Creating a Learning Environment using Game Development

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BACKGROUND

In higher education the traditional teaching methods and corresponding learning environments, although often resource efficient and still widely deployed, have a tendency to fail in enabling the authentic learning of management knowledge and skills and to develop genuine practice capability. With respect to fundamental and core skills, knowledge, and capabilities in course curricula this is often observable by academics and employers in students' inability to demonstrate and apply what has apparently been learned and assessed at an earlier level of the course or upon completion of it.

PURPOSE

Can an effective learning environment, where active learning in project management is observable, be created using a game development project?

DESIGN/METHOD

A third level core project management unit offered annually within accredited Bachelor of Engineering courses was used to develop and assess a game development enabled learning environment.
A total population of about 200 students was involved (across multiple engineering disciplines). This student population existed across two student cohorts (corresponding to two distinct modes of enrolment): campus-based (online study resources where on campus classes and seminars are available but not mandated) and cloud-based (online study resources distance where online seminars are available but not mandated).
A majority of the assessment for the unit (both formative and summative) involved the development of a board game by students working in partnerships of two. The development goal assigned to student partnerships was to design and produce a serious board game that taught and/or assessed players' knowledge and skills in fundamental project management theory and principles.
Peer learning and peer assessment were also included as techniques aimed at enhancing student engagement, active learning, and authentic achievement of learning outcomes.

RESULTS

The use of the game development project in a core undergraduate engineering project management unit was trialled in the second trimester of 2016.
This paper presents interim analysis of results, observations, and outcomes of the the game development project and corresponding summative assessment within the unit.

CONCLUSIONS

Compared to traditional and common methods of teaching management theory and assessing the corresponding learning outcomes in higher education (such as historical case study analysis, tests, examinations) the deployment of game development as an alternative for learning and assessment can create a learning environment that better enables authentic learning.
It is anticipated that management learning outcomes will be more capably demonstrated by students in subsequent stages of the undergraduate course and beyond the course in professional practice.

KEYWORDS

Project management, game development, project based learning, design based learning, peer learning, peer assessment, serious games

Introduction

In higher education and, arguably, especially for STEM undergraduate courses the teaching of management and specific management disciplines within it often defaults to the teaching and learning of 'textbook' theory with the explicit intention that students will apply it at some future time – most likely beyond the course as a graduate practising in the workplace.

Clearly this default can create a decoupling between attempts to learn management knowledge and skills and attempts to apply it leading to an increased likelihood of non-contextual shallow learning by students where the goal is not to achieve authentic learning outcomes but to achieve satisfactory short-term academic assessment outcomes.

In engineering undergraduate courses a common criticism is that the course design is overly focused on the teaching and learning of 'hard' knowledge and skills from the science and engineering bodies of knowledge and a tendency to overload the curriculum with this content, especially in the first two or three levels of engineering courses, encourages a cultural bias in students to be driven by, and focused on, the external demands of academic assessment rather than internal, i.e., self, motives and interests (Ditcher, 2001).

In engineering education the topic of curriculum design, especially with regard to establishing a suitable balance between 'hard' technically-oriented content and 'soft' management-oriented content, remains fertile and generates high interest and participation globally. A common problem affecting engineering undergraduate course design is the lack of generally accepted definitions of what knowledge, skills, and capabilities graduate engineers need to possess upon entering the profession and commencing practice. The lack of precision in definitions not only applies to specific, well established, and supposedly well-known engineering disciplines (mechanical, electrical, civil, etc.) but also to general descriptions of the engineering profession itself (Cavenett, 2014).

At face value the definitions of engineering, and of the necessary qualities and abilities of a competent engineer, show a misalignment with the curriculum content and course design of many undergraduate engineering courses. For example, the Royal Academy of Engineers in the United Kingdom specify that an engineer fulfils, or is at least capable of fulfilling, three roles (Beanland and Hadgraft, 2013):

- A specialist (possessing technical expertise)
- An integrator (operating and managing across technical and organisational boundaries)
- A change agent (providing creativity, innovation, and leadership)

Engineers Australia in describing what an engineer 'does' specifies that engineers are involved in, or are at least capable of being involved in, fourteen activities (Engineers Australia, 2011):

- Research and Development
- Market Assessment
- Design Development
- Commercial Production
- Drawing
- Specification
- Design and Manufacture
- Tendering

