

A NOVEL ASSESSMENT APPROACH TO ENHANCE MANAGEMENT, TEAM WORKING AND COMMUNICATION SKILLS FOR ENGINEERING STUDENTS THROUGH EMPLOYMENT EXPERIENCE

Peter MONAHAN and Lynette O CALLAGHAN
Technological University Dublin, Ireland

ABSTRACT

The *employment experience module* is an opportunity for mechanical engineering students to get academic acknowledgement of skills and experience gained while working in a variety of companies and industries. The careful design of the learning outcomes for the module has enabled students to develop skills required by accrediting bodies, such as Engineers Ireland, but uniquely does not require that the student be employed in an engineering company. In recent years college attendance has been compromised because many students are in part-time employment, and opportunities were sought to benefit from this reality while encouraging student retention.

The novel assessment approach significantly reduces the costly input of academic/university time, organisation and management as the student's ability to self-manage and use their own initiative is being assessed. The students must source the employment themselves. The employer must give permission for the student to avail of particular opportunities within the company. This highlights the 3-way partnership of responsibilities between the student, university, and the employer.

Inherent in the development of communication, teamworking and self-management skills are the requirements to document evidence in a work journal. Communication of technical information relevant to the company, in the context of safety protocols, operating procedures, quality assurance process and codes of practice, are key to enhancing the technical content and providing a broader context to the employment.

An outline and review of the authentic assessment approach and delivery of the process is presented, along with the participation statistics of students and companies over four years of implementation. The module learning outcomes and the type of evidence provided by students to align with the outcomes are discussed.

Keywords: Engineering, employment experience, authentic assessment, self-management, communication, organisational, self-directed, reflective, evidence

1 INTRODUCTION

A novel *employment experience module* is presented that utilises a students' existing employment arrangements to further develop the key skills of communication, self-management, and organisation. *Technological University Dublin* (TU Dublin) strives to encourage early career development by allowing the student to experience these core engineering skills through employment experience and alternatives to traditional engineering placements [1]. There is no requirement for the employment to be in an engineering company, or to involve technical engineering tasks. The students report on the achievement of learning outcomes relating to ethics, health and safety, codes of practice, quality assurance and environmental considerations. Key managerial roles within the companies' structure are also reported on by the student, along with evidence of their self-directed work within teams. The constructive nature of the module delivery process and the authentic assessment approach encourages students to view their job through a wider lens and to review company goals and structures. Permission for the employee to engage in and report on communication and organisational opportunities within the company is required from the employer and is key to encouraging self-directed development within the organisation.

The *employment experience module* aims to improve students' learning experience in mechanical engineering by enhancing "non-technical" skills required by accrediting bodies, such as Engineers Ireland, through work-based experience. The process aims to develop key competences of an engineering technician: effective communication and interpersonal skills, self-management, professional responsibility, and creating and applying safe working practices [2]. Behaviours and interactions between people have been shown to be important skills to enhance in engineering education, rather than technical skills alone [3].

Sourcing jobs for the large numbers of mechanical engineering students in a programme is often not a realistic objective for engineering schools due to resourcing issues. However, anecdotal evidence indicates that many students are already in part-time and summer employment to support their cost of living. Although working while studying has been shown to have adverse effects on the amount of time for attending university and completing assignments [4], opportunities were sought by the school of mechanical engineering to encourage student retention. Students present their engineering or non-engineering work experience to an assessment procedure to demonstrate that they have obtained these key competences during their employment. The independent sourcing of employment requires the student to use their own initiative, and the assessment of the self-management of the learning outcomes by the student significantly reduces management input using college resources in contrast to traditional engineering internships, which are costly to run and require significant academic and administration input.

Successful students are awarded a module exemption in a *professional development module* in the next academic semester. Internships in companies support lifelong skills and confidence to choose their preferred career path [5]. This gives students the opportunity to get academic acknowledgement of skills and experience gained while working in a variety of companies and industries that they would not achieve in the classroom. Students are rewarded in this process for presenting the value they add to the company in terms of contributions, valued opinions and personal development, skills that have identified as being essential to industry employers [6].

