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ALIGNING LEARNING OUTCOMES WITH PROFESSIONAL COMPETENCIES IN GEOMATICS EDUCATION

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Abstract

The Geomatics industry is a highly specialised field incorporating advanced technical instrumentation and complex measurement systems which form part of local, national and international Spatial Information Systems. As spatial information forms the basis for many aspects of construction, architecture, planning and development, the knowledge and skills required by the qualified Geomatics professional are varied. The professional surveyor must attain the required academic standard and satisfy professional criteria.

The BSc in Geomatics in the Dublin Institute of Technology (DIT) is the only programme in Ireland producing Geomatics professionals. It is accredited by a number of professional bodies including the Society of Chartered Surveyors (SCS) and the Royal Institution of Chartered Surveyors (RICS) and is designed to produce graduates who have academic integrity coupled with real-life problem solving skills thus servicing societal needs.

The subject area 'Geodetic Surveying' is taught in each year of the Geomatics Degree Programme and traditionally brings together a number of core surveying principles and practical problem solving skills which are reflected in the summative and formative module assessments. In this exercise the formative assessment element of module SSPL3005 (Geodetic Surveying 3), which is a 5 ECTS (European Credit Transfer System) module delivered to third year students, focused on an industrial simulation exercise as a means of meeting the demands of relevant stakeholders, *viz.* Students, Academic standards, Professional Bodies and Industry. This simulation exercise emulates the TV show 'The Apprentice' whereby students, operating in teams, had to solve a practical survey problem and present, and defend, their findings on camera before a panel consisting of two course tutors and a chartered surveyor who is the director of a large survey practice.

This paper outlines the pedagogical approach of using industrial simulation for survey education and evaluates the methodology employed and the outcomes achieved. It also highlights the challenges in aligning academic curricula and assessment with the professional competencies required by industry.

Keywords: Industrial simulation, Professional Competencies, Geomatics.

1 INTRODUCTION

The degree in Geomatics in DIT is required to meet specific academic standards in teaching, assessment and programme outcomes. In module SSPL3005 the challenge was to ensure that the module outcomes met all relevant stakeholders requirements.
Significant developments have taken place in the area of Geodetic Surveying in the past decade particularly in the use of reflectorless total stations and Global Navigation Satellite Systems (GNSS) for Engineering Surveys. Graduate surveyors are now expected to be very familiar with the instrument operations, techniques and data processing. Surveying has been a leading industry embracing new measurement technologies and academic institutions have been challenged to keep up with the latest technologies. In DIT Geodetic Survey equipment currently available in the Department of Spatial Sciences meets the industrial standard required for vocational training and thus provides a sound training base for students. The conceptual and technical complexity of the SSPL3005 curriculum was aligned with these new technologies and 40% of the module was directly assessed using interactive learning and formative assessment.
The academic standards of the Geomatics programme are linked to industrial and professional requirements through industry boards and course accreditation, respectively, both of which are fundamental to maintaining academic currency. A Geomatics graduate can become a Chartered Surveyor on successful completion of structured training known as the Assessment of Professional Competence (APC). The APC is a Society of Chartered Surveyors (SCS) mentored two year post-graduate programme employed to ensure potential professional members are competent to practice and meet the Society's high standards of professionalism [1]. The APC training structure is based on candidates achieving a set of requirements or 'competencies' to specified levels as shown in Table 1. These competencies include a mix of technical and professional practice and interpersonal and management skills.

Table 1: APC Competencies Structure

SCS Competencies		**Level of Attainment**	
Mandatory	Across all surveying disciplines	1	Knowledge and understanding
Core	Directly related to a specific discipline	2	Application of knowledge and understanding (doing)
Option	Additional skill requirements	3	Reasoned advice and/or depth of technical knowledge
[1] Assessment of Professional Competence. Requirements and Competencies. 3rd Ed.			

The Industrial Simulation exercise adopted in module SSPL3005 had to pass both internal and external scrutiny. By designing a 'real-world' vocational aspect to the academic learning outcomes, prior learning from lectures was contextualised and many SCS APC requirements were also met. In addition, assessment was aligned with professional practice by the inclusion of a prominent chartered surveyor and survey company director (Mr. Tom Mulreid, MSCS, Director Apex Surveys www.apexsurveys.ie) on the assessment panel. Thus, a rationale underpinning the teaching of this module was that resultant graduates were directly exposed to current industrial practices and professional competencies and should be better equipped to apply work ready knowledge and skills to solve critical problems.
The pedegagocial advantages of adopting industrial simulation specifically in a surveying context as an educational tool have been previously evaluated by Mclean [2] and are briefly summarised here. Industrial simulation is student centric in that the learning process is owned by the student and facilitated by learning scaffolds provided by the academic. It is closely related to Enquiry Based Learning (EBL) and Problem Based Learning (PBL), both of which empower the student to direct their own learning experience and identify problems and issues during the process [3]. The project based component of module SSPL3005 described in this paper closely resembles the guidelines for EBL as set out by the Centre for Excellence in Enquiry Based Learning (CEEBL) whereby a small scale investigation involving field work was adopted and a case study was adapted to meet the disciplinary contexts [4].

