

# Teaching in Engineering, Science and Computing: A Collaborative Process to Improve Quality

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## Introduction

This paper outlines a process encouraging the involvement of all academic staff in the Division of Engineering, Science and Computing at Curtin University of Technology to improve the quality of their teaching and students' learning. The Teaching Quality Improvement Process (TQIP), designed as an accountability framework, has been implemented to ensure that all Departments in the Division demonstrate their teaching effectiveness and provide courses that remain competitive in the national higher education market place. The TQIP extends a program developed by the University's central Learning Support Network of using student-derived, national and local data on course evaluations as an impetus for improving teaching and learning. Currently, analyses of data from sources such as the Course Experience Questionnaire (CEQ) and the Curtin Assessment of Student Satisfaction survey, indicate that improvement in teaching and learning in many courses is desirable and in some, essential.

Data from the CEQ provides evidence of students' perceptions of the quality of learning and teaching and the development of generic skills<sup>1,2</sup>. It has been used since 1993 to survey all graduates (approximately 170 000) from all 38 Australian universities soon after graduation. It is thus considered a useful instrument for the purpose of benchmarking and improving the quality of teaching in universities and also for informing student choice, managing institutional performance and promoting accountability of the higher education sector<sup>3</sup>. This information base is funded by the Federal Department of Education, Science and Training and supported by the Australian Vice-Chancellors' Committee. The Curtin Assessment of Student Satisfaction is an internal, annual Curtin University online evaluation instrument available to the whole student body. Its purpose is to collect data on students' perceptions of all areas of campus life, including learning and teaching, and learning spaces.

The Divisional Executive Dean has taken the position that the CEQ data are "part of the basis for informed choice" and can be used "to help staff make professional judgements about how to improve student learning outcomes" as suggested by Wilson, Lizzio, and Ramsden<sup>2</sup>. Resources (people, time and operational budgets) have been invested in the CEQ so that this measure of perceived teaching and learning quality can provide direction for the Division's TQIP which is ultimately directed to improving quality of teaching.

McInnis and Devlin<sup>4</sup> offer practical approaches to creating planned change in tertiary institutions: "identify the need for change, recognise the everyday realities of obstacles to change, raise awareness of the issues and generate discussion, promote change on multiple fronts, provide expertise and support, and connect [the change] to accountability and rewards

systems" (pp.13-15). These points provide sound advice for planning, monitoring, and managing the TQIP process across the Division and it is these issues that form the discussion in this paper.

### **Identifying the Need for Change: Initiating the TQIP**

The TQIP was preceded in the Division by a process of ranking departments on their teaching performance. CEQ and other data were used to compile a 'Teaching Quality Index' – a number used to rank departments on performance and allocate funding accordingly. Heads of Departments were unhappy with this approach for many reasons, including public humiliation associated with a low ranking. Furthermore, Departments argued that improvement would be made more difficult by any decrease in funding, leading to a downward teaching quality spiral. While the establishment of this Index was commended by an external audit of the University as an example of best practice, it was decided that the process required modification.

After much collaboration with stakeholders in the Division, the 'Teaching Quality Index' has evolved into the Teaching Quality Improvement Process which is a more positive approach to assisting Departments improve the quality of their teaching through closer collaboration and support and by removing the threat (and reward) and comparison through ranking. Instigating the TQIP in the Division is a challenge that has not been underestimated. The principle underpinning the TQIP is that a type of 'cultural' change, involving the way many staff think and talk about teaching, is required. Much of the instruction in the Division is based on a traditional and unquestioned expository model of teaching and learning with many staff holding to their beliefs that their primary teaching role is to transmit knowledge (in their respective disciplines) to students. Consequently, most lectures, tutorials and laboratory sessions are dominated by a teacher-centred approach where assessment is content driven. Often these staff respond to negative student feedback about the quality of teaching by claiming the causes for poor quality teaching and/or learning are due to lack of staff, resources, time or deficiencies in student ability or effort.

