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A coastal engineering industry affiliates programme model to enhance student learning

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ABSTRACT: Industry affiliates programmes, which place undergraduate students in the workplace as part of their undergraduate training programme and have been shown to enhance student learning, are growing in popularity. These programmes are an educational collaboration between a university, an industry partner, and – most importantly – a student. The article outlines various aspects of a model chosen for the new Bachelor of Engineering in Coastal Engineering undergraduate degree offered through the School of Engineering at Griffith University, Gold Coast, Australia, and shows how, with appropriate design considerations, a student-centred task can lead to enhanced learning by combining practical interactions with rigorous academic pursuits. Also presented are the tasks and benefits for each of the partners to highlight the significance of such a placement scheme in the improvement of student learning, and the development of valuable industry-university relationships.

INTRODUCTION

While students can learn the theoretical component of their course through lectures, readings, tutorials, laboratory activities, field studies and self-learning activities, the university environment cannot replicate the wealth of experiences, practical applications and learning opportunities available within the environment of professional industry. For this reason, many tertiary institutions have instigated industry placement programmes (also referred to as cooperative education programmes) as part of their formal teaching strategy.

An extensive study of industry placement programmes by Martin showed that these schemes are highly varied in both nature and approach [1]. Significantly, it was found that students learn more effectively from these programmes when combined with supportive teaching, high quality feedback, challenging but not over-heavy workloads, and clearly-stated goals and standards. Mead et al highlighted that these programmes are of significant advantage to both the collaborating university and industry partners [2]. For example, such schemes encourage the development of joint research and consultancy projects, and the sharing of knowledge and experiences that can lead to the enhancement of on-campus and industry-located activities.

It is somewhat disappointing to note that increasing social and economic pressures threaten the continued delivery or future uptake of industry placement programmes [3]. This is despite their provision of a tremendous educational benefit through the development of a broad range of generic and professionally-oriented skills [4-7]. Thus, methods and incentives should be developed and used to continue such programmes. This article presents the considerations used in designing an effective industry placement programme for use in the new Bachelor of Coastal Engineering degree programme at Griffith University, Gold Coast, Australia.

Coastal engineering involves aspects of civil engineering, nearshore oceanography and marine geology that are primarily directed at combating coastal erosion, navigational access and managing coastal zones. The Griffith University Bachelor programme places special emphasis on the development of practical and generic skills that are relevant to the coastal engineering profession.

This article will first review some of the existing industry placement programme types (citing both advantages and disadvantages), then go on to describe the newly-proposed model and how – through appropriate design – it is possible to structure the learning activity to enhance the development of student attributes.

REVIEW OF INDUSTRY PLACEMENT MODELS

According to Davies and Hase, the term *cooperative education* is so broadly defined that it describes almost any association between educational institutions and the industry workplace, with respect to the provision of student education or training programmes [8]. Over time, numerous models of industry placement-programmes have been developed and introduced, with the principle aim of enhancing student learning. These models can be broadly classified into the categories of: traditional sandwich courses, cognitive apprenticeships and cooperative education for enterprise development models [9]. A brief summary of these schemes is presented below:

Traditional Sandwich Courses

Within traditional sandwich courses, work experience is viewed as a separate component from the student-learning process, and the student takes time off from university attendance to undertake industrial training. There is little, if any, integration between the university and the industry.

Cognitive Apprenticeship Model

The cognitive apprenticeship model gives students the opportunity to observe and absorb the organisational culture of the workplace, and is particularly popular with courses in law and political science. In theory, the model is well suited to the concept of apprenticeship in a professional practice where the student absorbs a multitude of new learning experiences, reflects on them and, in time, puts them into practice. However, in practice, the experience is often different: students are frequently relegated to mundane tasks for fear of their making costly mistakes or – at the other extreme – are expected to plunge straight into the exploration stage, where they lack the experience and expertise to cope independently.

