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Active benchmarking in engineering education... half a decade on

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ABSTRACT: Academic exchange between engineering faculties at Auckland University of Technology (NZ), and Hochschule Wismar, University of Technology, Business and Design (Germany) was initiated in February, 1999, during a UICEE congress in Auckland. A 'Memorandum of Understanding' followed a formal lecturing visit by an Auckland professor to Wismar later that year. This agreement, initially planned to facilitate student exchange, soon expanded, with professors from both universities visiting and giving lectures to partner institutions. After a very positive student response to environmental engineering lectures given at Wismar, it was decided to expand the relationship further. This paper reviews the success of a fully benchmarked course: *Ethics and the Professional*, which is a compulsory fourth year paper in Auckland's bachelor of engineering degrees, and is now embedded in the Wismar curriculum. Consideration of the paper, from student, professor and administrative perspectives, is analysed systematically. There are pitfalls that may be effectively circumvented, and we discuss these. Overall, the project has been a resounding success, and we trust, will be a useful template for further co-operative projects.

INTRODUCTION: It may well be viewed as a truism, but the thesis of this project is *that knowledge transfer in the university is at its best when the learning requirements of the participants are constantly monitored and adjusted to ensure maximum effectiveness*. However, over the last century, the learning environment in universities has generally been one where the flow of knowledge has essentially been in one direction: i.e. from the lecturer to the student. The term *teaching*, in the narrowest sense, exemplifies this process. One tells, and perhaps explains... the recipients learn and perhaps understand. The process is didactic (or instructional), and often involved talking to (or at) the students from a fixed (and perhaps elevated) position or podium, i.e. an "us" and "them" relationship existed between students and lecturer.

However, this has not always been the norm; certainly it did not typify the learning environments of Classical Greece such as those of Socrates, or Plato's Academy, or Aristotle's Lyceum. In these environments, knowledge transfer was accomplished through a form of constructivism, where learners were encouraged to engage in an active dialog with the "teacher" (i.e., Socratic learning). The term "constructivism" is generally associated with Jerome Bruner [1], who applied it to situations where students transform information, construct hypotheses and make decisions, utilising a cognitive approach to accomplish this. This cognitive "structure" provides meaning and organization to experiences and allows the individual to think of application and concepts beyond those initially given by the lecturer.

Aristotle's technique in particular, was peripatetic, where the lecturer walked amongst, and actively interacted with students. Aristotle was thus able to identify subtle nuances in student behaviour; this then provided a mechanism through which a teacher could assess the effectiveness of the knowledge transfer process. Bruner (*loc. cit.*) identified key issues that influence

the manner in which learning is best achieved. Of these, some, such as the "student's disposition towards learning" (i.e. attitude and ability) are not of specific interest here. Although student disposition towards learning may be very relevant in secondary school education (Bruner's focus), it is rarely an issue when teaching ethics to engineering students. What is important at university level is the student's perception of the course, and this is the focus of this paper. Ethics in engineering is taught to mature students (generally later in the degree programme) at which point they should have a clear understanding of, and appreciation for, issues of professional practice such as ethics [2].

The teaching style adopted in the short course discussed herein, *Ethics & the Professional*, has deliberately moved away from the didactic to the peripatetic. This has been all the more effective when teaching in a student's second language. Further, interaction with students, especially if the lecturer learns and uses the student's names, can be shown to quickly remove barriers within the learning environment.

Following the UICEE congress in Auckland during 1999, Wismar University of Technology, Business and Design (Germany) and Auckland University of Technology (New Zealand), signed a memorandum of understanding that was to lead to a high level of exchange between the respective faculties of engineering. There have been numerous earlier similar memoranda that both universities have signed with other partners previously. However it was recognised at the outset that this agreement, to be effective, would need to be different. The distance between campuses required a much higher level of commitment than previous agreements, and this would demanded at all levels: undergraduate student exchange, postgraduate student exchange, professorial exchange and joint research.

The relationship has, over the last half decade grown from strength to strength. This paper examines the extraordinary success of the “Auckland-Wismar Project” and provides a template that others may wish to emulate [3].

WHY HAVE AN AGREEMENT?