It must be said, however, that there are several notable exemplary teachers in the Division who are acknowledged by their peers for their innovative approaches to teaching and who regularly receive recognition and awards and for their excellence in teaching. These teachers are able to maintain the integrity of knowledge that is core to their disciplines while adopting a teaching approach that is varied, flexible, and student-centred in order to accommodate students' learning differences. They constantly reflect on what and how they are teaching and monitor closely how students are learning, especially the ways that students can apply new knowledge, and how students are developing values and professional skills for their future work. Assessment, both formative and summative, is used to show students' achievement. These teachers base their success on what students have learned because of the teaching and learning they have facilitated. Such isolated examples of exemplary practice have highlighted the need for planned change to embed quality teaching into the Division's educational culture.

### **The Realities of the Change Process: Recognising Obstacles to Implementation**

Educational change takes time, often several years, because it is a *process*, an uncertain learning journey requiring both resources and management<sup>5</sup>. While the Division can plan for cultural change and create tension by placing value on the CEQ and other data to promote

change, it is widely recognised that change directed towards effectiveness and improvement must link "top-down" with "bottom-up" strategies<sup>6,7</sup>. Impacts on tertiary education, such as changing Federal government policies, further interrupt attempts to change and do not allow innovation to hold long enough to become embedded into an organisational culture<sup>8</sup>. Change requires supportive leaders, modification to the organisation and cooperative academic staff. Hargreaves<sup>9</sup> warns that most of the literature on educational change does not recognise the powerful influence of teachers' emotions and passions (worry, envy, boredom, despair, hate, hurt and the like) on change.

Teachers have strong feelings about changes to their accustomed classroom structures, curriculum planning and their pedagogy. Generally, they ignore "top down" initiatives, even if mandated, because they require more on-going support to develop new knowledge which they can translate into their classroom practice. James, McInnis and Devlin<sup>4</sup> warn that if an improvement approach is not based on real need "then any efforts to produce change will produce a cynical response from key stakeholders" (p.13). Furthermore, McLaughlin<sup>10</sup> maintains that improvement is idiosyncratic to each organisation. Policy cannot mandate what matters, implementation dominates outcomes, variability is the rule and uniformity is the exception.

Teaching staff in Curtin's Science and Engineering Departments have only recently been exposed to detailed public scrutiny of their respective CEQ scores, their teaching practices and the learning outcomes of their students. Understandably, staff can be defensive about this scrutiny and so different ways of coming to a point of consensus recognition of problems and issues has been an important part of the change process. It has been essential for staff to be allowed adequate time to discuss the CEQ as an instrument, its research basis and the information that can reasonably be inferred from the available data, before moving on to examine the teaching and learning implications of the CEQ results.

The Divisional Executive have acknowledged that improving the quality of teaching across the array of Departments in the Division will be confronting and frustrating for staff. At times, the change process may even be thwarted, but the operational planning and monitoring processes that have been instigated are backed by a strongly committed group of change agents focused on improving quality teaching.

### **"Top Down" Strategies: Creating Awareness and Collaboration**

A senior position of Dean of Teaching and Learning for the Division was created in 2002 to lead educational change. This publicly signified the importance placed on improving teaching and learning in the Division. In addition, the Learning Support Network provided an academic staff member to assist Divisional staff to access, understand, acknowledge and engage with their Department's CEQ data. The Learning Support Network also provided financial support to the Division to employ a Teaching Associate to work with staff and students to confirm priorities for planning improvement.

As part of leading the change process, the Dean of Teaching and Learning encouraged the representative Divisional Teaching and Learning Committee to create policy and to provide guidance for change. The committee developed an Operational Plan 2004-2006 based on the TQIP, implementation of a learning outcomes approach to teaching and a review of how best to evaluate teaching at the individual staff level. Primarily, the work of the Committee is to ensure that teaching is highly valued across the Division and that all staff engage in debate

about best teaching practices, and more importantly, develop a positive approach to innovation and change in their own teaching.

