

Team Project: A Method of Teaching Project Management?

S.J. Whitty¹, M. Schulz¹

¹School of Information Technology & Electrical Engineering, University of Queensland,
Brisbane, QLD, Australia

Corresponding Author:

S. Jonathan Whitty

School of Information Technology & Electrical Engineering,
University of Queensland,
Brisbane, QLD 4072, Australia.

Ph: +61 7 336-59797

Fax: +61 7 336-54999

E-Mail: jonw@itee.uq.edu.au

Web: <http://www.itee.uq.edu.au/~jonw>

Abstract

The School of Information Technology and Electrical Engineering at the University of Queensland in Australia has been evolving its approach to teaching project management to engineering students over a period of 10 years. An innovative strategy was implemented where final year students were given the opportunity to manage second and third year project teams, simulating an environment of supervision and management to transfer project management knowledge and skills. This paper discusses how these courses align together, their outcomes, lessons learned, and problems faced. Moreover, it suggests that a team project course can be regarded as a method of measuring quality in undergraduate engineering students thought their degree.

Introduction

The widespread employer appeal for graduate engineers to have more sophisticated project management (PM) abilities has brought PM into the core curricula of many undergraduate engineering degree programs. The Institute of Engineers Australia (IEAust) in its accreditation process of undergraduate degrees has been driving the teaching of PM.

One challenge facing university engineering teaching staff is that PM skills are difficult to assess, as many are put to the test in the project environment (Bobrowski and Kumar 1992).

The School of Information Technology and Electrical Engineering (ITEE) at the University of Queensland (UQ), has addressed the challenge of teaching PM by developing a new four year engineering degree with a series of compulsory project courses at its core.

Having evolved over 10 years, these project courses aim to provide students with experience of working in teams and to learn PM by immersing them in projects to produce a product. cursory glances at poor products suggest that there are deficiencies in ITEE's PM teachings however, a more rigorous investigation uncovers a deeper root cause. We argue that the team project pedagogy strengthens the curriculum by bringing to the fore its weaknesses.

This paper describes the rationale and development of a team project pedagogy to teaching PM. Further, it puts forward the case that team project is more than a collaborative learning course. We suggest that team project be regarded as a quality assurance process that can drive continuous improvement in the management and delivery of an engineering curriculum by practically assessing undergraduate knowledge throughout the degree.

Team Project Rationale

In 1994, the department of Electrical and Computer Engineering, now ITEE performed a review of subject offerings, teaching loads, and learning performance of students with a view to improve all under the endorsement of IEAust. As a consequence, the new engineering program, and in particular the second and third year team project courses as well as final year PM, were designed. The review report indicated that "While contributing to the creation of engineers who are current in specific technologies.....the real impact in engineering education will be made only by looking at the curriculum as a whole, in the context of present technological and societal needs,...".

The new curriculum included engineering courses in first year, reduced the number of compulsory subjects for greater flexibility in topic selection, and increased teamwork across the degree by placing a network of project courses at the core.

Team Project Alignment

In brief, each academic year centred on project work in the following way.

Year one

First year engineering students are introduced to teamwork and PM through an ‘introduction to professional engineering’ course which is compulsory to all engineering degree programs at UQ. Students are able to self select a project from a range of topics. ITEE facilitates one topic which usually attracts students to its degree programs. At the start of the semester students receive lectures on effective teamwork and use of basic PM tools. Students are randomly assigned to teams, and project deliverables are a feasibility report, PM documentation, and a 15 minute presentation. Student teams formally meet once a week for a three hour guidance tutorial. The deliverables contribute to their final grade that is adjusted by a peer assessment.

Years Two and Three

The second year team project 1 (TP1) and third year team project 2 (TP2) courses require multi-disciplinary teams composed of students from different engineering disciplines within ITEE: electronics, computer systems, and software engineering. Both courses provide a framework to teach PM, teamwork, communication and design by challenging teams to design and build a demonstrable product to conform to a fictional customer's requirements. The TP1 product is not overly challenging for a student with second year knowledge; TP2 the same for a student with third year knowledge. Teams are assembled according to academic ability or grade point average (GPA); the highest GPA students working together, and so on for other GPA levels. This homogeneity in grouping was deemed necessary to satisfy students' expectations and minimise free-riders.

