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Restructuring a professional practice course for engineering students

Fügen Daver

RMIT University
Melbourne, Australia

ABSTRACT: Professional Practice courses are an integral part of the engineering curriculum at RMIT University, based in Melbourne, Australia. The courses, in general, aim to expose students to the practices and skills required of engineers in their professional careers. In the recently formed School of Aerospace, Mechanical and Manufacturing Engineering, all modules of the first-year professional practice course were delivered separately under a different structure. There was a need for a single and better-integrated course, as well as for a new approach to delivery, given a now combined intake of over 200 students. In this article, the authors evaluate the process of restructuring and the delivery of the first year Professional Practice course to students enrolled in the School in accordance with the philosophy and principles of the RMIT University Teaching and Learning Strategy. The structure of the Professional Practice course, which consists of six modules, the assessment methods and the evaluation of the course outcomes are presented and discussed in this article.

INTRODUCTION

In engineering education, there has been a shift towards a new (engineering education) paradigm emphasising communication and leadership skills, teamwork, systems thinking, and life-long learning attributes to realise engineering graduates who are able to deal not only with the issues of technological importance, but also with the unforeseen problems of local, national and global significance [1][2].

RMIT University, based in Melbourne, Australia, is committed to ensuring student capabilities, and to improving the quality of teaching within the framework of the new engineering education paradigm [3][4]. The restructuring of the first year Professional Practice course was aimed at developing graduate capabilities through outcome-based, student-centred and problem-driven models of education [5]. The new course offers the potential to improve the quality of teaching by employing flexible learning and teaching models of instruction where effective use of educational technology is employed.

The restructuring of the Professional Practice course complies with the University's strategy of a *capability approach to curriculum*. It acknowledges that disciplinary expertise is not sufficient in developing successful graduates who will engage as responsible citizens in their professional and social lives. It seeks to create a learning environment that will enable graduates to deal effectively in novel situations in an ever-changing world.

STRUCTURE OF THE COURSE

The restructured Professional Practice course consists of six modules that are each delivered by a different lecturer/expert in her/his respective areas of teaching. During an introductory session conducted by the participating lecturers, students are introduced to the structure of the course and are provided information on the various modules, including the project work component which links all different modules and the use of the *Online Learning Hub*.

Online Learning Hub

The RMIT's Online Learning Hub enables students to access learning materials, such as courseware, and it is also used as a communication tool that provides access to e-mail and announcements. The course was designed to incorporate the Online Learning Hub, allowing students ready access to information about the course structure, module content, assignments, and various announcements about the day-to-day running of the course.

The Six Modules

The modules included are as follows:

- Introduction to Australian engineering;
- Occupational health and laboratory safety;
- Teamwork;
- Project management;
- Report writing (skills);
- Communication and presentation (skills).

While the modules were conducted independently of each other, project work has been introduced as an integrating module and has formed the backbone of the course. The projects served as a means of creating a *student-centred learning environment* where students can develop their skills in interpersonal relationships, problem-solving, decision making, planning, goal-setting and negotiating. A total of 10 different projects were offered to an initial class size of approximately 200 students.

Groups of five students were each assigned to a particular project. Although, the same project topic was assigned to four different groups; the open-ended nature of the projects reduced the possibility of plagiarism between the groups. Project topics varied from a small-scale laboratory type of work requiring analysis and interpretation of the experimental results, to more comprehensive but abstract topics.

The specific project topics were as follows:

- Design and construction of a dry-spaghetti bridge to withstand a specified weight;
- Construction of a calendar for Mars;
- Examination of the recyclablility of commercial airplanes at the end of their service life;
- Turning a city street into a pedestrian mall;
- A look at the current and future designs and applications of uninhabited aerial vehicles;
- Safer travel options for the current space shuttle fleet;
- Driving forces behind the new car designs;
- Investigation of (the) proposals for disposing/recycling of high technology electronic equipment;
- Investigation of the construction and maintenance of a gas pipeline; the environmental and economic impact of the project;
- Investigation into the organisation of a street party.

Each project had a clearly defined set of objectives. Students were provided with a comprehensive, but not necessarily exhaustive, list of outcomes. They were then asked to achieve some of these outcomes as the core of their investigative discussion. The nature of the projects was such that they provided opportunities for students to exercise basic concepts of engineering within the framework of the Australian legal and civil system.

Achievement of the project outcomes required teamwork and the application of project management concepts delivered during lectures. Similarly, the written reports had to conform to *report writing guidelines* provided during the lectures.

ASSESSMENT METHODS

A variety of assessment methods were required due to the particular nature of the course and the large class size. The *Introduction to Australian Engineering* module was assessed by using *Weblearn*, which is a feature of the Online Learning Hub. *Weblearn* provides a Web-based test utilising multiple-choice questions. While the inexperience of first-year students in using the electronic assessment mode created some difficulties; in general, it proved to be a fast and efficient method for the assessment of such large class sizes.