- Installation and Commissioning
- Maintenance and Testing
- Asset Management
- Disposal
- Technical Sales and Marketing

Engineers Australia (ibid) also makes the following statement about the typical role of an engineer in a team-based work outcomes-based work environment to ‘originate’:

> *Professional Engineers lead teams or work in them and need to be innovative and creative to develop the best possible solution. The engineer must frequently make balanced judgements between design refinement, cost, risk and environmental impact.*

In lieu of an internationally agreed definition of engineering as a profession the Washington Accord, as developed by the International Engineering Alliance provides a de facto standard for use in engineering education (Beanland and Hadgraft, 2013). The Accord defines twelve graduate attributes which have been classified by Beanland and Hadgraft (ibid) into four categories with seven attributes classified as being of non-technical knowledge, skills, and capabilities as allocated the two non-technical categories:

Technical understanding

1. Knowledge
2. Analysis

Technical engineering capabilities

3. Design
4. Investigation
5. Tool use

Community responsibilities

6. Society
7. Environment

Personal capabilities

8. Ethics
9. Individual & team member
10. Communications
11. Project management
12. Life-long learning

In the Washington Accord (IEA, 2015) the definition of the ‘Project Management and Finance’ graduate attribute is:

> *Demonstrate knowledge and understanding of engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.*

For an accredited undergraduate engineering courses, seeking to be compliant with the Washington Accord, it is this definition of project management that provides a valid starting point in assessing teaching and learning method effectiveness as measured on an outcomes achievement basis.

The Need for an Effective Learning Environment

Not atypically for the project management discipline, as indeed for most management disciplines, included in the undergraduate engineering course curricula at Deakin University the deployed teaching and learning methods tended to seek only to engage the student passively in the familiar “listen, watch, read, comprehend, and externally apply by case study analysis” modes.

Thus the learning environment for project management, a core curriculum component, was enabled through bi-weekly lecture sessions (offered for live attendance on campus and video recorded for online access), weekly seminar (tutorial) sessions (offered for live attendance on campus and for live attendance online), and online study materials. The Project Management Institute’s Guide to the Project Management Body of Knowledge book provided the textbook and the core set of project management knowledge for study.

At least fifty percent of assessment consisted of case study analysis assignments where the student was required to independently research and critically analyse major historical projects in order to demonstrate learned knowledge.

Learned skills were primarily assessed by project scheduling and financial management assignments as well as a product development project assignment utilising an online project management simulation provided by Harvard Business Publishing (HBSP). Therefore all summative assignments and hence all summative assessment involved individual and independent work by students.

Deficiencies with the learning environment provided for the core project management unit in undergraduate engineering at Deakin University were apparent and observable for some years but, especially with a project management syllabus, the constraints of an undergraduate course program, modes of enrolment to be supported, teaching resources, and the overarching boundaries of the university academic calendar and policies.

The learning environment failed to provide an effective learning experience (Litzinger et al., 2011) clearly by the absence of any meaningful experiential learning opportunity (Kolb, 2014). Enabling experiential learning, at least as directly associated with one summative assignment, had been attempted by using the online project management simulation (as provided by HBSP) in which students acted as a product development project manager within the virtual online simulation.

Used as part of a specific learning activity this type of simulation can provide significant learning benefits. However its deployment was less than ideal as used in the project management unit due to multiple constraints including the enrolment modes of students: approximately half of Deakin’s undergraduate engineering students study in ‘off-campus’ distance-education mode where they are required to attend activities on campus for only a few days during a specific week each trimester. The simulation required students to individually purchase a user license online directly from HBSP: a number of students did/do not have a suitable credit or debit card for international online transactions, and the site and its customer service are located in North America (and according time zone).

From a class administrator’s perspective, the online simulation presented significant issues as well: students needed to purchase their individual user license before they could be assigned to the simulation and once the total enrolment in the simulation exceeded one hundred students the simulation became slow and often unresponsive for administering.

For the provision of a experiential learning opportunity the online simulation was significant deficient for reasons including the inability to effectively customise the simulation scenario used, the lack of authenticity of the model in simulating a real project environment and project manager’s environment, and that the online simulation encouraged students to play it as a game (seeking higher scores for each simulation run) and hence focused on finding ways to earn game points rather than engaging in the role of the project manager to achieve the best (virtual) outcome by applying and enhancing the intended learned knowledge and skills.