Oakley (Oakley, Felder et al. 2004) argues that teams should comprise members of ability heterogeneity, suggesting weak or low GPA students receive mentoring or tuition from strong or high GPA students who benefit from this experience. Moreover, teams containing all low GPA students flounder aimlessly, while teams composed entirely of high GPA students adopt a divide and conquer policy, putting the product together without discussion. We strongly reject both these rationale for ability heterogeneity.

Teams were initially formed by students self-selecting team-mates which resulted in teams characterised by skill and ability homogeneity, as students formed teams with friends of the same engineering discipline and GPA. Teams were instantly disadvantaged this way when attempting to solve problems that required multi-disciplinary skills. Subsequently, teams were formed by course coordinators and characterised by skill and ability heterogeneity. However, many high GPA students grouped with low GPA students complained of being unfairly disadvantaged by being forced to work with students who had lower academic expectations. Our observations show that high GPA students feel burdened by low GPA students in ability heterogeneous teams. Moreover, low GPA students are often forced to “free-ride” because they cannot keep up. Validated by student feedback, we believe that teams characterised by skill heterogeneity and ability homogeneity works best. The former characteristic equips the team for a multi-discipline approach to problem solving, the latter satisfies academic expectations. Paradoxically, high GPA teams do not necessarily achieve a

high mark for their product; neither do they always work well as a team. Low GPA teams often achieve a high mark as they more openly share knowledge and synergise.

Year Four

During their final year, engineering students undertake their consummate PM training where they are given the responsibility to mentor and project manage a TP1 or TP2 team. This course has wide-ranging performance criteria as a method of assessment with the purpose of providing a real-world management scenario. The pedagogical approach of this new course was revolutionary for ITEE as it introduced a self-supervised, genuine team management environment in an undergraduate bachelor degree.

This PM course places students in an environment which helps develop less tangible attributes. They include team project work from a supervisory perspective, and responsibility for planning work schedules and assuring work practices within an organisation. Ultimately students adopt the role of mentor and are asked to distil their knowledge to those in TP1 and TP2.

In sum, year one exposes students to teamwork. Year two challenges students to design and build a product, possibly not using PM tools. Year three challenges them further, hoping they realise from previous experiences that PM tools could be beneficial. Year four appoints them project manager and closes the knowledge loop on TP1 and TP2 students. This was the theory of how all the years worked together. The practice of PM however, is very different.

The Practice of PM

Year One

Tutors observe that students only pay lip service to the PM process throughout the semester. Almost all do not use the project plan they created at the start of the semester. All PM tools handed in for assessment are created after the fact. Observations of team behaviour clearly demonstrate how students spend the first 6 or so weeks of a 13 week semester searching the internet for information for their project. Week 7 to 9/10 is used searching for possible complete solutions to copy, while at the same time exercising a social network built with other teams to find their solutions or information sources. The final few weeks are spent turbulently compiling, formatting, and creating documentation for submission.

Years Two and Three

Prior to 2005, all TP1 and TP2 teams were required to report on their project progress to tutors during intra-group meetings. Team representatives would bring along code or circuit designs to demonstrate, and tutors would ask probing questions about their progress and design ideas. Intra-group meetings discontinued in 2005 because there was no correlation between the progress reports and the final demonstrated product. Tutors observed that students learnt to tell elaborate stories about team and individual progress. In one example, a team member responsible for writing software code lied to their team as well as course tutors about their progress having not written a single line of code. Unfortunately the team discovered this situation after the team member concerned left the course shortly before project demonstration (demo) day. Ironically, it appeared that other team members were not willing to push to see proof of interim code because they had their own “no progress” secrets.

To combat bogus progress reporting, tutors now observe and assess a team's project meetings at regular intervals throughout the semester. The meetings are assessed on structure, synergistic behaviour, and the overall process of initiating and completing project action items. At the end of each meeting tutors provide feedback to team members on their PM processes.

Once again tutors found no correlation between the performance of the teams in their meetings and the performance of the product on project demo day. However, the ethnographic observations by the tutors have uncovered a general behaviour pattern of undergraduate project teams. In brief, TP1 and TP2 teams behave in a similar manner to those in year one by: looking for readymade solutions; developing a social network to source information and solutions from students in other teams; deluding themselves, their team members, and course tutors with regard to their knowledge, skill, abilities, and progress; and having low expectations about the quality of their work.