This paper presents a review of the novel assessment procedure for an employment experience process that has been implemented for four years as an optional module within the Mechanical Engineering Ordinary Degree programme (TU717) at TU Dublin. The module code is MECH2039. A review of the approach to enhance management, team working and communication skills for engineering students is presented. Section 2 gives an outline of the delivery and assessment approach. In Section 3 the participation statistics of students and companies over four years are presented. The module learning outcomes and the type of evidence provided by students to align with the outcomes are discussed in section 4.

2 METHODOLOGY AND DELIVERY OF THE EMPLOYMENT EXPERIENCE MODULE

The constructive nature of the delivery of the *Employment Experience Module* is dependent on the successful, authentic, and timely completion of four deliverables:

1. Employer's approval questionnaire,
2. Students work journal detailing the employment,
3. Final written report of the employment experience,
4. Oral Presentation to the review panel and accompanying PowerPoint.

The requirement of 200 hours employment is typically completed during the summer after 1st year, however part-time employment may extend into the student's 2nd year in college. The module delivery process and authentic assessment approach is delivered in three important stages of the early student learning journey.

2.1 Stage 1

The optional employment experience module is introduced and explained to the 1st year student cohorts. The learning outcomes that must be completed and the reflective nature of the report and presentation are outlined to the students. The deliverables that must be completed, and the relative weightings are explained in detail. As 1st year *mechanical engineering* students and the 1st year *general engineering* student streams feed into the 2nd year *mechanical engineering* cohort, both groups are presented with the opportunity.

Support from the *TU Dublin Careers Development Centre*, in terms of CV writing, employer and alumni connections, is provided. Students are encouraged to attend TU Dublin employment and careers fairs and events. Students are also encouraged to avail of the student membership of Engineers Ireland and the Institute of Mechanical Engineers IMechE.

At this early stage, interested students are given access to the module Virtual Learning Environment (VLE), outlining the module descriptor, submission dates for deliverables, and case studies of previous students' reports and presentations. Students are informed that their employer needs to approve their participation in this process. Examples are given as to how the learning outcomes can be achieved in a "non-engineering" company. This encourages students to keep the learning outcomes of the module in mind when looking for full or part-time employment, or to view their current employment in the context of the module requirements.

2.2 Stage 2

Employment is sourced by the student independently of the university. However, the employer's approval questionnaire needs to be sought by the student and signed by the employer during this stage. The objective of this questionnaire is to make the employer aware of the learning outcomes that the student requires and to facilitate these by permission to: i) attend meetings, presentations and to be included in companywide communications, ii) allow access to company information regarding its organisational structure, managerial roles, QA procedures, health and safety, codes of practice and iii) share knowledge of company projects, goals, resources, and marketing of these. Confidentiality is agreed where necessary.

The students are required to complete a descriptive work journal of the activities, training, and projects they are involved with to identify goals and gather evidence. If they deem the nature of their current activities in the employment are not sufficient to meet the learning outcomes self-direction is required by the student to obtain more information on achieving the outcome, or to request more opportunity or information from the employer. The work journal is the main tool used for self-reflection on activities completed and self-management of goals.

2.3 Stage 3

The *employment experience* module is processed and assessed in semester 1 of the 2nd year of the programme. The students partake in weekly mentoring meetings, where the work journals used to record and reflect on work tasks are reviewed by the students, and evidence of the learning outcomes completed during the placement is gathered and refined for the written report.

The module lecturer approves the participation in the module based on the completed employer questionnaire and the work journal, to confirm if the employment experience has the capability to meet the learning outcomes of the module. The lecturer answers student queries, monitors the timely completion of the deliverables, and gives feedback. Students receive weekly course notes, specific class group meetings and presentations from previous years' students.

The final assessments are an oral presentation on the employment experience and a written structured report giving evidence of the achievement of each learning outcome. Copies are given in advance of a sitting of a panel of TU Dublin lecturers who agreed to award the student a pass grade. Key to the completion of this pass/fail module is i) the ability of the student to complete the reflection activity on the employment experience they have completed and ii) the alignment of this experience against the employment experience module learning outcomes. Consideration is also given to the employer comments.

As this is an optional module, students must be very focused on completing the module deliverables based on their own initiative. Completing the process requires self-management skills and develops responsibility and awareness of lifelong learning. Communication skills are enhanced in preparation for the final presentation. The students are also asked to complete the confidential TU Dublin questionnaire reviewing their experience of the module.