### The CEQ Reports: Providing Expertise and Support

The most widely used form of the CEQ consists of five scales of between three and six items and one item asking students' to rate their overall satisfaction with their course. The five scales are called: Good Teaching, Clear Goals and Standards, Appropriate Workload, Appropriate Assessment and Generic Skills. Research underpinning the design of the CEQ suggests that the instrument does not measure 'good teaching' but rather it is a "... proxy measure for the quantity and quality of student learning outcomes ..." <sup>11</sup>. It thus measures how students experience aspects of the learning environment that affect how they go about their learning. More exactly, it measures the extent to which students *perceive* they have been involved in 'good learning' practices. This last point is not well understood by many academic staff.

When Departments first become involved in the TQIP, their CEQ data are collected, analysed and submitted as a report. The data are presented in graphical form. The first graph for each CEQ scale compares the Department's performance with that of the Division and the University as a whole over five years. See Figure 1. The second graph compares the Department's data with national data over the same five years. The national data comprise the mean of the three highest-scoring and the three lowest-scoring departments in the same field of education. See Figure 2. The scale in the graphs (-100 to +100) is proportional to the item scale, 1 to 5, where the middle scale score of three corresponds to zero on the graphs. This is the neutral point where students neither agree nor disagree with each statement. The graphs are represented over the full scale each time to allow ready comparison between them. The reports also contain sufficient guidance and information, such as confidence intervals and statistical significance of differences, to enable staff to evaluate the data for themselves.

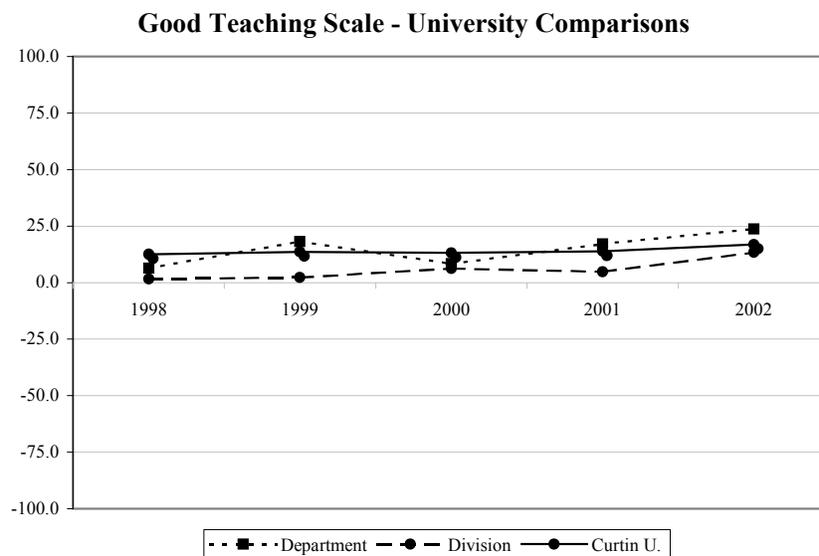


Figure 1. Graph showing comparison between department, division and university CEQ data over a five-year period (1998-2002).

### Good Teaching Scale - National Comparisons

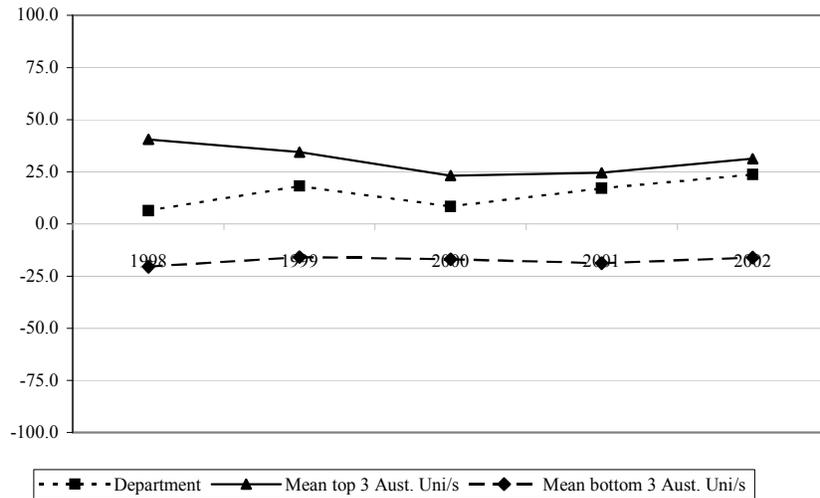


Figure 2. Graph showing comparison between department CEQ data and mean of the three highest and three lowest scoring Australian universities' CEQ data for comparable courses/fields of study over a five-year period (1998-2002).