The use of online simulations such as the product development project management simulation used in past years is valid as a tool in project management teaching, learning, and assessment however it has been concluded that the suitability and context is limited and requires it to be integrated with other methods, such as usage within a classroom environment for real time administrative monitoring and control as well as real time teaching and support of social learning. Attempts at its use outside a more (temporal and spatial) learning environment proved unsatisfactory for students and academics.

Knutson and Webster, in the American Management Association's Handbook of Project Management, describes the discipline of project management as (Knutson and Webster, 2014):

> *A unique branch of learning that deals with the planning, monitoring, and controlling of one-time endeavors.*

The obvious and prominent characteristics of projects are that, by definition, they are all unique and all temporary (PMI, 2016). And these characteristics present a significant challenge for project management education.

Since projects have a temporary (finite) existence then it implies that their occurrence most likely needs be controllable, or at least conveniently coincident, within any intended period of learning and assessment since the external constraints of university academic calendars on course programmes are fixed. It also implies that projects must be sufficiently unique as experienced by the learner. The need for uniqueness of projects, and hence of project experiences, further justified the need to seek experiential learning enabling methods alternative to the online simulation used.

So if not in the virtual domain then why not find and use projects in the real domain? The assessed learning outcomes for this project management unit include the need for students to be capable of initiating and managing projects through the entire project lifecycle, be capable of analysing and solving common types of project-based problems (that occur during the lifecycle), and to be capable of improving their project management capabilities through reflective learning.

Taking an outcomes-based approach to the learning environment needed for effective learning in project management it becomes clear that the following requirements need to be fulfilled:

- Experiential learning must involve at least one entire project lifecycle to enable project management knowledge and skills to be attempted and evaluated by the student in context.
- Teamwork is essential and ideally opportunities exist for leadership to be practised.
- Assessment should aim to authentically assess the learning outcomes.
- Authenticity of the project experience must exist for authentic learning of project management capabilities, e.g., genuine contextual elements of projects and project management as typically occur on 'real' projects outside the educational domain.
- In the project management discipline there exists a comprehensive, generally accepted, and commonly practised body of knowledge. As with most bodies of knowledge (e.g., scientific, engineering, medical, legal, management) there is an explicit need for deliberate inclusion of this in learning outcomes and the learning environment.

An outcomes-based approach to project management education as described here is not new or novel as described in Mengel's case study analyses of past initiatives (Mengel, 2008):

Project management education needs to apply an approach based on clearly defined, tracked, and assessed learning outcomes.

Mengel (ibid) further states:

While exposing students to real projects with the problem or project-based learning approaches is quite common this approach rarely includes teaching students the necessary project management tools, techniques, and skills.

Problem and project based learning methods aim to provide an effective learning environment by at least in part embodying Kolb's experiential learning theory (ELT). But the 'education universe' is increasingly becoming populated with a range of diverse and derived 'enabled learning' methods (some of which are intended for K-12 education rather than higher education) including CDIO, project oriented design based learning, practice based learning, inquiry based learning, industry based learning, work integrated (work based) learning, adventure based learning, action based learning, challenge based learning, scenario based learning, play based learning, case based learning, service learning, team based learning, game based learning, and digital game based learning. There is even *learning based learning* – or more correctly e-learning based learning (Ősz, 2013).

So what enabling method of learning is appropriate to project management education? From the 'universe' of enabling methods some are able to be readily eliminated for use with adult learning in higher education, e.g., play based learning (intended for child learning) and case based learning (case analysis lacking learner immersion).

Project oriented design based learning (PODBL) claims to integrate project based learning with industry based learning and 'integrative learning' (Littlefair and Stojcevski, 2012) but it appears in its deployment (Chandrasekaran, Littlefair, and Stojcevski, 2015) to date to be essentially design based learning especially as the projects used in the method tend to be well-defined and constrained group-based design projects design objectives and deliverables for assessment primarily consisting of design and design-related documentation.

The project based element of PODBL is embodied in the overarching management of the group resourced design project – something that is typical to a design process (to be managed as a design project) and hence common to most forms of design based learning. To test this hypothesis (that POBDL is essentially a form of design based learning) an 'opposite' method can be considered for feasibility – this opposite method being project oriented non-design based learning. The elimination of the design basis from the method removes essential elements and structure leaving it incomplete and unable to be deployed.