The German and New Zealand engineering education systems place great importance on industry placement. If there is a jointly held imperative on this, it is for undergraduates to have sufficient exposure to the world outside academia, so that when they do join the workforce, they quickly integrate and become active contributors. German policies in this regard are perhaps more adventurous than in New Zealand, for they encourage young Germans to venture outside their country to gain experience. Universities such as Wismar are keen to offer their students “packages” for overseas study and/or work placement, and this type of arrangement works best when there is a host university willing and capable to provide guidance and mentorship. A further and significant aspect is that successfully operating partnerships are more able to attract funding. Financial support for the Auckland-Wismar Project has been obtained through Deutscher Akademischer Austausch Dienst (the German Academic Exchange Service), and this has facilitated both staff and student exchange. The external funding, although generous, does not fully cover transport, food and accommodation costs; with professors, the balance is generally met by the respective partners.

In 2003 two New Zealand students studied in Germany, and seven German students in New Zealand. Staff exchange has over the last few years averaged out at about three from each partner per year. This has led to a variety of engineering and mathematics seminars in both countries being given by the partner institution. One of these, *Ethics and the Professional* has been operating sufficiently long to warrant a formal student course appraisal. This was carried out in 2002 and 2003.

STUDENT FEEDBACK AT WISMAR UNIVERSITY

Over the last few years, formal feedback about how students perceived the ethics course was sought. The purpose of this process, carried out as a survey, was:

- To determine whether the course was meeting the professional needs of the students.
- To determine how (or whether) the course could be improved.
- To evaluate the mode of presentation as an intense seminar over a short time frame.

A series of statements were made in this survey, and students were asked to indicate their concurrence with these by utilising grades over a five-point range (Table 1). The grades available were 1 (= strong disagreement), 2 (= disagreement), 3 (= neutral), 4 (= agreement), 5 (= strong agreement). In addition, space was provided for students to make any other pertinent comments about the course.

The survey was carried out at the conclusion of the course, **after** the assessment of the group presentations, but **before** the provision of the final grade. The survey was anonymous, and

was collected in a manner that would not compromise student anonymity.

Table 1: *Student Assessment of the Course Ethics and the Professional. Engineering students at Wismar University were asked to grade each statement on a 1-5 scale. 5 indicates strong agreement with the statement.*

Consider each statement below, and grade each accordingly.	Students are requested to grade this aspect on a 1-5 scale
a. I enjoyed the course (overall)	
b. I enjoyed the delivery style (as a block)	
c. The facilities were good (room, notes, presentation)	
d. The time in which the course was taught was good	
e. The course was useful to me as a “future engineer”	
f. Additional comments	

RESULTS

The results for students in the Process and Environmental Engineering programme for both 2002 and 2003 are provided in Figures 1-5. The values on the vertical axis are student numbers; the horizontal axis, grades awarded for that particular question. The class size in both years was 17, and this relatively small size was undoubtedly pivotal in much of the success of the course. Technical courses taught in a foreign language are going to pose students with some difficulty. When the topic moves from technology, to encompass issues such as morality and values, a “comprehension gap” has the potential to be even greater.

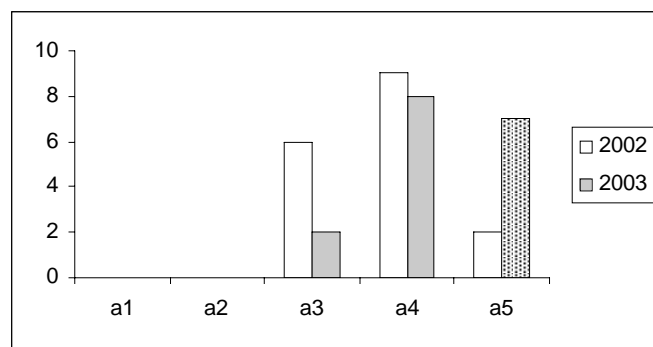


Figure 1: *Overall student enjoyment of the course. Results over 2002-2003. The grading, a1-a5, represents scores by students as per Table 1.*

There was an overall increase in student approval in *all* categories over the period. Figure 1 shows a very encouraging increase in the number of students who indicated strong positive endorsement of the course. An important variation in the course between the two years was the inclusion of German case studies.