Year Four

From 1996 to 2000, lectures were given by invited practicing project managers and assessment took the form of a short essay on each lecture. Students produced good essays, but there was very little evidence any PM knowledge was applied to TP1 or TP2 teams.

In 2000 the content and assessment methods were redesigned. Invited lectures were discontinued and replaced with lectures early on in the semester that comprised hands-on PM tools to help teams get a good start. During the semester lectures dealt with subjects such as communication, time-management and team development. Compulsory tutorials focused on team building activities such as communication and problem solving, as well as case studies for group discussion.

Assessment was based on a student's personal journal and project file comprising minutes of project meetings chaired as part of their duties, plus progress charts and graphs. This assessment method was unsuccessful as the documents proved an unreliable source of evidence. A creative pretense of management was taking place.

To address these problems a new assessment criterion, driven by learning outcomes, was used between 2001 and 2003. These included a broad knowledge of operational management, an in-depth knowledge of PM tools and techniques, personal and interpersonal communication and team building skills. Lectures were designed around the assessment criteria, which was performance based and continuous throughout the semester. There were six areas of assessment; Scope Statement; PM Systems/Policies; Schedule; Review; Closure Report; and Demo Grade.

The first five mapped directly to the National Competency Standards for Project Management (NCSPM) Level 5 (Australian Institute of Project Management 2001). The demo grade was the mark awarded to each TP1 or TP2 team on project demo day. Allocating part of a student's mark based on the performance of their team was done as an added incentive to actively participate in the project. This was not the case. Some students complained at being disadvantaged by being assigned low GPA teams. Students argued these teams were doomed to fail and that their own mark should not be affected by the efforts of others. A flexible assessment regime was introduced in 2004 to overcome this; comprising four compulsory and four electives areas from which a student must select two. One of these electives was the

demo grade. Optional tutorials and a compulsory class test was introduced based on the course text book 'Project Management in Practice' (Mantel, Meredith et al. 2001).

In spite of the evolutionary changes made to instil and develop PM, undergraduate students do not practice them. The class test proved to be a good method for measuring PM knowledge, but students still continued to 'create' documentation rather than reflect on actual project progress, and project products are still generally poor. The team project pedagogy appears not to work – or does it?

There is no new engineering knowledge explicitly taught in team project. It is a process to reaffirm knowledge through problem based learning. Knowledge content comes from first, second, and third year subjects. We argue that team project is, per se, not to blame for poor product outcomes, and course coordinators must be aware of a deeper root cause. Many undergraduate students are simply not equipped with the necessary engineering knowledge to complete projects. Other university wide systemic issues cause this tragedy - a tragedy of the students.

The Tragedy of the Students

Hardin's (Hardin 1968) thesis 'The Tragedy of the Commons' first demonstrated the problems of managing resources held in common. The metaphor illustrates how individual farmers increase their grazing livestock because it makes economic sense, but the overall demand would eventually exceed the land's (the common resource) ability to recover. This metaphor applies to all sorts of common property resources; natural, physical, as well as social or mental constructs (Vandermeer 1996). In the context of team project, we suggest that ITEE is experiencing a tragedy of the students. To substantiate our theory it is necessary to overview the general behaviour of academics in the university environment that causes the tragedy of the students.

The academic environment

Australian universities have experienced large changes over the last 20 years, the impact of which has been extensive, with massive growth in student numbers, reduced government funding, and increased pressure for accountability in teaching and learning (Marginson and Considine 2000). There is a new approach by management in higher education characterised by performance evaluations, and explicit targets and outcomes (Parker and Gould 1999). In short, academics are being market driven (Nelson, Bailey et al. 1998).

A majority of academics in Australian universities now regard research outcomes (publications, patents, PhD's) as the prevailing criteria for promotion, while teaching and course administration is seen as an ever increasing demand (McInnis 1999).

Reframing the academic environment

An academic's reputation and driving force for their research comes from their collegial group around the world. We suggest that ITEE, and perhaps other university engineering schools, are best characterised as technology or commercial parks. Each academic considered an 'innovation' business producing research output. Commercial businesses pay rent, and so do academics. They pay 'in kind' instead of cash. An 'in kind' payment amounts to conducting teaching and service duties.

