Building on strength, understanding weakness: realistic evaluation and program review.

Lesley Jolly
University of Queensland, Brisbane, Australia
ljolly@bigpond.net.au

Caroline Crosthwaite
University of Queensland, Brisbane, Australia
c.crosthwaite@uq.edu.au

Lizzie Brown
Engineers Without Borders, Brisbane, Australia
l.brown@ewb.org.au

Abstract*: The implementation of the EWB Challenge as a part of a compulsory first year subject for a large cohort of engineering students at the University of Queensland has had a mixed response from both students and staff. In evaluating "what worked for whom under what circumstances" we have begun to disentangle the ways in which disparate factors interacted to produce the observed responses. This will allow us to articulate a theoretical model to explain the mechanisms leading to those outcomes and to demonstrate how much could be attributed to the Challenge and how much to other factors. This paper describes this realist approach to evaluation and offers a model for the evaluation of innovations that goes well beyond whether the students liked it or not.*

Introduction

The EWB Challenge is a national design program targeting first-year university students and delivered in partnership with Australasian engineering schools. At UQ the EWB Challenge is used to scaffold the teaching, learning and assessment activities in the compulsory first year course ENGG1000 *Introduction to Professional Engineering.* It provides students with hands-on exposure to the nature, scope, demands, responsibilities and impact of professional engineering work. UQ students work on the EWB Challenge in small teams of 5 on an 11 week project addressing real needs and work being supported in selected communities in developing countries by EWB and their partner organisations. Students investigate and recommend appropriate technologies and designs taking into account the selected community's social, cultural, environmental and economic context. The fact that the client location is a developing country, with which the vast majority of students are unfamiliar, brings a valuable, and often elusive, international dimension to the curriculum. EWB's Challenge actively engages students in real, collaborative, project work. Their engagement in authentic team-based engineering and design work promotes the development of professional skills, identity and responsibility by exposing first year students to bona fide project work with international, social, cross cultural and sustainability dimensions. It is one of very few opportunities to practise engineering and make 'hard decisions' in what is conventionally a science and mathematics dominated first year.

The most highly cited factors influencing students' choice of engineering are their interests in problem solving, design, creativity, invention, and applying skills in a hands-on practical way (DEEWR 2008: 19). It is also widely accepted that students learn best from active learning approaches including project centered learning where they are learning through doing, experiencing or being involved and engaged in collaborative learning environments (DEEWR 2008:12). Principles of good pedagogic practice in undergraduate education e.g. cooperative learning, frequent faculty staff interaction, communication of high expectations (Chickering and Gamson 1987:3-7) and the benefits of engaging students in authentic learning experiences are also well known (Lebow and Wager 1994) and the use of the Challenge projects can be argued to provide such learning experiences (Crosthwaite et al. 2009). And yet despite many positive responses from students when asked about the Challenge projects, they had many harsh things to say about the course as a whole, usually related to a lack of integration between the projects and the lectures and other assessment. This raised the question whether the minority of students who responded badly to the projects were actually reflecting a problem with the projects or whether they were generalizing dissatisfaction with one part of the course onto the projects. Staff too had mixed responses. We therefore set out to discover "what works for whom under what circumstance" (Pawson and Tilley 1997) in the tradition of realist evaluation.

Realistic evaluation

Courses such as this are not monolithic "doses" of education but have many different aspects including content, organisation and staff, some of which might work better than others. Nor does any course operate in a vacuum. Students are doing much more than just their project work during the semester and there might be many possible causes for any given outcome. In addition there is commonly a range of responses to any innovation in the student body. This creates a problem for staff who want to build on the perceived benefits of an innovation such as the EWB Challenge, since it is not clear what outcomes can be attributed to what mechanisms under what circumstances. For instance, the experiential learning attributed to work on real life projects such as this can be more assumed than proven. Our preliminary observations suggest that much of the project work is in fact done individually and co-ordinated through team meetings. Future curriculum renewal based on an assumption about the success of the teamwork approach used here may fail if it turns out that it was not teamwork *per se* that worked well here. We therefore needed an evaluation that could factor out the separate influences of context (C), the various mechanisms (M) at work, such as organised teams, conceptual frameworks or EWB support materials, and a range of outcomes (O), not just the successful ones. Realist or realistic evaluation gave us such a tool.