The industrial simulation project was undertaken during Semester 1 2009/2010. It was used as a formative assessment activity to support the traditional teaching undertaken in the classroom environment. It was however specifically designed to expose the students to complex and advanced survey instrumentation and methodologies by inclusion of tutorial and seminar support, field operations and post processing. The project brief was designed as a client brief with specific technical requirements in-line with industrial requirements. Students had direct visible but discreet supervision during all aspects of the project and were not taken too far from their established 'comfort zone' thus ensuring that the learning experience was enhanced.

2 EVALUATION OF THE SIMULATION EXERCISE

The effectiveness of the simulation exercise was evaluated using a number of criteria including:

i. Suitability and timeliness of teaching content and course material
ii. Evidence of effective teaching, learning and assessment methodologies
iii. Enhancement of student Learning
iv. Evidence of effective evaluation strategies and quality assurance procedures

2.1 i. Suitability and timeliness of teaching content and course material

Much of the fundamental theory required for this project had been previously delivered in pre-requisite modules. However, specific topics necessary to complete the Client Brief were provided by the academic tutors in the form of tutorials and seminars and these can be seen in Table 2.

Table 2: Industrial Simulation Project Schedule

Week	Date	Topic	Lecture	Field/Lab
1	24/9/09	Overview of Module	Mission Planning GPS/ Obstruction Diagrams	
2	1/10/09	Project Introduction + Expected Outcomes.	Network Design & Optimisation	Lab-based reconnaissance.
3	8/10/09	Overview of TGO (GPS) software/Field	Control design competition. GNSS baseline issues, RINEX data sources and TGO processing	Station descriptions, including GPS obstruction diagrams, Establish control points on the ground
4	15/10/09	Field Day	Field briefing session	Observe control network & height control between stations
5	22/10/09	TGO Processing	Baseline processing	Download and process baselines, import RINEX data
6	29/10/09	Review Week		
7	5/11/09	TGO Processing	Overview of GPS network adjustment strategies	Process network with national control
8	12/11/09	Technical network report due		
9	19/11/09	No Field work due to poor weather	Desk Study on appropriate GNSS technologies	
10	26/11/09	Field Day	Field briefing session	Stop & Go and total station measurements
11	3/12/09	Data processing & road design	Overview of GPS detail & road design issues	Topographic processing and road design
12	10/12/09	Field Day	Field briefing session	Set-out works in the field Students to have video record
13	17/12/09	Presentation + Grading		

Table 2 highlights the integrated field elements of the project and the general structure to the timetable adopted for the project. All relevant support materials were made available to the students via Webcourses, DITs online learning platform, which was also adopted as the primary contact medium outside of scheduled contact time.

Excellence in teaching was achieved by aligning the projects academic goals with SCS professional competencies as evidenced in Table 3.0. The expectation of this project was that on completion of the module students would be expected to be more confident and competent using their applied survey skills in a work environment. Thus by framing project based assessment with industry inputs the standard, reputation and employability of DIT graduates would be raised.

Table 3.0: Alignment of Learning Outcomes with Professional Competencies

SCS Competencies		**Level of attainment**	**SSPL3005Learning Outcomes**
Mandatory	Verbal Communication	Demonstrate effective use of verbal and presentation skills in a variety of situations (Level 2)	Presentation of Project Material to Industry
	Team Working	Work effectively as a team member in your work/business environment (Level 2)	Group Based Project Learning
	Written and/or graphic communication	Demonstrate the effective use of written and/or graphic skills in a variety of situations (Level 2)	Organisation and presentation of project technical report material
Core	Measurement	Apply your knowledge to undertake measurement. Use basic and/or advanced instrumentation to collect data (Level 2)	Topographical surveys of selected areas are required with the data gathered using GPS where appropriate and Total Station measurements providing infill.
	Engineering Surveying	Apply your knowledge on site and be aware of safety, site management procedures and civil engineering/structural principles. (Level 2)	Design work will be undertaken, based on the topographical survey, and set-out using GPS & Total Station methods
	Geodetic Surveying	Apply your knowledge in practice, specify and plan surveys and instrumentation needs. Be aware of error sources and 'fitness for purpose' of data. Use industry standard software and apply network adjustments and/or transformations. (Level 2)	3-D survey control is to be established throughout the site using a GNSS-observed survey network.