Cooperative Education for Enterprise Development (CEED)

Cooperative Education for Enterprise Development (CEED) programmes are a university-guided industry placement scheme where the programme's learning objectives extend beyond the development of professional experience gained simply through working in an industrial environment. The programme is structured using a defined student-centred contract so that the student is regarded as a contributor to the operations of the collaborating industry, rather than as a source of cheap labour. Through a student-university-industry partnership, these schemes promote enterprise development in training, innovation and development. The CEED programme provides the industry partner with the opportunity to capitalise on the accumulated expertise of both the student and academic staff, and vice versa. Industry may also be given access to a high degree of university resources. The CEED programme is rapidly becoming the dominant cooperative education programme of modern education on the way to rendering *old style* programmes obsolete.

While details of CEED programmes can be readily located (eg ref.s [10-12]), the design rationale, strategies and steps used for such schemes are not freely available (and possibly not even documented). The following section addresses the design considerations for the newly-developed industrial affiliates programme so as to present an overview of what was undertaken to assist with design and/or upgrades of future schemes.

THE NEW PROGRAMME AND ITS DESIGN

Programme Overview

Since CEED programmes enhance student learning and achieve the educational objectives of course developers, it was decided that the new Bachelor of Engineering in Coastal Engineering programme at Griffith University should contain an integrated Coastal Engineering Industry Affiliates Programme (CEIAP). In designing this CEIAP, a number of important issues were identified and addressed, including:

- Student attribute development;
- Student-learning assessment;
- Preparation required for the programme;
- Availability of industry partners;
- Roles of the programme's partners;
- Potential benefits to each partner from the programme.

It was determined from the planning process that the CEIAP would be conducted during the entire first semester (14 weeks) of the student's final academic year (4^{th} year). This timing allows adequate opportunity for students to develop the base academic knowledge required by a coastal engineer. During the CEIAP, students work under the guidance of an industry partner for four days per week to gain industry-orientated experience. Students are also required to attend on-campus activities one day per week, during which time they attend lectures, obtain guidance from university supervisors and at times present progress reports on their projects to other students, academics and industry partners in a common environment.

The on-campus activity was designed to remind students that they are undertaking an academic programme (as opposed to an industry working only scheme). The academic supervisor also visits the workplace to meet with students to assess their overall performance and to offer any necessary support. These site visits also afford the opportunity for the industry partner to meet and interact with academic staff, and for the academic to view current industry practices. It was determined from the planning process that sufficient numbers of industry partners exist within the local region to allow consideration of the CEIAP programme.

Student Project Selection Process

Before commencing their industry placement activity, a student must be suitably prepared. This preparation is undertaken throughout the duration of their undergraduate programme where they learn theoretical knowledge and other generic skills (such as communication and problem-solving skills), within the academic environment. Additionally, they must apply to and be selected by an industry partner; the educational aim of this is to expose the student to the job application process they will experience during their professional career that, in turn, will help develop their communication skills base. In the unlikely event of a student not being successful in finding a placement, they will be able to undertake a similar programme on-campus, wherein an academic will act as an industry partner. The student will be treated no differently from those placed directly within industry and, given it is the academic's role to actively pursue and undertake industry activities, it is expected that any such student will still receive appropriate industry-like training. All students receive the same testimonial upon graduation (except, of course, for honours grades, which are based upon overall academic achievement).

Although seemingly straightforward, student selection is actually a very complex task that requires detailed planning and management. To help all parties understand the process (and therefore minimise confusion), a flow chart has been developed for this CEIAP (see Figure 1). This chart clearly indicates the complexity of the process, and in some ways helps enhance student attributes by increasing their awareness of project management issues and the personal, academic and professional skills required when applying for a position.

Figure 1 does not show all participants' requirements. For example, legal representatives (at least from the University) are required to cover any intellectual property issues, while an insurance officer is required for indemnity aspects. It is for these (once hidden and of lower concern) reasons that costly pressures are being placed upon this type of educationally-rich programme. However, given the educational benefit of industry placement programmes (especially the CEED types for engineering students), all endeavours should be made to continue and further enhance them.

