Assessment strategy for virtual teams undertaking the EWB Challenge.

Lyn Brodie
University of Southern Queensland, Toowoomba, Australia
brodie@usq.edu.au

***Abstract**: The Engineers without Borders (EWB) Challenge has been incorporated into a core first year course in the Faculty of Engineering and Surveying at University of Southern Queensland. This paper examines an assessment strategy which supports developing a team and problem solving process as well as the final outcome for the team. The assessment strategy aims to encourage teams and individual students to develop practices and strategies which can be used in other projects and problem solving situations as well as producing this one team report in one course. The team and problem solving process is critical as the majority of our teams work as virtual teams having no face to face contact with either other team members or facilitator. Significant emphasis is placed on developing strategies for virtual team work and encouraging individual student learning in line with individual learning goals set with consideration of prior knowledge and experience.*

Introduction

Students are largely assessment focused. Their work and subsequent learning is determined by what is assessed and what weighting is placed on the assessment piece. Academics subscribe to this practice with a philosophy of "if you want students to learn it, assess it". This may have resulted in over assessment and learning *for* assessment.

In team based projects this is particularly true. Practically students will quickly devise who has particular skills and knowledge, work ethic and motivation and use these characteristics accordingly. The result can be a report of a professional standard, but can we be sure that students have learnt any new skills and knowledge or taken on new roles outside their normal comfort zone? The addition of a reflective component to the assessment scheme can ask students to think about and document this area, but sharing of skills and knowledge particularly in a diverse student cohort needs to be explicit to engage the students in peer assisted learning and the gaining of new knowledge and skills.

The assessment strategy discussed in this paper specifically rewards students for mentoring and proactively addressing team problems. This ensures students gain transferable skills and knowledge beyond producing one technical report.

Background

In 2001 the Faculty of Engineering and Surveying introduced a strand of 4 courses using a Problem Based Learning (PBL) paradigm (Brodie 2007). The first of these courses ENG1101 Engineering Problem Solving 1 is a core course for all students in the Faculty. It covers all programs and majors. This includes the 2 year Associate Degree, 3 year Bachelor of Technology, 4 year Bachelor of Engineering or Surveying and the 5 year double degree programs. There are 9 majors included in these programs giving a very diverse student cohort.

The diversity extends to age, prior education and work experience. Often mature aged students have significant engineering or technical work experience. This is balanced by the younger students having more experience and up to date knowledge on 'technology', mathematics and physics. Combining these students in teams and encouraging mentoring and peer assistance through assessment strategies provides a unique learning environment (Brodie 2006).

The majority (~75%) of our students study via distance education (University of Southern Queensland, 2007) with students dispersed across Australia and the world. Therefore teams are virtual teams with members separated by distance and often time, communicating solely via electronic means. Our early experience of using PBL in a virtual mode showed that teams focused on producing the report or solution and not necessarily on learning new knowledge and tasks. This was largely assisted by the team diversity. Teams quickly divided up tasks according to areas of expertise and members rarely took on new tasks. For example the student who worked as a project manager, took that task; the student who enjoyed math took those tasks etc. This often produces a good product or outcome but students often did not learn new knowledge or step into new roles within a team setting.

To encourage learning rather than the practicing of existing skills a number of changes to the course and assessment schemes were made. Firstly setting individual learning goals based on prior knowledge and skills was established and then mentoring and peer assistance to meet these goals became part of the assessment criteria.

The move to incorporate the Engineers without Borders Challenge into the course required only minor further changes. ENG1101 had largely been problem based, although with elements of project based learning. The Challenge tipped the balance to project based learning, but in an engineering education context the line between project and problem based learning is not as clearly defined as in other disciplines (Brodie, submitted).

The two main distinctions between project and problem based learning is that in problem-based learning the overall goals and the problems are set by the teachers and project-centred learning requires students to set their own learning objectives and decide on their own learning strategies. In addition project based learning has a goal of producing a product or artefact. Problems will be encountered which adds to the learning, but these problems may or may not be solved. Projects reflect real-world practices and the *process* of producing the product is as valuable as the end result itself (Cavanaugh, 2004).

