AC 2009-511: HOW WELL DOES COLLABORATION WORK IN ENGINEERING PROJECT CURRICULUM REDESIGN?

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John St George is currently a senior lecturer in the Department of Civil and Environmental Engineering, University of Auckland. . His academic qualifications are a BSc degree in Mining Engineering from Imperial College, London, an MSc in Rock Mechanics and Excavation Engineering from Newcastle University, UK and a PhD from Auckland University for research on probabilistic approaches to slope stability. Professional qualifications include, Chartered Engineer (UK), Member of IMMM, Fellow AusIMM and Member of the International Society of Explosives Engineers. He has industrial experience in the minerals industry working in Africa and the UK, and teaching experience in the areas of rock mechanics, slope stability, environmental engineering and surveying. For a number of years he has been involved with coordinating and assessing the Part 4 research projects in the Department.

His research interests are in the permeability of coal in relation to stress changes due to desorption, the spontaneous combustion of coal and related heating effects, stability issues related to mineral extraction sites mainly subsidence and slope stability. In the last 5 years he has published over 18 papers (5 in refereed journals) and 29 technical reports. He is also actively involved in consulting on a wide range of projects in slope stability, rock properties and subsidence.

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How well does collaboration work in engineering project curriculum redesign?

Patsy Hulse, John St George and Li Wang

Abstract

Academics, librarians, and student learning advisors collaborated to redesign the Civil & Environmental Engineering undergraduate course curriculum at the University of Auckland and to integrate information literacy principles. The aim was to improve students' research skills in line with the University's Graduate Profile, and also meet the Institution of Professional Engineers' requirements for accreditation.

This paper will focus on the changes that have been made to the compulsory Civil & Environmental Engineering Year 4 research-based project paper. The curriculum was redesigned by introducing a series of lectures and tutorials to lead students through the project process. These covered literature reviews, annotated bibliographies, searching and evaluating information resources, writing and presentation skills, data analysis, referencing and use of Endnote. Academics, librarians, student learning support staff and IT staff collaboratively designed sessions on information literacy resources and annotated bibliographies using a student-centred approach. The required literature review had to include items from at least three different sources such as patents, journal articles, standards, conference papers and e-books. Search techniques were taught by the subject librarian in a hands-on computer tutorial. Student learning advisors and academics developed a framework within the automatic online peer review system (Aröpa). Using this, each student reviewed three, randomly assigned, double-blind, students' annotated bibliographies, literature review and abstracts. This enabled weaknesses to be identified and addressed at an early stage of the project by student learning advisors.

The collaboration between academic staff, librarians, and student learning advisors proved time-consuming but achieved excellent results in curriculum redesign. In this paper we will discuss the aims, methods used, results achieved, lessons learnt and proposals for future improvements.

Introduction

This paper will discuss the collaboration between academic staff, librarians, student learning advisors and IT staff to provide information literacy skills for Civil & Environmental Engineering undergraduate students at the University of Auckland, New Zealand, with particular focus on the research-based project paper held in the fourth year.

The University of Auckland is the largest of eight universities within New Zealand and is ranked in the top ten in Australasia. The School of Engineering has over 3000 students and 250 staff. All undergraduate Bachelor of Engineering (BE) degree programmes are four years in duration. The first year course is common to all students who then select their speciality.

Admission to Year 1 is assessed on the students' academic levels based on their performance in the National Certificate of Educational Achievement (NCEA) normally undertaken at high school, and, in marginal cases, by interview. With rigorous selection procedures, the academic ability of the cohort entering the School is very high (within the top 5% of New

Zealand), and, typically, the intake is of a similar academic standard to that of the Medical School. Entry to the School of Engineering is therefore highly competitive, with 1500 to 1800 applicants for 620 places in Year 1.

All engineering degree programmes offered by the School of Engineering are accredited by the Institution of Professional Engineers New Zealand (IPENZ) which is a signatory to the Washington Accord.

Five departments offer nine separate engineering specialisations at the undergraduate level.

Almost one third of the total number of students completing first year are currently admitted to the Department of Civil and Environmental Engineering (CEE) – around 200 students in 2008.

Course overview

In the common first year, students gain exposure to fundamental engineering and scientific principles across a wide range of subject material. Over the following years, students build on this core material for their specialisation, as well as developing technical and communication skills. Throughout the papers there is a strong emphasis on problem solving and students are encouraged to think creatively. The School of Engineering is guided in its teaching by the University of Auckland Graduate Profile[1], which expects graduates to be able to understand and appreciate the characteristics of scholarship; research and creative work; have the ability to recognise when information is needed; and be able to locate, evaluate and use this information effectively.