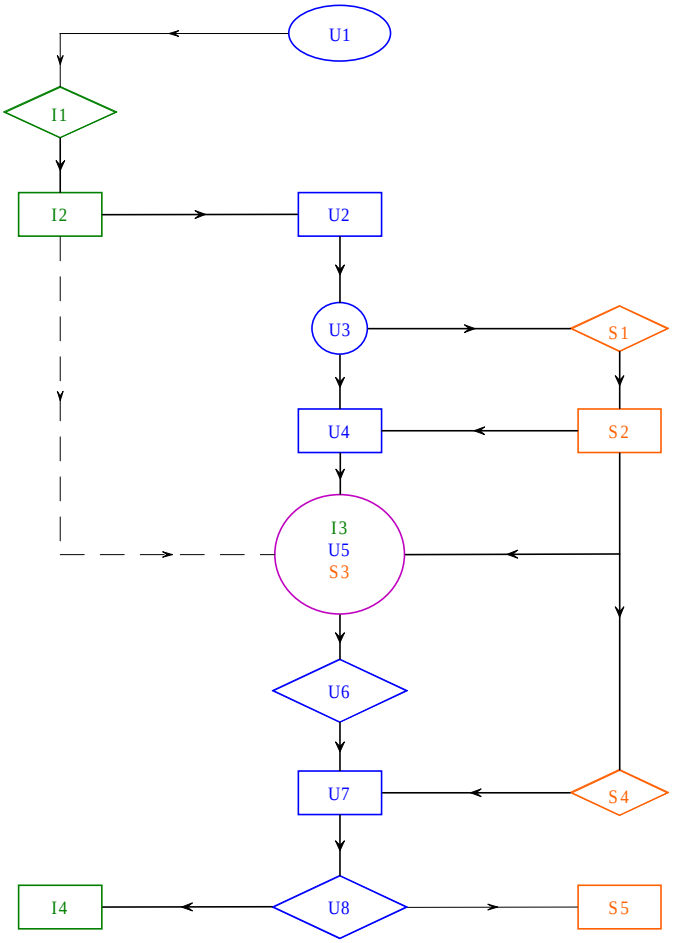

Figure 1: Flow chart of the project selection process.

In the flow chart, circles indicate an activity, diamonds represent a decision, while rectangles symbolise an administration duty. The tasks can be identified as follows:

- U1: Industry partner identification and approach.
- U2: Receipt of one page industry project brief and identification of work requirements.
- U3: Posting of industry brief for student viewing.
- U4: Receipt of student resumes and letter of suitability.
- U5: Conducting on-campus interview with students.
- U6: Ranking of students according to suitability for positions.
- U7: Receipt of order of preference from students.
- U8: Matching of students with appropriate industry while attempting to satisfy requirements of both students and industry.
- S1: Students select jobs that interest them.
- S2: Students submit resume and letter to University coordinator.
- S3: Conducting on-campus interview with students.
- S4: Submission of order of preference for positions.
- S5: Receive industry placement.
- I1: Identification of work requirements.
- I2: Submission of industry project brief and identification of requirements.
- I3: Conducting on-campus interview with students.
- I4: Receive notification of student placement.

Student Learning and Attribute Development

Student assessment for this CEIAP is achieved through various mechanisms that evaluate a number of key learning outcomes based on those developed by The National Commission for Cooperative Education [13]. According to the Institution of Engineers, Australia (who accredit engineering programmes within Australia), there must be demonstrable assessment processes for each of the required graduate attributes, and the overall assessment process must demonstrate that the stated outcomes are being measured and achieved [14]. To help guide student learning in the CEIAP (like other effective CEED schemes), students are required to complete specific tasks that can be readily evaluated. If not, there is no guarantee that students will attempt any activity at all, and consequently will develop limited skills.

As presented in Table 1, the assessment items for this programme consist of a planning report, work journal, presentations, employer evaluation, final report and a project debrief. This table also shows the desired objectives of each task; for example, the assessment items of work journal, planning report and project debrief help develop interpersonal skills through planning and reflection, which can in turn assist with the development of student attributes including the ability to work within multidisciplinary teams. Indeed, this was an important design method used in this particular CEIAP, as the concern was to maximise learning outcomes and to actively develop the attributes most required by the engineering student. If such a scheme were designed for another profession, it is likely the focus and use of different assessment items and methods would be required.