To have these reports available to all Departments has been an important accomplishment in itself. Some Heads of Department have subsequently requested student focus groups to be conducted to gain feedback about teaching in a Department before presenting reports to staff to increase the likelihood of a more positive discussion about the data. Other Heads of Departments have asked, after staff have reviewed their CEQ data, that student group discussions focus on a specific CEQ scale, such as the 'Good Teaching' scale, where the trend in the data is undesirable. These focus group discussions have ascertained from students their candid views about their learning experiences. A documented summary of each focus group discussion has been provided to the Head of Department. Some Departments, however, are under so much pressure due to other resource constraints, that adding another requirement on them, engaging with their CEQ data, is untimely. As McLaughlin<sup>10</sup> reminds us, uniformity is the exception in the improvement process.

### The TQIP Accountability and Reward System: Mapping the Change

The TQIP is a way to allocate funding to Departments for the teaching and learning component of performance-based funding in the Division. It consists of two components: Course Quality (as measured by CEQ results) and the Improvement Planning Process (as measured by engagement in the TQIP). The Course Quality component is based on national and Divisional averages according to the CEQ scales together with consideration of overall satisfaction with courses and CEQ survey return rates. The Improvement-Planning component is dependent upon the Departments engaging in the TQIP by:

- Organising a Departmental Teaching and Learning Committee to support staff to implement and monitor improvement strategies;
- Prioritising CEQ scale/s for improvement planning at both a Departmental and individual staff level; and

- Identifying other areas for improvement at both a Departmental and individual staff level such as professional development, teaching portfolios, teaching awards, conference papers/presentations on teaching and learning, research on teaching and learning, teaching grants, online teaching and learning, committee representation, and working with student focus groups.

The TQIP involves Heads of Departments and staff meeting with the Dean of Teaching and Learning and other teaching and learning advisers to review teaching practices and to plan strategies for implementing, monitoring and evaluating the change process – all of which are part of an on-going improvement cycle. See Figure 3. The Heads of Departments are requested to document examples of “good practice” and to provide:

- priorities for improvement based on their Departmental CEQ data;
- achievable targets within a specified time frame;
- strategies that the Department will adopt to move towards the identified targets; and
- the ways the improvement process will be monitored and evaluated.

There are negotiable aspects of the improvement planning process such as the CEQ scale/s that are set as priority for improvement by a Department, timelines, and how resources are used within a Department. Also, it is understood that the improvement planning cycle will be necessarily different in Departments and for individual staff within a Department.