Design based learning involves learners collaborating in groups to achieve a specific goal (e.g., a design goal) or solve a problem using a design process and design principles and methods. Ideally, design based learning should require the learner to engage in design thinking and to work through a design process from concept development at least until an artefact is produced that can be evaluated against the goal. This would enable the learner not only to experience the process of design but also to reflect on the evaluated outcome of the process and of the process effectiveness as managed and executed by the group and experienced by the self.

Problem based learning seeks to enable effective learning through the development of a solution to a particular problem. To be inclusive of the learner in this definition Boud explicitly includes a need for motivation of the learner to engage in this method of learning by stating (Boud, 1985):

… the starting point for learning should be a problem, a query or a puzzle that the learner wishes to solve.

In the broadest sense, problem based learning can be inclusive of design based learning if the 'problem' is a design problem (or goal) to be solved (Dym, Agogino, Eris, Frey, and Leifer, 2005).

For project management education from this it can be assumed that project based learning (and possibly within that, design based learning) offers a method of enabling a suitable learning environment. But is this assumption true? In order to determine this further examination of ELT is justified. Although widely embodied and deployed in various 'based learning' methods, Kolb's ELT has also been the target of significant criticism. A common criticism of ELT is that is overly simple and unable to account for various learning styles (Jarvis, 2012).

However critics of ELT also point to flaws in traditional learning methods best summarised by Jarvis (ibid), "*Theory is learned in the classroom …. applied in the workforce*."

The obvious and significant flaw with learning methods relying on this assumption is that the theory will be retained by the learner until it can be applied in the workforce. Therefore it assumes capability will be attained by the learner through a decoupled process of classroom learning and workforce application and as such, presents itself as an undesirable open loop learning process.

With direct, but not intentional, relevance to project management education, Jarvis (ibid) considers where effective learning can occur with regard to environment and context:

> *Much professional practice lies at the interface of theory and practice, where the worker brings knowledge and skills to the situation and is frequently forced to think and learn in a unique situation. In such instances, new knowledge or attitudes may be created, even though it is often unrecognised.*

In stating this, Jarvis declares that learning through practice may involve changes in the learner's attitudes, i.e., behavioural change of the learner. This is especially relevant to project management education as the importance of social interaction in the project management discipline is gaining increased attention. Some researchers of the praxis of project management propose that the discipline as observed in 'project actuality' exists as a 'social conduct' involving complex social processes that occur at various levels of projects (Cicmil, Williams, Thomas, and Hodgson, 2006).

The social elements of project management and also the social elements of effective learning are directly considered with regard to Kolb's ELT and its inadequacies (Berggren and Söderlund, 2008):

> *… the theory has received a lot of criticism, for instance because of the tendency to 'decontextualize' the learning process and that the theory fails "to adequately account for the relationship between social and personal learning".*

Kayes is one who is critical of ELT for this decontextualization problem (Kayes, 2002):

> *… it decontextualizes the learning process and provides only a limited amount of the many factors that influence learning … an emphasis on individual experience comes at the expense of psychodynamic, social, and institutional aspects of learning.*

If the premise that project management discipline exists in project actuality as a social conduct is at least partially accepted and that effective learning should seek to involve psychodynamic, social, and institutional aspects then it follows that the development of learner's cognitive abilities relevant to project management also be considered.

Hartman proposes management education explicitly acknowledge human cognition as embodied in the left/right side of the brain model (Hartman, 2008). Accordingly he identifies the left side of the brain to the centre of logical and sequential thought, for detail, and analytical skills whereas the right side of the brain is the centre of contextual comprehension, to see and identify problems, and of intuition.

Hartman (ibid) considers virtually all of the project management body of knowledge, specifically as defined by PMI's Guide to the Project Management Body of knowledge, to be predominately left brain hemisphere-oriented thinking. Accordingly Hartman's hypothesis states:

… these structural and rational components of the thinking process are not enough to achieve excellence in project management or leadership management.

So for project management education, the development of an effective learning environment that involves both hemispheres of the brain to enable the development and/or advancement of requisite cognitive abilities in the learner is possible by use of a learning methodology that enables learning of knowledge and skills coupled with a contextually appropriate experiential environment (Hartman, 2008; Kayes, 2002; Mengel, 2008).

