their small classes were significant in helping them to get to know their students, and the contact they had with their students in the lab classes. This relationship extended beyond matters of study; as one tutor explained, "You get to know your students and chat with them, not just about work stuff, particularly the mature students who I have things in common with, like kids etc". The tutors felt that it was important to know each student by name, and show concern for a student's progress. As one tutor noted, "sometimes the student would come out and tell you 'I have some personal things' and I would say 'can I help?'". Tutors felt this rapport with their students happened more readily when a student was seen to have a positive attitude towards their study. However, the tutors were cautious about getting too involved in students' personal lives.

Students felt that their tutors were very friendly and approachable, even outside class. As one student commented:

> The tutors here are absolutely brilliant, they are extremely approachable, they are always willing to help you out if you've got problems, they've got the time to assist and I think that this is probably the biggest drawcard of coming here to Wintec itself. They're great tutors, they really are, they're fantastic.

This feeling was echoed by all students interviewed in the three focus groups about their tutors. The students particularly commented on the opportunity that laboratory classes gave them to get to know their tutors and get help. They also noted how some tutors used humour, as one student commented:

> Some of the tutors, and ours is one of them, they like to add their little bit of dry humour towards the class as well. That sort of does help to relax, it just puts a whole different sort of feel to it, it's really relaxing, it's enjoyable actually to come to his class, it's great.

The students commented that the small class sizes were important in helping them to get to know their tutors and approach them; as one noted, "I think 'cause it's quite a small class, it's not too big and if we have problems, we can ask [our tutor] easily".

The small class sizes were also credited by the students in helping them get to know each other. They greatly valued this. As one commented: "Feels as though when this course finishes we'll all still be friends you know". The students felt that knowing each other well helped them to study together and support each other.

The tutors also felt that it was important for the students to get to know each other. This was seen to enhance student cooperation and sharing of resources, as well as provision of support. In one case, a tutor described how some members of the class had taught the other members a new skill:

> What they did is they all ended up teaching each other how to use PowerPoint, and everybody used PowerPoint and so for my first year chemistry students that was the best group of presentations that I had. It was only because they got to know each other reasonably well.

The tutors all noted the role that peer support could play, as one said, "to share any difficulty that they may have over the course or in their personal life, you know all those things do help and help directly or indirectly into their learning". One tutor suggested that a stronger community could be built by providing common facilities:

> I would actually like ideally a computer suite for our science students specifically, in the building, I'd actually like their own science library in the building and I'd actually like a science common room for students in the building, once again to me it is just keeping them all together that's important.

The observations revealed that classes were small in size, at around 15–20 students, and were relaxed. Students appeared to relate well to each other during breaks in class, chatting about course work and their lives outside study. Tutors knew their students by name and strove to obtain their participation in the class. There were good levels of tutor-facilitated student participation in class.

When comparing the second year with the first year, students at Wintec and the other institutions appeared to be just as clear about what was expected of them in their programme of study, but felt that lecturers expected them to produce work of a higher standard than in their first year (69 percent).

More students at Wintec (39 percent) disagreed that they had got to know their lecturers/tutors more in their second year of study but this could be because the students had got to know their tutors more in the first year because of small class sizes.

Progression

The tutors were asked whether expectations of student learning and approaches to teaching varied between first and second year classes. The tutors noted that at the lower level the emphasis was on gaining basic skills and knowledge which could then be used at higher levels on more complex problems applying those skills; as one explained, "what is important for me is that they've got those basic skills and knowledge that they learnt in the first part of their course and then being able to apply those basic skills later on when they get exposed to more complex, complicated problems and work". This led to providing students with more opportunities to think about the ideas they were being taught at higher levels. One tutor said: "I do expect more discussion amongst students, more argument if you like and more reading outside of the core notes here". This expectation of students to engage more enquiringly with the material and to do additional learning also translated into assessment where students were expected to integrate information and show understanding rather than just memory. As one tutor explained:

> I think it's just recognising the fact that at Year 2 we're expecting more from them in terms of, you know, being able to process the information and their understanding, they should be, it's more an understanding type thing rather than just memorising stuff which is kind of what goes on at Year 1.

When students were asked if their experience of the learning community had changed in their second year, most students appeared to be just as clear about what was expected of them in their programme of study. However, many (88 percent) reported a need to remember at least as much if not more information to pass assessments in their second year compared to their first. Most students (61 percent) found the theoretical parts of their studies harder to understand.