Table 1: Assessment material and its desired objectives.

Item	Objectives
Planning Report	- Establish project objectives and means - Define aims and expectations of all parties
Work Journal	- Allow students to recognise, reflect upon and articulate their learning - Experience in maintaining a journal - Future employment documentation
Presentations	- Develop student communication skills - Enable students to brief other students and assessors on the progress of their project
Employer Evaluation	- Involvement of industry partners - Quantification of skills development
Final Report	- Communication development - Summary of student work - Major assessment item

Participant Benefits

When designing any industry placement programme, it is essential that the benefits of each participant are clearly defined and understood in order to ensure an effective and efficiently-run educational experience. For this CEIAP, the design process involved developing a table of benefits for each participant; this was then critically reviewed to determine their importance and whether any had been omitted (the results of this analysis are presented in Table 2). Briefly, the industry partners provide a supportive environment for the student placement, together with the necessary guidance, information and resources for the student to succeed in the programme. The University provides academic supervisors who must have an open, accessible relationship with CEIAP students, and who will provide guidance (as required) for the students' programme. The University supervisor should ensure that the student not only continues to progress satisfactorily, but also achieves optimum

results in their programme. Most importantly, the student is required to undertake the CEIAP placement in a professional manner in order to gain maximum benefit from the programme. The previously-mentioned assessment requirements assist with an evaluation of the programme's success and, significantly, permit all participants to evaluate their own effectiveness in the implementation of the programme.

Table 2: Summary of CEIAP benefits.

Student
- Well-rounded education, enriched by practical applications - Realistically evaluate interests and aptitudes - Development of skills people interaction skills - Development of resume and job search skills - Valuable networking opportunities - Exposure to the latest business practices and technology
Industry Partner
- Access to well-trained and highly motivated students - Short term: opportunity to initiate pilot projects - Longer term: evaluation of potential employees - Exchange of ideas and new developments - Enhanced image of the organisation - Improved networking opportunities - Use of the latest university technology and equipment
University Partner
- Opportunity to enhance student education and learning - Transfer of knowledge - Improved liaison with the industry - Feedback on the quality and relevance of programme - Improved opportunities for collaborative research projects - Enhancement of consultancy project involvement

It is anticipated that through ongoing implementation of this CEIAP, some of the tasks will continue to evolve as more experience is gained. Therefore, all of those involved in the programme on a regular basis should continually reassess their own roles and those of others, and the outcomes distributed to all of the CEIAP participants whenever changes are recommended. This proactive task is significant, as it will assist all members in maintaining an understanding of the programme's objectives and duties.

Students first completed the CEIAP activity in Semester 1, 2003. Reports from the students and the industry partner revealed that the activity was highly beneficial, with students gaining significant industry-related education. While not quantifiable, students appeared to show an improved level of understanding of the requirements of life following graduation, a broader understanding of the profession, and an enhanced range of generic skills. The industry partners also felt that the CEIAP was highly beneficial to the students' education, a major highlight being an improvement in students' overall professionalism and expertise. As a reflection on the benefits of the CEIAP, one student has been approached by their industry partner to undertake an industry-supported PhD study programme.

CONCLUSIONS

A new CEIAP programme has been developed for the Bachelor of Engineering in Coastal Engineering degree offered at the Gold Coast campus of Griffith University, Australia. The preparation of CEIAP has shown that a great deal of planning is required for the introduction of a CEED programme. It is essential to consider both the desired and achievable learning outcomes, as well as the attributes that the programme is seeking to develop. From this, it should be possible to devise appropriate student tasks to maximise their learning. It is also clear that students, industry partners and the University all have tasks and responsibilities and benefits, which must be made clear to all participants and regularly reviewed to maintain an effective educational scheme.

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