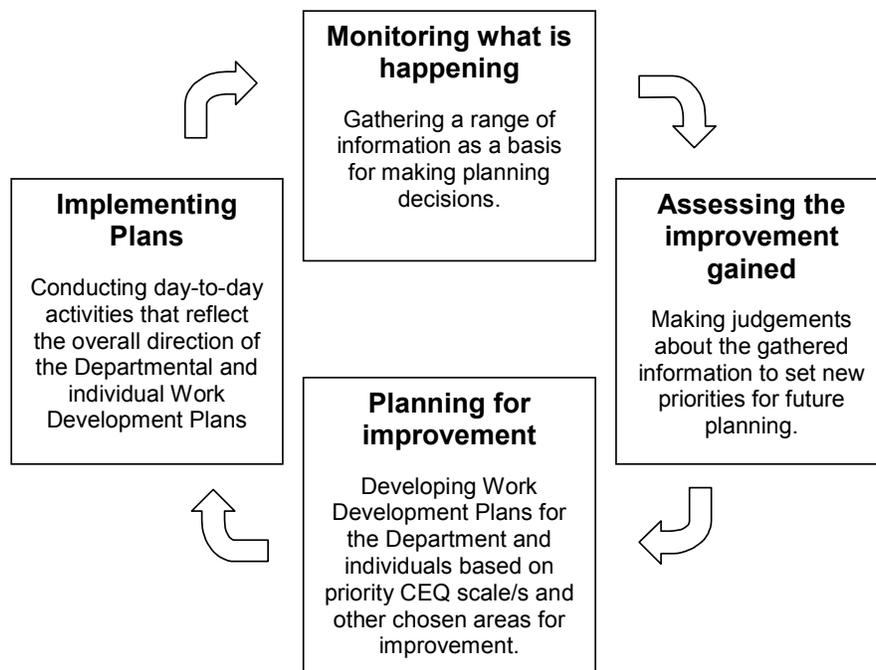


Figure 3. The TQIP cycle that acts as a model for both Departments and individual staff within Departments.

The planning cycle is integrated with Curtin University’s Management for Continuous Improvement and Growth process, which requires every academic staff member to develop an individual Work Development Plan on an annual basis.

One of the critical strategies in managing the change process is mapping the successes Departments are achieving in improving the quality of their teaching. Figure 4 illustrates

identified success indicators for the Departmental level approaches to the change process and maps the evidence where Departments have achieved success. Success is a qualitative judgement negotiated between the Dean of Teaching and Learning and each Head of Department. It is now clearly evident that some Departments have taken up the challenges placed before them during the early stage of the change process. Other Departments have shown some reluctance to tackle the change process.

<i>Success Indicators</i>	<i>Evidence of Change in Departments</i>									
	1	2	3	4	5	6	7	8	9	10
Departmental/School Level										
Dean initiates TQIP with Head/Dept.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Staff set up a T&L Committee.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Staff request CEQ data (analysis and report).	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Staff examine and interpret the CEQ data.	✓	✓				✓	✓		✓	✓
Staff acknowledge improvement is required.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Staff identify priorities for change.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Feedback on priorities gained from students.	✓	✓	✓				✓	✓		✓
Department documents a TQIP plan.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Head/Dept guides CEQ link to staff work plans.										
Head/Dept assists staff to develop work plans.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Head/Dept monitors staff work plans.										
Head/Dept monitors Department's TQIP.										

Figure 4. Success indicators and evidence of change in Departments.

It is easy to detect the Departments in which change has been limited or where the uptake of the TQIP is fragmented. We recognise that it is a significant step for some Departments to document their TQIP and link this improvement cycle with staff work plans. One major problem for Heads of Departments is finding extra time, usually considerable time when planning for change, to allow on-going whole staff discussion to develop strategies for change. The Dean of Teaching and Learning can provide some financial support for staff to meet, especially where there is an outward commitment to improving teaching quality, although staff are often hard pressed in their work schedules with limited time to embark on innovation and change. Thus, while there are various reasons for differential engagement in the TQIP, the strength of the mapping process is that it allows for the patchwork of change across the Division to be managed strategically and for support to be provided at the point where is most required.

**"Bottom Up" Strategies: Working on Multiple Fronts**

The challenges for Departments to meet in the initial part of the change process are followed by even bigger ones to be negotiated at the individual academic staff level. It is here that the change process has the greater potential to falter because it focuses on the personal practices of all staff. Some staff view this as an invasive approach and an affront to their professionalism even though much has been done in raising awareness and discussion in the Division about teaching and learning. While a climate of trust is building between the change agents and staff, continual discussion about the practical day-to-day realities of teaching and learning are crucial. Staff are encouraged to become more reflective practitioners and to engage in research that can be connected to their teaching in some way. These strategies may well be key success measures in promoting cultural change in the Division. Some of the issues that have arisen out of the CEQ and CASS data, and from student comments during

focus groups discussions, are related to student-teacher relationships, motivation and learning, and support for students' learning needs. These fundamental aspects of effective teaching and learning will be catalysts for future discussion with academic staff.

