MANAGING PROJECTS FOR SUCCESS: INTEGRATING CDIO AND MANAGEMENT SKILLS

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ABSTRACT

The school of engineering at Taylor's university (Malaysia) adopts a project-based education system where students need to be involved in a multidisciplinary group projects each semester. These projects are exhibited and judged in an end-of-semester Engineering Fair that is organised by the students' society, the Society of Engineering and Technology (SET). This paper reports on integrating the delivery and the assessment of a project management module, a design module and the organisation of the engineering fair in the attempt of providing an authentic experience to the students involved. This is achieved through getting the students registered for the "Managing Projects for Success" module in semester 4 to act as "Project Managers" to student teams registered for "Engineering Design and Communication" offered at semester 1 and for different tasks needed for the engineering fair. This is designed to provide both the senior and junior students a unique more realistic experience in both project management and design.

KEYWORDS

Project-Based Learning, project management, integrated curriculum delivery.

INTRODUCTION

The School of Engineering at Taylor's University offers three undergraduate engineering programmes, namely chemical engineering, electrical & electronic engineering and mechanical engineering. In order to address the ever increasing body of technical knowledge and personal and professional attributes expected to command and posses, the School adopts a project-based approach where each semester, students from the three disciplines are required to take a project-based module where they work in multidisciplinary teams to conceive, design, build and operate an engineering system. Besides the project-based modules, the programme structure includes other business and management related modules to ensure a well-balanced exposure. These modules are outlined in Table 1.

This paper reports on integrating the delivery and assessment of "Engineering Design and Communication" offered at semester 1, "Managing Projects for Success" offered at semester 4 and the organisation of the end of semester engineering fair. Twenty of the semester 4 students are offered the opportunity to be the project managers to the 20 students teams at semester 1 while the rest are appointed as project managers for different engineering fair tasks. The study aims at evaluating the effectiveness of this integration of delivery and assessment in improving the students learning experience.

ENGINEERING DESIGN AND COMMUNICATION

Taylor's University runs two 14-week semesters per year and Engineering Design and Communication is a three credit hour module offered to all the semester 1 engineering students. Students teams are formed randomly by the module coordinator, the only requirement is that the team should have at least 1 student of each programme, chemical, electrical & electronic and mechanical.

Table 1
Project-Based and Non-Engineering Modules Offered.

Semester	Module	Credit Hours
1	Engineering Design and Communication	3
2	Engineering Design and Ergonomics	3
3	Multidisciplinary Engineering Design	3
4	Engineering Design and Innovation Managing Projects for Success	3 3
5	Engineering Group Project1	3
6	Engineering Group Project1 Business Skills for Engineers	3 3
7,8	Final Year Project	12

Engineering Design & Communication Learning Outcomes

Upon successful completion, a student is expected to be able to

1. Explain the social, cultural, global, ethical and environmental responsibilities of a professional engineer.
2. Understand the importance of effective team working and be able to adopt team working strategies.
3. Use reverse engineering to infer how a given device works.
4. Describe the design process, including the concept of design constraints and the iterative nature of design, and recognise design in other disciplines.
5. Critique different design ideas, comparing and evaluating them.
6. Produce clear and accurate sketches and drawings (both manual and computer generated).
7. Write effective technical reports and updated logbooks.
8. Use appropriate visual communication techniques to communicate concepts and ideas.

Engineering Design & Communication Module Structure and Assessment

The centrepiece of this module is a design competition in which teams of 5 students are required to conceive, design, build and race solar model boats. The teams are required to race their boats across the lake at Taylor's University lakeside campus. An aerial view of the lake is shown in Fig. 1. The boats should fit within a box of 60cm x 60cm x 60cm dimensions and be solely operated by solar energy with zero stored energy at the beginning of the race. The cost of building each boat should not exceed RM 250. To give the students the opportunity to manage a budget, the university is providing the funds to build the boats. The students will need to maintain a basic set of account and receipts for the purpose of project closure.

Figure 1. An areal image of the university campus with the lake at the centre where the boat race venue is. (Google Maps).