In CEE, the Year 4 research project paper was originally an elective which the more able and those majoring in environmental engineering were encouraged to take. Two factors promoted the introduction of a compulsory project for final year students. One was the requirement by the New Zealand Qualifications Authority (NZQA) for all BE (Hons) students to carry out a research project in their fourth year. The other was a specific recommendation by IPENZ in their accreditation report on the Department[2]. With these external drivers to include a compulsory project, it was resolved to introduce it into the programme, starting in 2007.

All Year 1 and Year 2 students were given a tutorial on online library resources. From 2006, those students taking the Year 4 elective project were given the opportunity of training in library databases and this was taught in a one-hour hands-on tutorial. However, there was very little formal teaching of research methods, or preparation in information literacy skills.

In 2007, on the initiative of library staff, discussions were held on the best way to integrate information literacy into the project paper. After wider consultation with CEE academics, library staff and the Student Learning Centre (SLC), it was decided to redesign the course to include a series of ten lectures, of which six focussed on information literacy skills. In this paper the authors will discuss the structure and outcomes of these changes to the programme and the benefits of this collaboration.

Fourth Year Project structure and collaboration

The final year project is intended to give students an exercise in conducting and reporting on the investigation of a topic in civil or environmental engineering, and demands independent thought and action. It normally comprises some combination of information research, theory and laboratory work. Students work in pairs on the project with the work shared between them. The civil and environmental engineering field offers students a wide variety of subject matter – from management to technical design, and testing to numerical modelling. Most projects involve elements of the following: literature review, data collection from surveys or experimentation, design of equipment, modelling, development of code, analysis and simulation. The project supervisor, normally a member of the academic staff in the Department, looks after the day-to-day running of the project with the student group.

The assessed output from the project is a written report, a poster presentation and an oral presentation on the work. Students are expected to work on the project throughout the academic year. However, they usually utilize the semester breaks to carry out experimentation or data analysis.

The Year 4 research project also encourages students to develop skills in time management and teamwork, and to exercise self-discipline, since graduates must have the ability to work both independently and in collaboration with others.

To develop expert support for the 56 students taking this paper in 2008, a project team was established in late 2007.

It consisted of:

- Project coordinators from CEE
- Project supervisors (tutors) as required
- Subject librarians and the Library's Learning Services Manager
- Student Learning Centre advisors
- IT staff

The academic staff provided the discipline, content and expertise; the Library's Learning Services Manager provided information literacy support and design expertise; the engineering subject librarians provided expertise in engineering resources and services; and the SLC advisors provided study skills, writing skills, oral presentation skills and learning support to students.

As a result of a number of meetings of this team, it was agreed that a formal lecture programme of ten lectures backed up by coursework, peer feedback and hands-on tutorial work would provide a good balance for students during their research.

The first lectures covered an introduction to research and the development of objectives and research methodology. This was followed up by the various forms of literature review and some guidance with preparation. Further lectures on writing styles, reporting results, referencing and formatting the final report were delivered at key times during the project as students were commencing these tasks.

Two sessions on statistics were added to the programme to help the students with their project design. Although engineering students are strong in mathematics and all have completed two modules on statistics before Year 4, they lack specific knowledge and skills on sample collection, experimental design and the requisite data analysis. To offset this deficiency a specialist in this area of statistics from the SLC was seconded to the project team. The lecture on experimental design was delivered to coincide with students' preparation of their experiments, while the second lecture was delivered later in the year when most students had collected their data.

In addition to the lectures there were five tutorials, usually hands-on. These were:

Library databases

A tutorial was prepared by the Learning Services Manager and the CEE Subject Librarian with the assistance of other engineering subject librarians. This was delivered by the CEE Subject Librarian. It focused on a wide variety of information resources: previous project reports, journal articles, internet resources, conference papers, books (including online books), patents, reports and standards. Evaluation of web sites and how to obtain the full-text of documents were also covered. The course was specifically designed to follow a student-centered approach. Students worked in groups, discussed questions in class and explored the answers to the questions provided. Engineering subject librarians participated in this discussion.

Reference management and Endnote

A second tutorial, delivered by the Engineering subject librarian team, covered the use of the Endnote reference management software. Course content included exporting references from library databases to Endnote and manipulating these in Microsoft (MS) Word documents to create in-text citations and bibliographies.

Annotated Bibliography

Annotated bibliography exercises were developed by SLC advisors, in collaboration with library staff. These provided students with guidelines on how to write an annotated bibliography, with the use of a sample annotated bibliography as a template. A worksheet for the sample bibliography was created by the Learning Services Manager. With feedback from the CEE Department staff, the examples were tailored to be relevant to civil engineering.

Presentation

This session, given by academic staff, concentrated primarily on successful presentation using PowerPoint. Teaching resources were compiled and included examples of both successful and unsuccessful slides as well as formatting guides. A template presentation was made available for the students to use.