A Development Enabled Learning Environment

As applied within engineering and engineering-related initiatives, the project management discipline is commonly employed for development projects. When considering the multiple engineering disciplines (mechanical, electrical, civil, etc.) the existence and occurrence of development projects on an intra- and inter- disciplinary basis remains valid.

To provide the experiential elements of the project management learning environment to be trialled in the core project management unit within undergraduate engineering courses at Deakin University during trimester 2 in 2016 a major development project was included. Specifically a product development project was included so as to require students to develop a product according to the definition of being 'something sold by an enterprise to its customers' and product development according to the definition of being 'the set of activities beginning with the perception of a market opportunity and ending in the production, sale, and delivery of a product' (Ulrich and Eppinger, 2016).

Students were formed into two person partnerships at the beginning of the trimester and for the duration of the development project which occurred for the first half of the trimester. By requiring students to work in a small group with only one other student the intent was to encourage a close and intensive working environment within partnerships and to enable all students to experience project-related teamwork and leadership (specifically co-leadership) duties and responsibilities. The use of two person partnerships in project management and leadership undergraduate education is not new or novel, for example it has been employed by Renaissance College since 2005 for a (project management) leadership in theory and practice course (Mengel, 2008).

Partnerships were given a simple design brief for the development project: develop a board game that will assist players in learning and assessing their skills and knowledge in fundamental project management theory and practice (as described in Chapters 1 to 3 of the PMI's Guide to the Project Management Body of Knowledge, 5th Edition). The project goal was for partnerships to develop a project management board game that was engaging, entertaining, educational, informative, challenging, and rewarding to players.

The major deliverable for the project was specified as a fully functional and complete board game to be provided and demonstrated during the seventh week of trimester during a dedicated 'demonstration day' involving the entire class (consisting of over 80 partnerships and nearly 200 students). The end of the demonstration day, with all games produced, demonstrated, and assessed brought the closure of the project.

A board game development project was selected for the experiential learning component of the unit's learning environment for the following reasons:

1. Board games are familiar to most people, regardless of cultural and socioeconomic background.
2. Popular board games are easily obtainable from second-hand stores inexpensively for the purposes of product research and for obtaining materials and parts for production of the partnership's designed game. Popular board games range in style and complexity and therefore a spectrum of game design possibilities exists for students to evaluate and seek inspiration from.

3. Explicit inclusion of partial learning outcomes (of project management theory) could be included into the development project, i.e., students were required to learn the specified fundamental project management theory in order to incorporate it into the developed board game product.
4. The development project required partnerships to be effective in design thinking while minimising the need for systems engineering and technical detailed design.
5. A fully functional artefact could be developed by students so that learning outcomes related to the project could be more effectively assessed both on an academic and peer basis.
6. The target customer for the game was the student themselves and all other students in the unit. Therefore any empathy in design could be readily achieved through personal evaluation and peer (social) interaction and discussion.
7. The project was scalable to be used with a large class of almost 200 students and (initially) almost 100 partnerships. The major deliverable (board game) was suitable for simultaneous demonstration and evaluation by the entire student cohort collectively at the same place and time due to its compact form and attributes.
8. If a partnership was successful in achieving the development project goal then it would be relatively obvious to most students by evaluating their delivered artefact (fully functional board game) and from feedback from other members of the target customer cohort (peer students also having undertaken the project).
9. Collaboration across partnerships could be encouraged and facilitated in order to encourage social interaction during the experiential learning element as there exists no uniquely 'most correct' solution for this project goal rather there exists an opportunity for many unique yet equally correct solutions.
10. The board game development project provided a deliberately ill-defined boundary on the depth and complexity permissible in the development work by students (other than as minimally needed to comply with the project goal). Therefore it accommodated highly engaged students who might seek to employ their personal advanced technical design and production capabilities to determine what they could achieve.

In combination with the development project, conventional teaching methods were also employed: online study materials, online discussion boards, lectures, and seminars were provided. Project management theory to be included in the board game was covered during the first two weeks of trimester. During the project, seminars were provided on a 'flipped' basis so that students could seek advice and opinion on various aspects of the development project from academic staff as well as peer students. Representative samples of popular board games were also made available during campus-based seminars to enable students to play them and evaluate them.