In their second year, students at Wintec, as with those at the other institutions, agreed that they had less free time than in their first year of study. As with those in the other institutions, Wintec students thought that the level of organisation in their study habits was similar to the previous year, although their workload was heavier. Their level of enjoyment of the programme was similar to that of the first year. This was in contrast to the experience of students at the other institutions, who, on average, expressed greater enjoyment in their successive years of study. Their increased enjoyment was not because of greater enjoyment of lectures however, as students at all institutions tended to experience similar levels of enjoyment to the previous year. Most students (82 percent) did find practical teaching sessions more interesting and enjoyable than their previous year, and the majority (91 percent) felt that they had been expected to work more or as independently in practical teaching sessions than the previous year. Most agreed that they were learning more practical problem-solving skills in the second year (60 percent of students)

In their second year of study, students reported using teachers (92 percent), classmates (95 percent) and the Internet (95 percent) more or the same amount as their sources for help as in their first year. They reported using the library the same amount but used family and student support less. One notable difference was that Wintec students expected to use the library or other books for help with their studies less that students at other institutions after their first year of study.

4. Summary and implications

This study has investigated the perceptions of students and teachers of their experiences in a science and engineering learning community at Wintec. These experiences have been elicited through the use of questionnaires, interviews, classroom observations, and document analysis. The perceptions provide a picture of this community at Wintec and an opportunity to compare this community with other similar communities in tertiary institutions in New Zealand.

The student cohort participating in this study was predominantly male, and included significant numbers of mature students who were not entering the institute directly from school. In comparison to the other institutions studied, students in this Wintec community were more likely to be part-time and in employment while studying. This may have contributed to students reporting that they did not feel any more a part of the Wintec learning community in their second year than in their first. Equally, the students reported a low level of engagement in sporting and cultural activities at Wintec. It is possible that the fact that many students reported being part-time, that they were studying in their home city, and that the campus was located in the inner city contributed to a perceived lack of connection to the institute.

A lack of connection was not apparent within the classrooms. Both students and teachers placed importance on the relationship between the teacher and student, and student to student. Teachers demonstrated good rapport with their classes, and emphasised the role that practical sessions played in helping them to get to know their students. Students saw their teachers as friendly and approachable and appreciated their efforts to develop a working relationship with them. Students also valued their relationships with each other, which they felt were enhanced by feeling more confident to engage with their classmates in the small classes.

Small class size appeared to be a key factor in the science and engineering learning community at Wintec. With classes of 10 to 20 students, relationship building was seen to be relatively easy and allowed for greater participation in the teaching and learning process. This participation included ready access to help both during classes and outside normal class time, active involvement by students in discussion, and better opportunities for teachers to monitor student performance.

Science and engineering at Wintec was characterised by the need to teach and learn what was seen to be a large amount of subject knowledge. Both teachers and students recognised this high level of knowledge within their papers. Teachers identified the importance and responsibility of delivering subject material to students. Although all teachers interviewed had undergone some training in tertiary-level adult education, and appeared willing to adopt student-centred teaching practices, they felt unable to do so because of their perception that use of these practices would take up valuable time needed to deliver the subject content. Teachers relied on giving students pre-prepared lecture notes as a way of covering the subject knowledge, a practice which the students appreciated as a means of ensuring that they knew what had to be learned. Students saw the purpose of lectures as the means for delivering what they needed to know and appeared resigned to being subject to a transmission of that knowledge through lecturing. However, they

valued the practical sessions, and the way that a lecture on a subject and laboratory sessions using that knowledge often coincided in time to assist their learning.

Both students and teachers saw the end goal of the learning process to be preparation for the workplace. Each party emphasised the relevance of what they were learning for their career, although students recognised that what they were learning was just a base to get them into a job. This emphasis on vocational education is in keeping with the nature of the two-year diploma qualification that the students were undertaking and the philosophy of the institute.

These findings have the following implications for tertiary learning in science and engineering:

- Tertiary institutions need to consider ways to create a stronger sense of inclusion in the learning community for all students, but particularly for part-time students.
- Tertiary institutions need to consider ways to facilitate the development of strong teacher–student and student–student relationships early in a student's career at the institution.
- Tertiary institutions need to consider ways to create and maintain small class sizes to make the most of the learning opportunities they offer.
- Tertiary institutions need to consider ways to train teachers in methods to deliver high levels of subject knowledge in student-centred ways.
- Tertiary institutions need to consider ways in which to deliver science and engineering courses such that theoretical knowledge and practical applications complement each other in a timely fashion.

Although the context of this research is tertiary science and engineering, the findings may have relevance to other areas of tertiary study. In particular, the methodology of the research could be adapted to any subject area, and this study's findings may have implications for other subjects within universities and polytechnics.

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