Report writing using MS Word

All students prepared their final reports in MS Word and used the template document, following normal practice for conference type publications. To help students unsure of the

finer points of MS Word, use was made of an interactive tool which is essentially a tailored MS Word help package. This had already been developed by the Department of Mechanical Engineering and takes the user through the main features of MS Word for technical documentation.

Peer feedback

The software package Aröpa was developed by the Department of Computer Science to enable peer assessment, peer marking, collating results and receiving feedback. Three submissions to Aröpa were planned during the project course, with no formal marks assigned to them. The submissions were:
1. Project objectives – the requirement was to submit a description of the project and some clear objectives.
2. Methodology – this was really an expansion of the project objectives with the methods specified to meet them.
3. Annotated bibliography – the students were given an assignment requiring them to select at least two references from each of three different types of sources e.g. journals, standards or patents. They were then required to evaluate and include them in an annotated bibliography, in order to assist with their literature review.

Aröpa handles everything electronically from receiving the documents, allocating peer reviewers and reporting results. A double blind process of reviewer and reviewee was selected with each student reviewing three submissions. Coordinators were able to monitor all information throughout the process.

Results and benefits

A number of groups with different levels of involvement and collaboration implemented this course. These were the two project coordinators from the academic staff, four subject librarians and the Learning Services Manager, three advisors from the Student Learning Centre, IT support staff and nearly 20 project supervisors. This collaboration was instrumental in producing a successful project course.

There was a noticeable improvement in the standard of the submitted literature reviews as evidenced in the marks given by the project supervisors and second examiners. This translated through to their written reports. The quality and accuracy of referencing was found by the project coordinators to be greatly improved over previous years, because these principles were reinforced in the hands-on sessions on Endnote.

An outcome of the collaboration between the Learning Services Manager and the engineering subject librarian team was a new student-centered approach to hands-on library tutorials, which has subsequently been applied to similar tutorials in other papers.

The information resources tutorial broadened students' knowledge of the many different types of resources available, especially standards, patents, journal articles, conference papers and engineering reports. The practical application of library tutorial content to the annotated bibliography exercise reinforced students' knowledge of these tools. Students commented particularly on their previous lack of awareness of standards and patents.

A benefit of having non-assessed, peer-reviewed work was that students did not feel threatened by any impact on their final grade. They were able to gauge their ability against other students, particularly with the annotated bibliography requirement on peer review. Some of the material from their annotated bibliography directly translated to their literature review which was formally assessed.

An advantage not foreseen at the outset was that the submissions for the annotated bibliography exercise gave an insight into the student's writing ability. The coordinators were able to identify students who were weak in this area. They were referred to the SLC for help with their writing skills.

One of the pleasing aspects of the Aröpa coursework was the high participation rate of over 85% even though no formal marks were assigned to these submissions. The Aröpa software was still under development, but overall it proved to be very successful. During the submission and review phases the coordinators scanned through the submissions and reviews. For the project objectives this process was intended to pick up any students with a work programme that was overly optimistic or not clearly defined. This proved to be useful since a small percentage were referred back to the supervisor. It was pleasing to find that there was a good deal of maturity and constructive criticism in student reviewer comments. This is in accord with other research[3] where peer feedback rather than grading with peer assessment has enhanced understanding and learning. The online feedback encouraged students to be more forthcoming and constructive.

Within the project team there were various levels of collaboration. One of the major advantages, particularly for the statistics modules and the annotated bibliography, was the ability to call on staff from other units who could step in quickly and efficiently.

Conclusion

Collaboration between Library staff, academics, the Student Learning Centre advisors and IT staff worked very well in producing a successful series of lectures, tutorials and hand-on sessions for a research project paper. A key outcome was a noticeable improvement in the standard of the submitted literature reviews and this was reflected in their final reports. Students were able to access a wider range of information resources without resorting to merely Google, and the quality of referencing was greatly improved over previous years. The ability to identify weak writing skills in students early in the course was an advantage since they could be referred to experts for help in time to improve their skills in this area. One bonus of using teaching support was the ability to call in specialists at short notice, as was demonstrated in the statistics modules. The student-centred approach developed for the library database teaching was very effective and has been adapted for other courses. The librarians were pro-active in communicating to the academics the benefits of integrating information literacy principles into their courses. The project aims were largely achieved because of their enthusiasm, perseverance and initiative and this drove the collaboration. Also, it was vital to find appreciative academic staff and suitable courses in which to apply the principles.

Overall, the teaching of information literacy skills by a multi-disciplinary team was very successful and hopefully will translate to other courses within the University. This collaborative initiative will encourage lifelong learning and transferable skills that will be useful throughout the students' professional careers.

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