The term “overall enjoyment” as asked in question “a”, provides students with an opportunity to reflect upon a wide range of values, such as intellectual stimulation, humour and

the opportunity of thinking beyond the traditional engineering realm.

The delivery of the course as a seminar was strongly supported overall, again with a clear increase in approval rating over the two year time period (Figure 2). The one student who did not favour the block course structure did not elaborate on reasons for this.

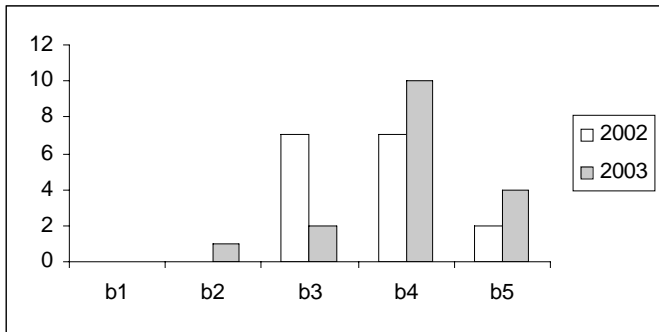


Figure 2: The delivery style (as a seminar, or block course as opposed to weekly lectures over a full semester). Results over 2002-2003. The grading, b1–b5, represents scores by students as per Table 1.

The learning environment results (Figure 3) show that students enjoyed the ambience, style of presentation and general class operation (including hand-outs). In previous years, there have been more hand-outs, as a course manual, journal articles and case study sheets. In 2003, much of this was condensed into the text *Ethics and the Professional* [4], which was tailor-made for this course.

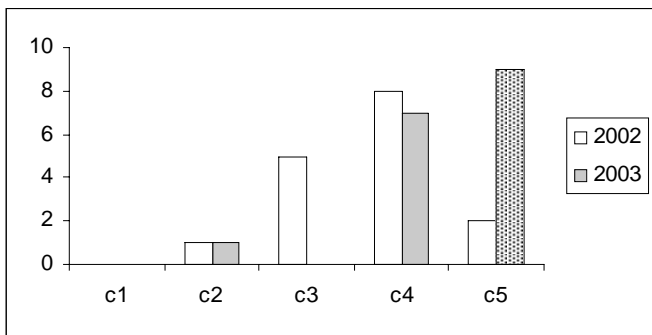


Figure 3: The learning environment (the room, course notes, presentations). Results over 2002-2003. The grading, c1–c5, represents scores by students as per Table 1.

The timing of the course in 2002 was later in the semester, and the students clearly did not appreciate this. In 2003 this was reconsidered, and the course was moved closer to mid-semester. The final examination in both years was in the following week. The feedback in 2002 regarding timing was sufficiently negative to warrant the change (Figure 4).

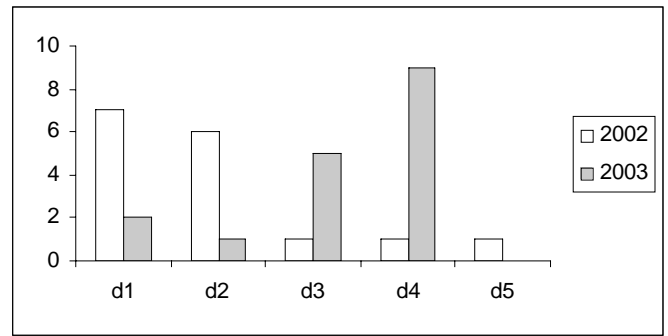


Figure 4: Timing of the course. Results over 2002-2003. The grading, d1–d5, represents scores by students as per Table 1.

Most of the students had had a small amount of exposure to professional engineering, and this provided them with an opportunity to assess the value of the course to them as engineers of the future (Figure 5).