An individual *hurdle assessment* was performed for the evaluation of the *Occupational Health and Laboratory Safety* module. Hurdle assessment means that a student is not allowed to pass the course unless a satisfactory submission is made.

Assessment of the *Project Management* module was linked to the group project work and students were required to submit a management project report where they were asked to demonstrate their ability to apply the tools and concepts of project management to their specific projects.

Assessment of the *Technical Report Writing Skills* necessitated a formal laboratory experiment to be conducted in small groups and to provide a technical report on the analysis and documentation of the experiment. The technical report was written based on the guidelines studied during the lectures.

The *Communication and Presentation Skills* module was assessed by actual delivery of a group project work to other groups in a format outlined in the presentation guidelines. The use of the peer assessment of the project presentations was aimed at developing critical evaluation skills by encouraging students to take greater responsibility for their own learning; one of the most important attributes of a life-long learner.

As part of the assessment, each group was required to produce a written report and make a formal presentation. While all lectures were conducted for the whole class, presentations were conducted at three different rooms where the presenters and the other students were able to interact freely. Presentations of the project work to the other groups enabled students to further develop their communication and presentation skills.

Finally, at the end of the semester, a summative examination was conducted, which included both multiple-choice and reflective questions. The majority of the methods employed to assess the individual modules and the project work were of a formative nature, and sought to assist understanding and provide two-way feedback. Assessments were utilised to enhance the learning experience of engineering students in developing practices and skills that are required of today's professional engineers.

EVALUATION OF THE COURSE

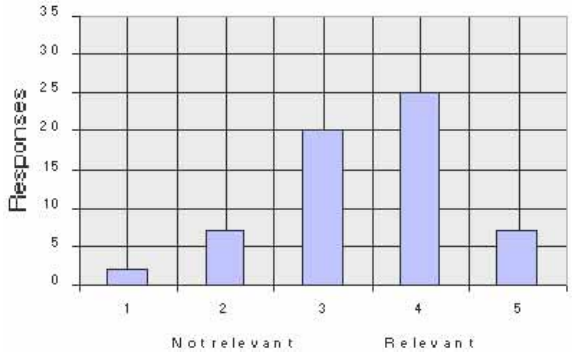
At the end of the semester, an evaluation of the course was conducted by means of a questionnaire. A total of 61 students responded. Each module and the projects were separately evaluated in terms of content, assessment and presentation. Students recorded their views by circling the appropriate response from 1 (negative) to 5 (positive). A neutral response was indicated by 3 (the middle of the range). The survey also included an open-ended section where qualitative comments were obtained.

In general, the responses were towards a neutral or slightly positive response for the majority of the modules for almost all the questions. The detail results for the *Project Management* module are shown in order to illustrate the general result.

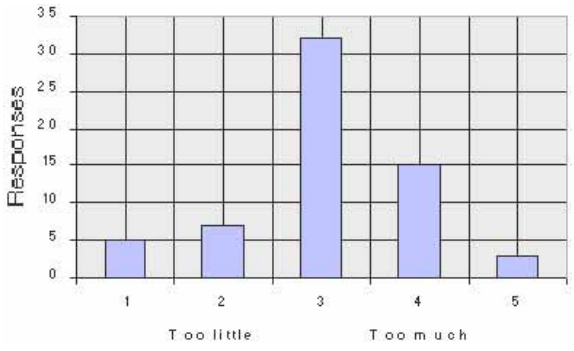
Figure 1a-1f show the evaluation of various aspects of the module content. More students considered the material relevant than not relevant (a), but as seen in (b) this did not mean that they found it interesting, or that (e) they considered their study time well spent! The amount of work put into the module (b); and the amount learned (d), were considered to be average.

Also, it was clear that students were spending considerably less than the necessary hours for each module (f). The Professional Practice course was assigned 12 credit points, consisting of four contact and eight non-contact hours of study. However, students indicated that they spent, on average, only three non-contact hours per week to study each module.

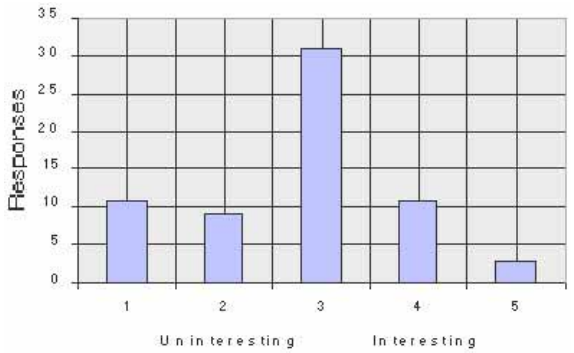
Figures 2a-2c show the assessment of the module. While in general, students were happy with the assessment method (a), and they thought the assessment grading was fair (b), they considered the grade level with respect to competence as rather low (c).