3 REVIEW OF RESULTS OF THE ASSESSMENT APPROACH

In the four years that the *Employment Experience Module* has been taught, 39 students have successfully completed and passed the module. Figure 1 shows the number of students who successfully completed the module from 2020 to 2024. Class participation rates varied from 11% to 21% of the registered students in each of the four years examined.

Students were not required to obtain a job in an engineering company; however, it was observed that significant proportions of students worked in an engineering environment. Figure 2 outlines the number of students who worked in engineering companies as being between 31% and 67% of students participating in the module each year. This cohort also achieved significant additional technical skills specific to engineering, in addition to meeting the learning outcomes of the module. 31% of the students

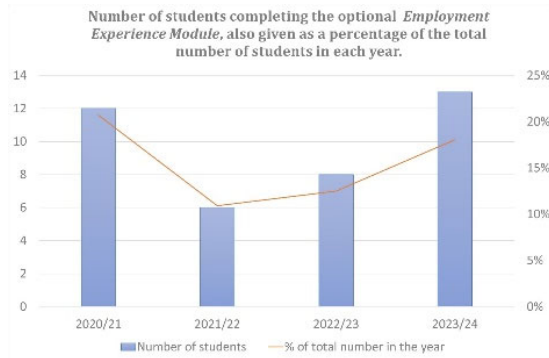


Figure 1. Employment Experience Participation

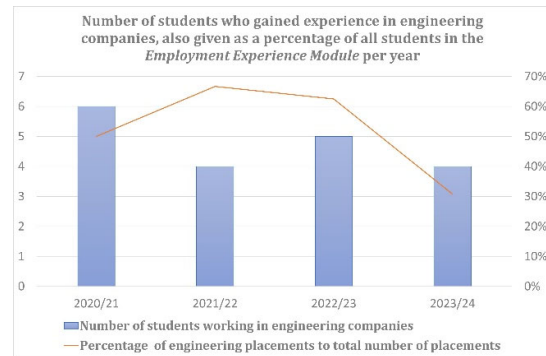


Figure 2. Students with Engineering Experience

who completed the module came through the general engineering 1st year programme, indicating that the assessment approach is robust and adaptable and has the flexibility to be applied in a variety of programmes and disciplines.

4 DISCUSSION ON THE QUALITY OF EVIDENCE OF ACHIEVING THE LEARNING OUTCOMES

The learning outcomes of the *employment experience module* are outlined in Table 1. They were developed using the key competences of an engineering technician that are expected to be developed after two years of the programme: effective communication and interpersonal skills, self-management, professional responsibility, and creating and applying safe working practices [2]. In addition, consideration was given to the 2nd year *professional development module* learning outcomes successful students would receive an exemption from. On completion of the *employment experience module*, the pass/fail is awarded based on the achievement and demonstration of the following module learning outcomes.

Table 1. The specific learning outcomes of the module

1	Communicate technical and other information effectively, both orally and in written form, in a professional environment.
2	Work effectively as part of a team and develop self-directed work management skills.
3	Discuss the relevance and application of safe working practices in the workplace, in the context of relevant statutory requirements and codes of practice.
4	Describe the company structure, including management roles, HR functions and Quality Assurance systems.
5	Outline the project/process/service you are involved with, the key management roles and your role in contributing to the achievement of company goals and technological tasks.
6	Summarise and report on learning experiences through preparation and presentation of a reflective journal and final report, as per the guidelines given in Employment Experience Module Handbook.

4.1 Learning Outcome 1

Evidence of communication of information, both technical and non-technical was provided in many forms. Some students had clear customer service and support roles, with others providing training to new staff members in company protocol or sales techniques. Other examples were developing Computer Aided Drawings (CAD) drawings and website designs. One student worked in a car

dealership as a parts advisor managing stock and interacting with customers and mechanics. Where students had little opportunity to communicate at departmental or project meetings, the students were required to demonstrate to the panel the details of the companies' business activities.