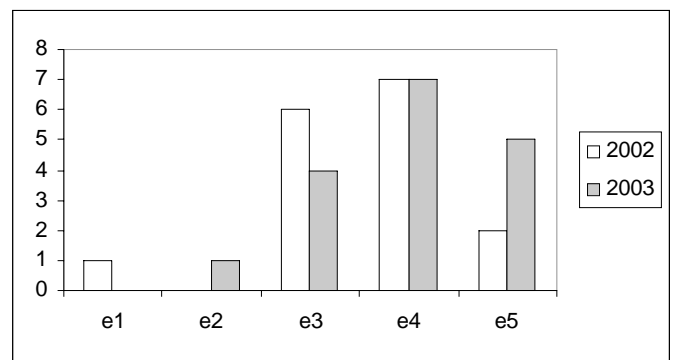


Figure 5: Value of the course to students as “future engineers”. Results over 2002-2003. The grading, e1–e5, represents scores by students as per Table 1.

Results show that on the whole, there is a perception that the course will be of use in their professional careers; further, there has been an increase in the approval rating over the two years.

It is noted that in each of the years, one student indicated that s/he felt that the course would be of no, or minimal value, to them as a future engineer.

ANALYSIS

It is comforting to receive a positive trend in the student’s approval rating for any course. It is likely that this reflects new developments such as:

- The publishing of a specially designed text on ethics for engineers.
- The re-adjustment of the timing of the seminar.
- The inclusion of German case studies, within what had previously been a very strongly Southern Hemisphere oriented course.

One aspect of the course not separately evaluated was the teaching style, which in these seminars has been decidedly peripatetic. Students in the relatively small classes are constantly challenged to provide their own (and their groups)

views on case studies. All students will spend time presenting before their peers. The fact that they are required to do this in English is perhaps a burden that some may have balked at. However, many students have surprisingly seen this as a positive aspect. Time and time again, relatively shy students become impassioned about a topic. That they can do so, in English, without fear of ridicule is a result of *rules of conduct* established at the outset of the course, and strictly maintained throughout. Students quickly learn to respect the views of others, and whilst not necessarily adopting them, develop an appreciation of the world-view of others... some of the first lessons in learning to be a professional engineer.

POTENTIAL PITFALLS

It is a given that the success of any project is dependent upon the enthusiasm and dedication of key participants. The key participants in this project are staff that are sufficiently senior in the university to be able to plan processes, and sufficiently involved (personally) to ensure that they happen. Unfortunately these staff generally have a heavy administrative load. To date the Auckland-Wismar Project has worked well because of the involvement and endorsement of one (or two) senior staff from each university. But the future of the relationship can only be assured if the current level of mutual support and collegiality is maintained. A pitfall arose recently, when one of the Wismar professors who had been instrumental in setting up the programme (NG) was elected as Rector of his university. The change in academic rôle that this necessitated removed him from any direct relationship at staff/ student level. Wismar is fortunate however, in having at least one dedicated professor who has quickly moved to maintain continuity.

As discussed in the introduction, the success of this course is also due to the *nature* of the course; i.e. the live interaction between students and teacher and the inter-student learning environment that this readily provokes. This structure of course requires an Auckland professor (up till now JB) to travel to Germany on an annual basis. Even with the relative comfort and speed of modern air travel, there is a personal toll involved with a high level of long distance air travel.

An alternative: Although initially rejected as unsatisfactory (due to the reduced personal interaction in the learning environment), it may be necessary to revisit options such as live video conferencing. A further option could be the establishment of “net clubs”, where students concurrently studying the course in different countries communicate their ideas (and concerns), with each other. At present, students in the three countries involved in this project, (Australia, Germany and New Zealand), sit the same examination, have the same lectures, but the only contact they have with each other has been vicarious - via the lecturer (JB).

A further option currently being explored is for student groups to present a web based power-point presentation for students in other countries to view. The current assessment technique for group projects (i.e. 50% of the marks are awarded by local peers + 50% by the professors), could thus be extended to permit assessment by *overseas* peers. A grading based on a 33.3%+33.3%+33.3% model is envisaged.

CONCLUSIONS

Student feedback demonstrates that the Auckland-Wismar Project has been a success. Over the last two years, there has been a clear improvement in the student perception of the course, the delivery style and the learning environment.

The challenge is to plan for ongoing improvement in the course, in anticipation that this will be reflected in successive student appraisal surveys. The reality is however, that things will continue to improve until a plateau is reached. After this, positive and negative fluctuations can be expected.

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