From the beginning of trimester students were informed, and regularly reminded, of how the development project would be assessed and the key dates for the project. Overall the development project accounted for fifty percent of a student's individual assessment consisting of a project charter to be developed by each partnership and submitted at the end of the third week.

During the seventh week of trimester a 'demonstration day' was held on campus to which all partnerships (and hence all students) were required to attend and participate by demonstrating their board game (and having it assessed by academic staff) and by reviewing and assessing other partnerships board games. To facilitate and encourage student participation in the peer review and assessment task a simple and easy to use online form was developed and provided for students to use on their smartphones within a web browser.

As well as awards for the best three games, as determined by the academic staff, a ‘player’s choice award was also provided with the winning partnership determined by peer student voting (using the online form). A key principle of the assessment by academic and peers on demonstration was that the delivered and demonstrated board game product, as it existed on that day, was assessed. This principle sought to explicitly emphasize the need by partnerships to deliver a developed artefact (functional and complete board game) compliant with the project goal and all associated specified constraints and requirements.

The third assessment task for the development project required students to individually reflect on the development project and submit a project debrief report. Ideally the project debriefing exercise would seek to be formative as well summative but logistical constraints for the unit required a sub-optimal alternative of student’s individually preparing and submitting a debrief report.

During the second half of the trimester, with the development project completed, the learning environment was absent of experiential learning elements and consisted of the online study materials, bi-weekly lectures, and weekly seminars. The remaining fifty percent of assessment within the unit consisted of individually assessed project scheduling and financial management assignments and a case study analysis assignment.

Interim Results and Observations

From the first week of the trimester and of the development project it was observed that some student partnerships were highly engaged. For example one partnership produced an early proof-of-concept prototype of their game board in a seminar session during the second week.

On demonstration day there was 100% active participation by all partnerships as existed within the unit at that time. This was observed as 93 partnerships delivering 93 functional board game products for demonstration and assessment by academic staff and peer students. There were no requests from any partnership for an extension of time to complete and deliver their development project artefact (functional and complete board game) and attendance remained high throughout the day until the end of the final session (the awards session). And of 93 partnerships only 5 were determined by the academic team to have failed to achieve the assessed learning outcomes for the project.

Pride of workmanship was evident in a significant number of board games both in the depth and effectiveness of design thinking and in the quality of the production exhibited by the board game artefacts. Some outstanding examples were produced by partnerships where the design and quality of the produced board game (including all parts, components, and packaging) was indistinguishable from professionally developed mass produced retail board game products.

Participation in the peer review and assessment task, offered on an entirely voluntary basis, exceeded expectations with over 1250 individual responses recorded during the day from the almost 200 students attending and participating. Student responses were recorded anonymously and individual comments were collated and provided to each partnership within two weeks after the event.

Direct access to the peer review feedback was not provided for students during or immediately after the demonstration event due to concerns of inappropriate comments given they were submitted and stored on an anonymous basis. However no moderation of comments was necessary as no abuse of the process by any student occurred and where provided most comments were honest and genuine in reflecting the individual students’ assessment of their peers’ work.

Post development project (post experiential learning element) the unit retained, compared to previous years, a higher attendance rate to lectures even though attendance is not mandated but optional for all students since all study materials are provided online and all lectures are recorded and recordings made available online to all students.

Also the participation rate in the last fifty percent of assessment tasks remained consistently high and higher than in past years where a reasonably significant proportion of students would seek to engage with the learning and assessment on a minimum level to just earn a passing grade but no more.

At the time of writing this paper it is not possible to complete a full analysis of learning outcomes for students who undertook this unit in 2016. This remains a task to be undertaken once all summative assessment has been completed and collated for the unit.

How and when to review the participant students' management learning outcomes assessed in this unit within the development enabled learning environment trialled this year remains an area of further research. In particular it would be of relevance and interest to determine if the developed or enhanced knowledge, skills, and capabilities as assessed within this unit are observed to be retained and transfer to subsequent units, such as the level 4 capstone design project, within the course and to be retained and transfer beyond the course into graduate professional practice.

Conclusion

The inclusion of an experiential learning element to facilitate an effective learning environment for project management education in undergraduate engineering courses appears to have been successful.

However this conclusion is preliminary and remains to be fully justified subsequent to completion of analyses of assessed student learning outcomes within the unit and research to evaluate if transfer occurs into subsequent units of the course and beyond the course into graduate professional practice

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