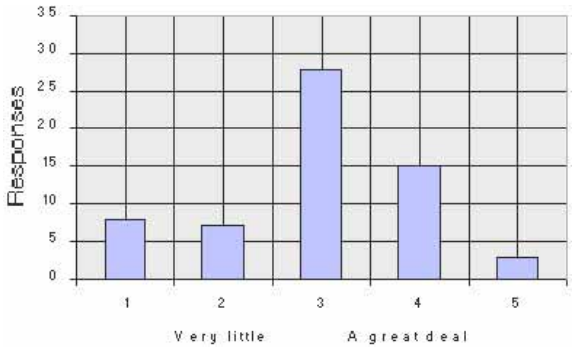
(a) Relevance to the degree.



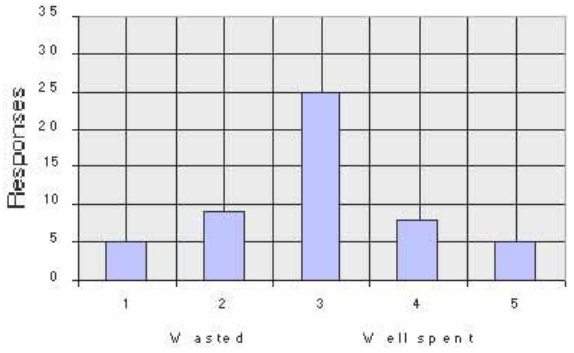
(b) Amount of work.



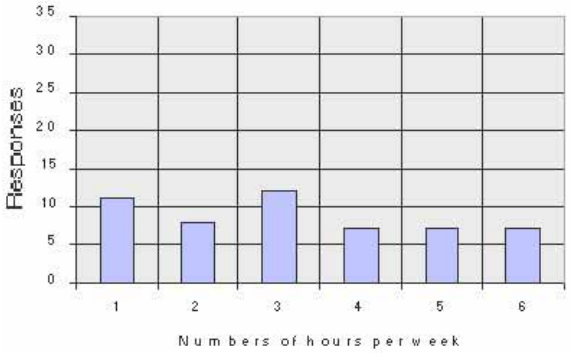
(c) Module content.



(d) Amount learnt.

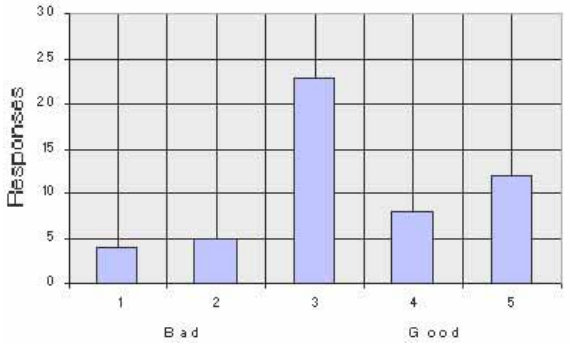


(e) Study time.

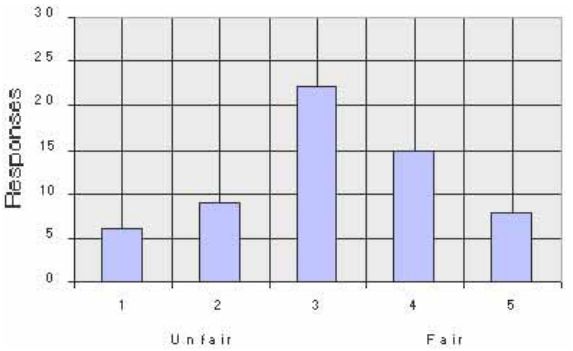


(f) Number of hours per week.

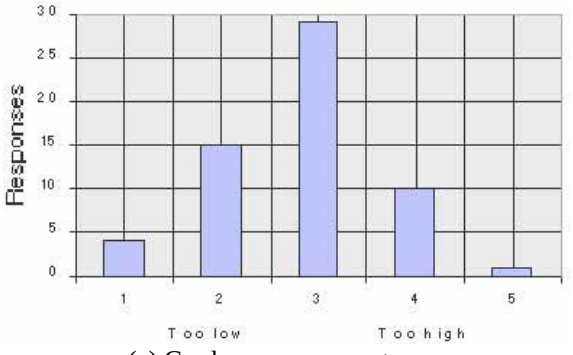
Figure 1: Assessment of the module content (1a-1f).



(a) Assessment method.