ENGINEERING FAIR

Twice a year (at the end of each semester), the students' society, Society of Engineering and Technology (SET) organise an Engineering Fair where all the students are required to exhibit their project work. The organisation of the Fair is largely voluntary and seen by the students as a leadership opportunity. Managing an Engineering Fair involved the tasks listed below.

1. Opening and Closing Ceremonies
2. Engineering Fair T-Shirt Design and Production
3. Food & beverages management
4. Engineering Fair Awards
5. Layout & Logistics
6. Corporate Guest Support & Relations
7. Visitor Support & Relations
8. Marketing & Publicity
9. Documentation
10. PR & Media Relations
11. Decorations & Aesthetics
12. Fund Raising

MANAGING PROJECTS FOR SUCCESS

To provide the engineering students with a professional project management experience, all students are required to take “Managing Projects for Success”, a three credit hour offered during semester 4.

Managing Projects for Success Learning Outcomes

At the end of the semester, a successful student should be able to

1. Define what a successful project is.
2. Explain project management process groups.
3. Apply techniques to manage and balance scope, schedule, cost, resources and other aspects of a project.
4. Evaluate the success or failure of a project.

Managing Projects for Success Module Structure and Assessment

Managing Projects for Success is assessed through a final exam (40%) and coursework (60%). The students need to manage a project using the tools and techniques introduced in theory classes. The students are offered a choice of either managing a semester 1 solar boat team or work in groups of 3 to manage an Engineering Fair task. The job description of a project manager for semester 1 project is shown in Fig. 2. As the solar boat is a competition, the Project Managers need to sign a non-disclosure-agreement NDA to ensure confidentiality of the design idea.

RESULTS AND DISCUSSION

The preliminary results of the study indicate that the students taking “Managing Projects for Success” found managing a real project with a real timeline and a real project challenging yet satisfying. They also found the process to be generally very enjoyable. On average, those who managed a semester 1 team of students perceived the module to be more challenging, satisfying and enjoyable.

On the other hand, majority of the students taking “Engineering Design and Communication” found having a Project Manager to be a useful resource. They Project Managers helped not only in managing the projects but supported with the technical aspects of the projects.

Running these two modules simultaneously required continuous alignment and communication between the two module coordinators and teaching teams. It also mandated rigorous monitoring of projects’ progress and project managers and teams performance to weed any conflict as early as possible.

CONCLUSIONS

In an attempt to give engineering students registered for “Managing Projects for Success” an authentic project management experience through handling a real project with a real budget, timeline and project team, the students are assigned to projects related to run tasks associated with the engineering fair and leading junior students teams working on building solar boats. The students generally found the experience to be challenging, satisfying and enjoyable.

Project Manager Job Description

Job Title

Project Manager

Qualifications and Competencies

- Registered for Managing Projects for Success module
- Dynamic and resourceful
- Team player and results driven
- Good negotiation and communication skills

Job Description

The successful candidate will lead a team of first semester students to successfully complete their Design project. He (she) is responsible for the overall project management including initiation, planning, execution, control, and closing the project in a manner consistent with the best project management practices to ensure the achievement of the project goals and objectives. The Project Manager will report to the Module Coordinator of "ENG1513 - Engineering Design and Communication"

Main Job Tasks and Responsibilities

- Lead the initiation, planning, execution, control and closure of project
- Facilitate the definition of project scope, goals and deliverables
- Define project tasks and resource requirements
- Develop project plans
- Regularly meet project team and keep a logged record of all discussions
- Manage project budget and resources allocation
- Plan and schedule project timelines
- Track project deliverables using appropriate tools
- Motivate and support to project team
- Monitor and report on progress of the project to Module Coordinator
- Implement and manage project changes and interventions to achieve project outputs
- Evaluate project results and outcomes
- Motivate and inspire team members
- Resolve any conflict that may arise in the team

Figure 2. Project Manager's job description.

Biographical Information

Mushtak Al-Atabi is a Professor of Engineering and Dean of the School of Engineering at Taylor's University in Malaysia. He is a Fellow of the Institution of Mechanical Engineers (IMechE) in the UK. His research interests are in the areas of engineering education and thrmofluid engineering

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