The common students

Undergraduate students are common to academics of the same school. As with each individual farmer increasing their grazing livestock for selfish benefit, so an academic will farm as much as possible of their research interests into their students through the subjects they teach, diluting the content matter taught. This behaviour is not necessarily conscious on behalf of the individual academic, but driven by an academic rewards system not within the scope of this paper. Suffice it to say that undergraduate students become overgrazed, their knowledge weakened, and their skills quantitatively unmeasured; until team project puts them to the test.

Discussion

Team project is more than a means of teaching PM; it is a curriculum quality assurance process in the delivery of an engineering degree, sampling knowledge and skill. By its implementation it has brought to the fore student behaviour and issues of curriculum regulation.

Student behaviour

When assessing a student using traditional methods there are always opportunities for them to “talk up” their ability. This is true of ITEE’s fourth year project thesis, with many topics not requiring a demonstrable product, a poster sufficing as evidence of a successful outcome. TP1 and TP2 provide no escape. On project demo day the fruits of a student’s labour sits on the laboratory table in view of student and assessor. Many students find this exposure uncomfortable. Many teams also see nothing wrong with their poor attempts as their expectations were low to begin with.

Our observations confirm that students have learnt how to fake the practice of PM from their seniors. It is this that is the content of any mentoring. It would be easy to blame students for this behaviour. However, we argue that students are driven by an educational system that exploits, leaving them bereft of knowledge and undefended as engineers in the making.

Defending engineers in the making

There are three solutions to a tragedy of the commons (Vandermeer 1996); 1) privatise the common, 2) create a social contract or agreement between individual common users, and 3) nationalize the common and appoint an ombudsman. Privatisation is not an option as students have nothing to trade. An agreement between academics also seems unworkable as it will favour the academics at the expense of the students. An ombudsman that defends the interests of the students appears a realistic option. This ombudsman, committee, or teaching peer review process, must have the power to verify published course content and assessment, and the authority to enforce and change curriculum. Only then can we assure industry of the quality of engineers we make.

Quality assurance

TP1 and TP2 will certainly continue at ITEE for two reasons. First as a quality assurance process that challenges students to apply their knowledge. Secondly, as a pedagogical framework to transmit PM content.

Team project, per se, will include its own quality cycle. This year both courses will include a proof of concept stage so that real progress can be observed and feedback given.

Concluding Remarks

Academics that are currently or planning to run team project courses must be made aware that colleagues will judge the effectiveness of these courses by the quality of the demonstrable product. Poor quality will drive team project coordinators to critically evaluate these courses, even question its validity. We argue this should never be done without a thorough investigation of what in the curriculum is truly delivered.

References:

Australian Institute of Project Management (2001). National Competency Standards For Project Management. <http://www.aipm.com.au/html/ncspm.cfm>

Bobrowski, P. M. and P. Kumar (1992). "Learning project management outside the classroom: The internship." *Project Management Journal* **23**(1): 27-31.

Hardin, G. J. (1968). "The Tragedy of the Commons." *Science* **162**(3859): 1243-1248.

Mantel, S. J., J. R. Meredith, et al. (2001). *Project management in practice*, John Wiley & Sons, Inc.

Marginson, S. and M. Considine (2000). *The Enterprise University: power, governance and reinvention in Australia*. Cambridge, Cambridge University Press.

McInnis, C. (1999). The Work Roles of Academics in Australian Universities, Australian Government: Department of Education, Training and Youth Affairs.

Nelson, I. T., J. A. Bailey, et al. (1998). "Changing accounting education with purpose: market-based strategic planning for departments of accounting." *Issues in Accounting Education* **13**(2): 301-326.

Oakley, B., R. M. Felder, et al. (2004). "Turning Student Groups into Effective Teams." *Journal of Student Centered Learning* **2**(1): 9-34.

Parker, L. and G. Gould (1999). "Changing public sector accountability: critiquing new directions,." *Accounting Forum* **23**(2): 109-135.

Vandermeer, J. (1996). "Tragedy of the Commons: The Meaning of the Metaphor." *Science & Society* **60**(3): 290-306.