Note: For all SCS competencies see [1], Mandatory competencies refer to the Geomatics discipline

2.2 ii. Evidence of use of effective teaching, learning and assessment methodologies

The method of Industrial Simulation used was very effective in providing a supported work environment for students which closely mirrored actual work practices. The Client Brief was provided well in advance to prepare the students for the exercise. Students were also discreetly supported throughout the project by the tutors on site. Online communication was facilitated through the use of a dedicated WebCourses area and each Survey Team was allocated a private discussion area for dissemination of information. This had the advantage of allowing facilitators discretely monitor the range and quality of reference materials used by each team and thus the effectiveness of this teaching process. EBL and peer teaching within the groups were found to be very effective as learner driven teaching processes which reduced the tutor support required, particularly in the field. Indeed students with previous relevant work experience were very effective and enthusiastic in disseminating information and vocational skills to their peers.

Effective learning was achieved through the problem-solving approach with direct industry and professional relevance. An understanding of the technical solution to the Client Brief came through the

appreciation of relevance of individual topics culminating in a technical report and presentation to industry. In this project the requirements of a number of stakeholders i. Academic Standards, ii. The Students, iii. Professional bodies and iv. Industry were identified and satisfied. The learning achieved was clearly identified by the Industry Partner and supporting Professional who was greatly impressed by the standard of student presentation and reporting during the assessment element of the project.
Effective assessment was achieved as evidenced through the maintenance of academic standards. Student attendance exceeded 85% throughout the project and grades compared favourably with those for previous years as there was real engagement with the process. Formative assessment included elements of critical thinking, quality of research and effective group methods. Students also engaged in peer assessment. This assessment element mainly focused on the group dynamics rather than academic quality and was shown to be robust. In addition, students also undertook a Self Assessment whereby each team member assessed their own contribution to the process. The grades achieved in each assessment element were found to be on average higher than previous grades achieved by similar cohorts. All students achieved in excess of 60% in the final assessment with nearly 30% of students gaining grades in excess of 80%. It should be noted that this cohort of students were particularly dedicated to the course and are in general considered to be high achievers. The final presentation was undertaken in the DIT Telematics Facility, Aungier St., in front of a panel including the two academic tutors and the chartered surveyor in the style of the TV show 'The Apprentice'. Each group presented to the panel, and their peers, and had to defend their solution to the problem in the face of some uncompromising questioning. This element, in particular, proved very successful and students very much engaged in presenting to a prospective future employer. All presentations were video recorded for evaluation and for academic transparency.

2.3 iii. Enhancement of student learning

The enhancement of student learning resulting from this significant development in the SSPL3005 module is evident from an examination of the high quality of (i) the team interim technical reports, (ii) the team oral presentations and (iii) the team defence of their solutions at the professional interviews. In comparison to the traditional, instructivist approach to the teaching of the third-year Geodetic Surveying module, the learners were found to have integrated a significant breadth of complex technologies and skills, and have successfully applied them in a realistic, real-world environment. Furthermore, while also developing written and oral presentation skills and learning to work effectively in team-led situations, the learning framed around an industry problem has clearly developed individual work-oriented capabilities and vocational skills. Individual thoughtful review and self-appraisal skills are evident from the professional interviews and original thought is apparent, e.g. the use of YouTube as a means of presenting in Powerpoint video captured in the field using mobile phones (Powerpoint does not support the phone's MPEG4 video format).

2.4 iv. Evidence of use of effective evaluation strategies and quality assurance procedures

Effective evaluation was through the strategies of a final meeting of staff involved including the Industrial Partner. In addition, student feedback was through informal round-table meetings and also followed normal DIT Quality Assurance procedures [5] which use a grading system (Q6 form) to evaluate the module in terms of resources available, organisation and content, presentation, the effectiveness of communication and general comments on the module. The results from this feedback indicated an overall high level of satisfaction with the module and the comments, in particular they highlight the favourable response to the enhanced practical element. Additional feedback from the industry professional who led the interviews provided an positive reflection on the standard of student competence in the area of Geodetic Surveying and it was found that the relationship between the the academic outcomes and the SCS competencies (Table 3.0)were appropriate and attained.

3 CONCLUSION

The change from an instructivist approach to teaching to an enquiry-led approach resulted in less structured classroom time, which is often passive, and more class/discussion/lab time with a more mature, and hence satisfying, learner-lecturer interaction which will be continued. In addition, using a more flexible approach, day-long blocks of time could be allocated for fieldwork sessions, when required, so that work packages could be completed in one day this approach was considered successful and will be continued.
The industrial simulation project was deemed worthwhile and successful, as evidenced by the depth of learning clearly apparent from the presentations and interviews. It was apparent during the semester

that levels of student engagement and enthusiasm for the module had significantly improved, compared to heretofore, and their ability to explain and defend their technical solutions, in confidence, in an ‘Apprentice’-style environment was impressive and a morale-booster as they prepared for their industrial semester. The link with industry and the professional competencies required of a graduate was considered very successful in meeting the demands of all stakeholders.

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