Engineers without Borders

Engineers without Borders (EWB) is a volunteer organisation that, "*works with disadvantaged communities to improve their quality of life through education and the implementation of sustainable engineering projects*" (EWB, 2006). The EWB challenge is a national competition for first-year university students designed to motivate first year engineering students by engaging them in real-life sustainable development projects. The competition aims to develop students' learning experiences and key attributes "*through a team-based design approach utilising inspirational sustainable development projects*" (Bullen, Webb, & Brodie, 2007).

EWB worked closely with Australasian Association of Engineering Educators (AaeE) and the Australian Council of Engineering Deans (ACED) to ensure that the Challenge supported the core curriculum for an ideal first year engineering experience including the following (Bullen et al., 2007):

- Introduction to the engineering design process;
- Developing communication skills;
- Introduction to teams, teamwork and team dynamics;
- Hands-on design project, including reverse engineering;

In 2008, 25 universities and over 6000 first year students across Australia and New Zealand are participating in the EWB Challenge (Tran, 2008). Whilst the Challenge offers many advantages for both institutions and students such as assessment of design capability of each team and reflective learning opportunities, disadvantages have also been acknowledged.

Disadvantages include focusing on technical aspects of the design and inherently on the final output of the team. In addition different assessment strategies, course requirements and resources and assistance provided to teams between universities need to be acknowledged.

Under the EWB guidelines the methodology of assessment as part of university curricula remains with the home institution. Universities have the flexibility to develop assessment criteria and strategies which reflect the effort (workload) and learning objectives of the course into which the Challenge fits.

USQ Learning Objectives and Assessment

The course objectives of ENG1101 includes learning and applying basic engineering science (math, physics and statistics) but it also has a large emphasis on the often down played skills of teamwork, communication (formal and informal), problem solving and reflective practice. Assessment criteria used to provide an individual student grade of the work for the Challenge must reflect these *process* skills and not just the final report for submission to EWB.

The assessment for ENG1101 is broken up into 3 team reports (15%, 25% and 25%) and three individual portfolios (10%, 15%, 10%). Team results are adjusted by peer and self assessment to give students individual marks based on contribution to the project goals. To pass students must adequately contribute to all three team reports, but the individual submissions of portfolios are not compulsory. The portfolios include tasks such as setting and planning individual learning goals based on prior educational and work experiences, individual reflections and set learning tasks.

The team reports focus, not only on producing a well written and structured formal report detailing a technical solution to appropriate standards but also document mentoring of team members to help meet individual learning goals, critiquing (not just proof reading), and reflection on the team process. If a team has had teamwork, conflict or communication issues, provided these problems have been acknowledged, analysed and an improvement strategy implemented a good grade can still be achieved. This encourages teams to face problems and work on team and communication skills as well as the technical aspects.

Team Report 1

Team Report 1 aims to set the foundation of the subsequent team work, which is done by the majority of students in a virtual or electronic mode. Virtual teamwork is unfamiliar to most students and therefore new skills and communication protocols need to be recognised and established. This foundation is also the basis of subsequent problem solving courses in the strand. A summary of the requirements for Report 1 and edited guidelines is shown in Table 1.

Table 1 Requirements for Team Report 1 (modified from Brodie, 2008)

Part A	Team Code of Conduct, Roles and Responsibilities	A workable and comprehensive Code of Conduct and Cooperation. This should include roles and responsibilities of team members and evidence that the team has give due thought to the *process* of team projects e.g. assessment of *positive* contribution, *active* role, and *fair share*. *Has your team discussed these aspects of team work?*
Part B	Team Meeting Strategy	A workable and comprehensive meeting *strategy*. This should include methods of communication and reference to organising and running meetings in the medium you plan to use e.g. if you are going to use chat facilities can all members access and use the software; how will you ensure all members have the opportunity to contribute even if their keyboard skills are weak? How will you keep your facilitator informed of progress or problems? What is different about *virtual* or electronic meetings?
Part C	Peer Assessment Strategy	Comprehensive peer and self assessment strategy to determine individual allocation of marks from the team project. Should be done in conjunction with the Code of Conduct.
Part D	Project Choice and mentoring plan	Project choice (from the EWB list of topics), rationale for this choice, strategy for mentoring and plan for *demonstration* of individual and team learning goals.