Mapping the successes in change at the staff level will be similar to that used in Departments. As maps take shape, variability in the ways in which staff within each Department engage in the change process will become evident. This mapping process will, more than likely, further strengthen the idea that each Department can only implement its improvement cycle based on its unique context and how each staff member in a Department makes a commitment to engage in the change process to improve their teaching. Success indicators for staff change include: work plans with planned change indicated, course and unit reviews, documented changes to teaching practice, evidence of reflective practice, action research reports, improved assessment procedures and evidence of improved student learning.

Another critical strategy to ensure success in the change process will be to establish connecting threads that coordinate the plans of all staff within a Department to focus on some common priorities. It requires Heads of Departments to provide leadership in the change process and be strategic in the use of Departmental resources to support staff in their endeavours to improve the quality and effectiveness of their teaching. It is also vital that each Head of Department can couple the Department's priorities for improvement with individual staff work plans.

## **Conclusion**

In a national institutional system that is focused on accountability, there remains a need to have the opportunity for Departments in the Division of Engineering, Science and Computing to report their variability in teaching and learning quality as a positive and productive part of the change process. While reform is essential to improve the quality of teaching and learning in the Division, it is difficult to effect because staff do not readily welcome the need for change, and indeed, many do not see the need to change their current teaching practices. The TQIP is a way to drive change in teaching and learning by embedding innovation into the operational management of Departments. Furthermore, building a climate of trust and respect, where the professional management of staff is accepted, is critical for the change process to be institutionalised. It is imperative, however, that resource allocation be targeted to support Departments in their quest for quality teaching. We believe that the connection we have made between evaluative data, such as those revealed in the CEQ, and the TQIP improvement cycle augers well for improving teaching and learning in the Division of Engineering, Science and Computing.

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## Biographical Information

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Dr Joan Gribble is the Teaching Associate for staff in the Division of Engineering, Science and Computing where her role is to work collaboratively with staff to meet the challenges of improving teaching and learning. She has worked for more than 30 years in school and tertiary education and has completed a masters thesis on curriculum and educational change and a doctoral thesis on school effectiveness, school improvement and student learning outcomes. She is a member of the Australian College of Educators.

### PETER LEE

Professor Peter Lee is currently the Executive Dean of Engineering, Science and Computing at Curtin University of Technology. Previously he held senior positions at Murdoch University and the University of Queensland. He also worked with ICI Australia for a number of years. He has worked in Process Control for the last 25 years, both in academe and industry. An author of 3 books and over 220 papers, he also has an active consultancy practice in the feasibility, development and application of process control methods. He is also a consultant to the United Nations Industry Development Organisation. He was awarded the Shedden Pacific Medal for Excellence for contributions to Chemical Engineering in 1993, The Institution of Engineers Australia Excellence Award in 1998 for the design of laboratory facilities at Rockingham and the Centenary Medal for services to Australian society in 2003. Peter was educated in Melbourne and has degrees from RMIT (BE) and Monash University (PhD). He is a Fellow of the Institution of Engineers Australia and a Fellow of the Institution of Chemical Engineers, London.

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Dr Shelley Yeo is a Lecturer in Professional Development in the Learning Support Network at Curtin University of Technology. She has a background in science education and previously worked in the Division of Engineering, Science and Computing on a Studio physics programme where she completed a doctoral thesis on students' physics learning in higher education. She is a Member of the Australian Institute of Physics. One of her current roles is to provide specialist learning and teaching support to the staff in the Division of Engineering, Science and Computing.

### MARJAN ZADNIK

Professor Marjan Zadnik is the Dean of Teaching and Learning in the Division of Engineering, Science and Computing at Curtin University of Technology, and a founding member of the Curtin Physics Education Research and Development Group. He has won a number of teaching grants and awards including a CAUT National Teaching Fellowship. His current interests include improving learning in student-centred environments and assisting staff in improving their teaching in engineering and science.