An example of this was a student who processed paint cans at a waste processing plant. In his report and presentation, he provided a review of other process provided by the plant about soil cleaning, waste oil, and pesticide management. A student working as a courier manager for a national food delivery service, interacted with courier services in many locations and provided a review of the range of software technologies that facilitated timely delivery of hot food from many providers on the website. The written report and oral presentations are evidence of the student's ability to communicate their experience, and present technical information.

4.2 Learning Outcome 2

An example of teamwork was given by students who were general operatives in a heating and ventilation company working on air handling units for data centres and in furniture manufacturing. They were general operatives who worked in a team of installers who had regular interactions regarding scheduling, coordinating tasks, problem solving and upskilling within the team. Reporting on how problems were resolved in a retail or farming environment highlighted their role in teamwork, and how processes are run by all team members conforming to operating procedures.

A smaller number of students obtained intern field engineer posts, and performed roles in operations management, liaising with contractors, managing schedules and implementing communication and safety protocols while work was being done in relation to water and mast installations and developments within a hospital environment. Self-directed management skills were also developed by completing the process of reflecting on the experience gained. Students described their role within the team in solving company issues and meeting company goals.

4.3 Learning Outcome 3

The application of safe working practice was evident in all employment types, where counter hands in supermarket meat counters were responsible for meat processing equipment and safety and cleanliness protocols. The HACCP management system for food safety in farming, food production and food retail environments was the most prevalent in the evidence. Protocols for selling controlled drugs in a pharmacy environment, and codes of practice specific to construction industries and factory floor assembly were presented. Students demonstrated that they were conscious of their own safety and the safety of others and were trained in using the required Personal Protective Equipment (PPE) requirements correctly. In several instances, the improvements by either corrective actions or operating procedure revisions were recommended by the students to the employers.

4.4 Learning Outcome 4

Students provided graphics of the organisational structure of key departments and managers in larger companies. Examples are leading manufacturing contractors and public supply chain outlets such as Argos, PowerCity, JustEat, Noonan Cleaning, Jones Group, and Intel. The key responsibilities of managers at each level were described, in terms of meeting company goals and managing staff. The roles of Human Resources were presented in varying levels of detail. Details of the quality assurance processes in the particular companies also provided an opportunity to describe some technical detail of requirements they were operating within.

4.5 Learning Outcome 5

Students described the projects, processes, or service they were employed to partake in. They presented an understanding of both the commercial value of what they do and what value they added to the company. Some case studies of interest were selected as good examples of meeting learning outcomes. While some students did work in engineering environments, learning outcomes were achievable in a variety of industries.

Student A worked in a retail franchise and was promoted to a key holder and supervised the maintenance of the fire alarm and sprinkler system. He signed off on new staff inductions and provided training.

Student B worked on a vegetable tillage farm and has received manual handling training and gained a forklift and pallet truck license to complete his work. He developed a system that notifies his employer by text of the current vegetable fridge stocks to ensure orders were met.

Student C worked in a family business installing ventilation ducting and insulation. He developed a new project costing system by producing material quantities from CAD drawings and he set up a document control system to ensure the current project drawings only were in use.

Student D gained a summer placement with a heating and ventilation manufacturing company and was trained on the use of the fabrication machines. He was able to work on his own initiative to complete the equipment selection and installation of systems. He has since used this knowledge for his final year project to develop and test a domestic heat recovery unit and is being sponsored by the same company.

4.6 Learning outcome 6

Evidence of the previous five learning outcomes was compiled by all students in the written report and summarised and presented orally in the presentation. This provided evidence of an ability to communicate the required information effectively in written and oral form.

5 CONCLUSIONS AND FUTURE PROSPECTS

The success of the novel authentic assessment approach has encouraged and rewarded employment experience in the mechanical engineering programme. Students have sourced work in farming and food supply, local businesses, services providers, company summer placements and internships. The process has encouraged connections and strengthened links between industry and TU Dublin. The successful implementation of this *employment experience* module has been used as a reference guide to the recent introduction of employment experience in the Mechanical Engineering Honours Degree (TU822) programme.

The approach offers a template to develop work experience modules in other disciplines in engineering or in other disciplines altogether with the careful design of the learning outcomes and the process implementation. The students who completed the *employment experience module* have approved employment experience criteria incorporated into their Ordinary Degree in Mechanical Engineering, which has been approved by TU Dublin and accredited by Engineers Ireland.

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