Team Report 2

Details of the assessment are shown in Table 2. The stated goals for Team Report 2 are:

- Complete the outline of the final report structure i.e. major headings (including a numbering system) and contents page (to be updated as report progresses)
- Complete a Project Management Plan, and the Introduction and Objectives sections for your report
- Significant progress on ideas for solutions and supporting your report with appropriate literature
- Reflection and evaluation of your team to date

In Semester 1 (2008) offer of the course a pro forma for a formal technical report was given to the students. For Report 2 they were asked to complete the Introduction and Objectives sections. These were the only sections formally assessed at this time. Teams were encouraged to complete other sections e.g. alternative solutions etc in draft form for feedback. However less than 10% of teams made any significant progress on the remainder of the report and timelines and workload for report 3 were therefore high.

In addition several problems were observed:

- Alternative solutions were poorly done and there was little variety in the ideas proposed.
- Evaluation strategies were not researched and this section was also poor. Further resources and guidance on this section are required in future.

It seemed most teams focused on only one solution and then 'back engineered' both alternative solutions and the evaluation strategies usually with little reference to either the objectives or the socio/cultural background of the project.

For the current semester of offer (S2 2008) Alternative Solutions and Evaluation Strategy section have been moved forward to Report 2 as shown. Hopefully this will encourage more a holistic and planned approach to the report solutions.

Table 2 Assessment criteria for Team Report 2 (modified from Brodie 2008)

Criteria	**Percentage**
Team Refection and evaluation • Problem solving *strategy* • Management plan • *Evidence* of mentoring and skill sharing to meet individual and team learning goals • Review and analysis of code of conduct • Demonstrate an understanding of team dynamics, use of COC when problems arise • Analysis and critique of performance with a view for improvement	50%
Technical Report • Presentation and language • Appropriate style, professional standard	10%
Introduction • Appropriate socio/cultural aspects addressed • Problem definition • Backed by appropriate literature	10%
Objectives • Appropriate level of technical detail; quantify and qualify as required • Clearly stated assumptions and justifications	10%
Alternative solutions • Quantity, quality, variety and detail of proposed design solutions to the problem	10%
Evaluation strategy • Effective strategy to evaluate all proposals to determine best solution	10%

Team Report 3

The goals for Team Report 3 are:

- Complete the report as per the structure from Report 2. Use the correct numbering system, contents page and appendices as required
- Prepare a PowerPoint presentation to support your report.
- Comment on your project management plan
- Evaluation of your team effort and outcomes

Table 3 Assessment criteria for Team Report 3 (modified from Brodie 2008)

Criteria	Percentage
Completed Report • Accuracy and clarity • Depth and scope • Conclusions and recommendations • Graphs, diagrams and graphics • Structure and presentation • (Introduction and Objects are not reassessed but they may be altered or corrected from the first submission)	70%
PowerPoint • Clearly identified audience • Content appropriate to audience • Graphics • Speakers notes for presentation	10%
Team Reflection and Evaluation • Includes review of project management plan • Topics similar to those listed in Report 2 for team evaluation	20%

Marking Rubrics

All marking and feedback is completed electronically. Comprehensive marking rubrics for all team and individual reports have been developed. They are generic and one scheme can be applied to all teams regardless of design topic addressed. This generic design allows the release of marking criteria and helps direct the teams though key learning objectives e.g. referencing, literature reviews etc. Rubrics are divided into 5 levels of achievement and consistent wording applies to each area. A range of marks for each section are calculated automatically and percentages and total marks can easily be modified to suit weightings.

Electronic rubrics have provided:

- Consistency between markers and positive feedback from facilitators and students
- Ease of comprehensive feedback to individuals and virtual teams via the Learning Management System (LMS – USQ currently uses Moodle)
- Guidance to students on learning objectives to be clearly addressed.

Conclusions

The assessment scheme addressed in this paper offers clear incentives to students to meet the learning objectives of the course and not just produce a technical report. Integration of individual portfolio and allocated EWB project tasks encourage and rewarded students for taking on unfamiliar roles and tasks, for mentoring, for demonstration of learning goals and for setting in place problem solving, communication and team work strategies. They are not overtly penalised for team problems but are encouraged to openly and honestly address these issues, thereby learning new skills which will last a

lifetime. Students are not focused entirely on the technical concepts of the project but learn and practice a wide range of other graduate attributes. These 'soft' skills of virtual teamwork and electronic communication are becoming increasingly important in a global economy. Whilst many universities are still incorporating them into a traditional curriculum with face to face teamwork USQ has moved to further enhance graduate attributes by embracing electronic communication technologies and their application to engineering teams.

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