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

The impetus for this project grew out of our involvement in tertiary teaching in science and engineering courses. Our own experiences as teachers 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 in terms of learning to be a scientist or an engineer, and wondered about the sense of identity that these students developed through their involvement in these papers. Research (Eames & Bell, 2005) had 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 practised in the working community.

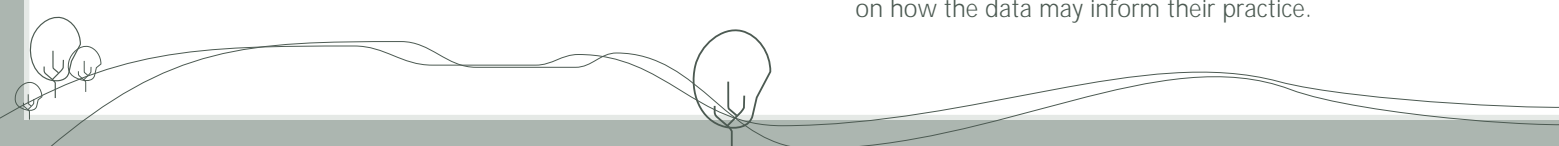
## Aims and objectives

This project aims to build upon current research in the area of teaching and learning at tertiary level. 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 objectives used to achieve these aims involved:

- 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
- examining teachers' perceptions of their purposes in teaching, their perceptions of student learning, and how the nature of the learning environment impacts on their teaching
- gathering data on teacher and student views about these relationships, observations of the relationships, and their development over time
- 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
- working alongside lecturers in planning and carrying out the research, analysing the data, and reflecting on how the data may inform their practice.



## Research question

This project addresses the nature of tertiary learning communities and sought to understand, from the perspective of the participants, what it means to teach and learn tertiary science and engineering. In particular, the project sought to use a sociocultural approach to address the question:

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

## Research design

This was a two-year project involving four tertiary institutions: two universities and two polytechnics. The project adopted an interpretive methodology and used a case-study design to produce four case studies—one from each partner institution—that were subsequently the basis of a cross-case analysis.

The project was designed to examine student learning experiences of up to four years of undergraduate education and, for some students, a transition into graduate study. To accomplish this over two years, 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. In the first year of the project, first- and third-year students were surveyed about their tertiary learning expectations and experiences, and interviews were conducted with volunteer student focus groups from within these cohorts to further explore the broad issues obtained from the surveys. In the second year of the project, second-year students were surveyed, and second- and fourth-year students took part in focus group interviews. In each year of the project a number of lecturers and tutors involved in teaching these students were also interviewed about their experiences and perceptions. In addition to the surveys and interviews, data was also collected by classroom observations and document analysis.

## Findings

The following themes emerged from a cross-case analysis of the four case studies developed in this project.

### Relationships

One of the strongest themes to emerge from the case studies was the centrally important role played by relationships in shaping the quality of teaching and learning experiences. 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. 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 and teachers 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.

### Class size

A consistent theme across all case studies was the impact 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, 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 to them enrolling there.



### 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 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 and 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 integrated and related in a timely way, but were much less helpful if they were disconnected or disjointed.

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 interaction, 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, but often felt that these approaches were more time consuming and would reduce their ability to adequately cover the required course content.

### 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 appears to take most students several months, with the transition being more difficult for students who have come straight from high school. Being able to quickly form relationships and connections with other students and with teachers appears to be an important factor in facilitating this transition. The large first-year classes that students often encounter in tertiary institutions are seen as a barrier to forming these relationships.

### 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.

### 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. 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. This data was not collected and this is therefore a limitation of the project.

### Building capability and capacity

This project has provided an opportunity for a group of tertiary educators to undertake 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. 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.

The emergent themes and accompanying implications from this project suggest a number of avenues for further research but one of the clearest indications is



the centrally important role played by relationships in shaping the quality of teaching and learning experiences—a finding that resonates with recent research by Leach, Zepke, and Prebble (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.

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