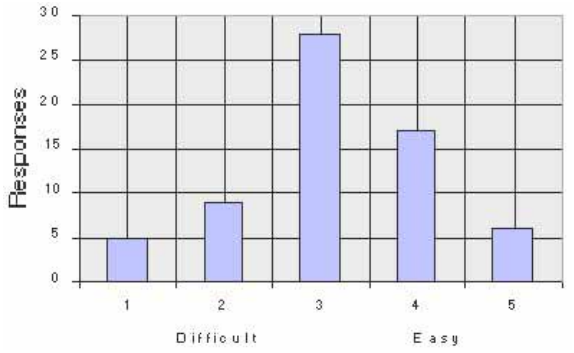
(b) Assessment grading.



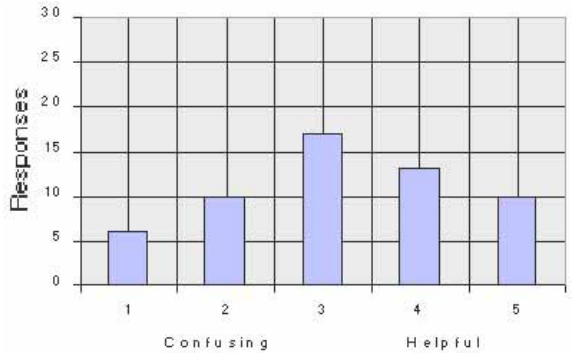
(c) Grade versus competence.

Figure 2: Assessment of the module (2a-2c).

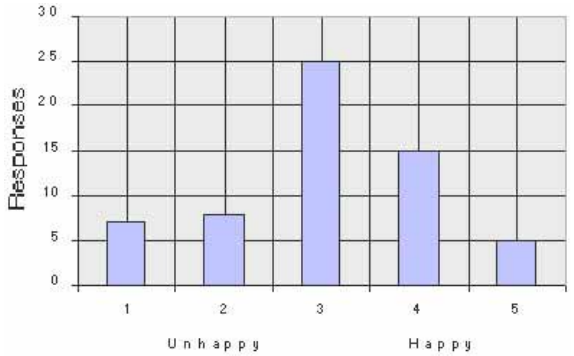
Figures 3a-3c show the assessment of the module's presentation. Presentation was assessed in terms of the ease of understanding of the teaching material (a), quality of the explanation and answers to student questions (b), and the satisfaction with the presentation of the teaching material (c). Responses indicated that the students were reasonably satisfied with the overall presentation of the module.



(a) Understanding of material.



(b) Explanations, answers to the questions.



(c) Satisfaction with presentations.

Figure 3: Presentation of the module (3a-3c).

DISCUSSION

Evaluation of the course revealed that while students were, in general, satisfied with the delivery and assessment of the modules, they were also sceptical about the relevance of some material to their core discipline. This was strongest in the project-work module. It might be argued that project topics should have been allocated based on each student's particular discipline. Yet this may simply help to reinforce students' narrow, ill-informed view of what the practice of their discipline involves. Similarly, some students felt that the *profession-level* material should be delayed until much later in the degree programme. But this is a paradox inherent in the very idea of a *first-year professional practice course*.

Traditionally, professional practice was taught via *add-on* subjects/courses in the final year of degree. There is now general agreement that this approach was not adequate and that the teaching of professional skills should be conducted and awareness developed throughout the programme. However, there are also difficulties inherent in this approach. What is the appropriate level to introduce different aspects of Professional Practice? Is there a danger of trying to teach students *to run before they can walk*?

Also, the push to develop professionally primed engineering graduates would appear to conflict with the current approach to marketing engineering programmes. Having *sold* the engineering programme to prospective students by using the glamour of technology (eg racing cars, jet fighters, robotics, etc), the School then seeks to correct this somewhat overoptimistic image via the *Professional Practice* course that claims to better reflect professional reality.

However, according to the minutes of the staff-student consultative meeting, held in the following semester, students expressed their appreciation of the course. Clearly, the skills developed from it had proved relevant and helpful in some of their second semester studies.

CONCLUSIONS

It is believed that, in developing a capability-driven curriculum for the first year engineering students of the School, the Professional Practice course, which incorporated a project component, created an outcome-based, problem-driven, student-centred learning environment in accordance with the RMIT University Teaching and Learning Strategy [3].

Although the use of educational technology, such as RMIT's Online Learning Hub and associated features, were found to be limited, they nevertheless contributed towards achieving a flexible learning and teaching model of instruction, which is an important feature of the life-long learning concept.

As a further development to the course, projects and module content can be reshaped to include environmental sustainability and an awareness of indigenous issues, while also incorporating work-integrated learning that is based on the RMIT's tradition of professionally relevant education.

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