This approach derives from realist philosophy which emphasises the embededness of human action in layers of reality, as when we think of courses acting in a semester full of other courses, extra curricular activities and paid work, over a mechanistic cause and effect view of courses as analogous to a dose of medicine with invariable predictable results. Within such a framework mechanisms cannot be thought of as the interaction of variables but must take the form of propositions about how both micro and macro processes constitute the intervention (program, course) and produce the observed outcomes. For Pawson and Tilley (1997: 66) this will involve "people's choices and the capacities they derive from group membership" and other social processes. Choices and capacities are both contingent on the contexts in which they are triggered. Pawson and Tilley (1997: 71) sum up the task of realist research thus:

> *The basic task of social inquiry is to explain interesting, puzzling, socially significant regularities (R). Explanation takes the form of positing some underlying mechanism (M), which generates the regularity and thus consists of propositions about how the interplay between structure and agency has constituted the regularity. Within realist investigation there is also investigation of how the workings of such mechanisms are contingent and conditional, and thus only fired in particular, local, historical or institutional contexts (C).*

To understand how this works in course or program evaluation we can consider the case of our students doing teamwork on sustainable development projects. It is commonplace when introducing a non-technical skill such as teamwork into the curriculum for there to be not much more than exposure as the mechanism for students to acquire the skill. That is they are expected to learn how to work in teams by working in teams without much in the way of scaffolding to support the learning. (This is not the case in the course under discussion which puts a lot of effort into developing teams, but readers will be familiar with the phenomenon.)This applies to many other skills as well, such as in this case the adoption of sustainability values, and clearly works well enough for some students. However, in a realist framework we want to understand why it sometimes works and why it sometimes doesn't. The following list of possible mechanisms is by no means exhaustive but is meant to illustrate realist thinking.

Team outcomes

- *The "in at the deep end" mechanism*. Students forced to work in groups may decide that they need to make the teamwork successful to get the outcome they want and they therefore quickly develop teamwork strategies or research them.
- *The mutual dependence mechanism*. Students forced to work in groups learn to depend on the pre-existing skills of their teammates and the team gets a result because between them they add up to one competent worker.
- *The rugged individualist mechanism*. Students forced to work in teams may not find ways to make the teams work but may battle on singlehandedly to produce a result that looks like the product of a team but isn't.

Sustainability outcomes

- *The heartstrings mechanism*. By sympathetically depicting the plight of underdeveloped communities in the third world students will come to care for sustainability issues.
- *The "change the world" mechanism*. By appealing to engineers' ability to improve the world students will become committed to sustainability.
- *The inter-connectedness mechanism*. By depicting the needs of underdeveloped communities in their full social, cultural and environmental complexity students will appreciate the systems basis of sustainability.

Clearly more than one mechanism may operate at the same time and if space permitted we could continue with this list and go through a similar exercise for the various contexts in which such mechanisms operate. Typical contexts might include the *cohort context* where the size of the cohort and the fact that this is their first semester at university may increase the effectiveness of the mutual dependence mechanism, but not for rugged individualists, and the *preconceptions context* where ideas about the ways in which engineering goes about its business may enhance the change the world mechanism. The point here is that by spelling out the mechanisms and contexts in this way we can formulate testable hypotheses about not only what works and what doesn't but why. The range of evidence that would do so might include longitudinal data about how students perform in subsequent teamwork situations and comparative data on the size of cohort and the success of teamwork strategies but such approaches have been outside the scope of this project and we have concentrated on understanding what the staff and students can tell us about what works for them under what circumstances.

Methodology

The data gathering has included document analysis, interviews, focus groups, surveys and observations as detailed in table 1.

Table 1: range of data gathering techniques

Method	Example	Questions
Documentary analysis	Course documents and policies	What were the primary goals and assumptions in planning the course?
	students' online journals x 791	What were their motivations and preconceptions?
Interviews	11 staff teaching in the course	How do they understand the way the course works?
Focus groups	9 hrs with students 2008 cohort	How do they understand the way the course works?
Surveys	formal course evaluations x 653	How coherent was the course, what were personal learning outcomes?
	online surveys x 348	What were major strengths and challenges of the course?
Observations	Lectures (11hrs)	How did lectures work within a range of mechanisms?
	Project groups (6hrs)	How did project groups work within a range of mechanisms?

In carrying out these investigations we remained true to the realist framework which recognises that embededness implies the need for multiple types of data and sees interview situations as occasions for the interviewer to refine their theory of the contexts, mechanisms and outcomes which explains how things work. Interviews therefore function to establish a common understanding of the target experiences between interviewer and interviewee, and to clarify concepts (Pawson and Tilley 1997).

Findings

Space does not permit discussion of all of the findings to date so we will concentrate here on the issues of teamwork, which appears to be a strength of the course, and the adoption of sustainability principles, which seems to be a weakness.

Teamwork

All of the data revealed that the teamwork component of the course was very important to students:

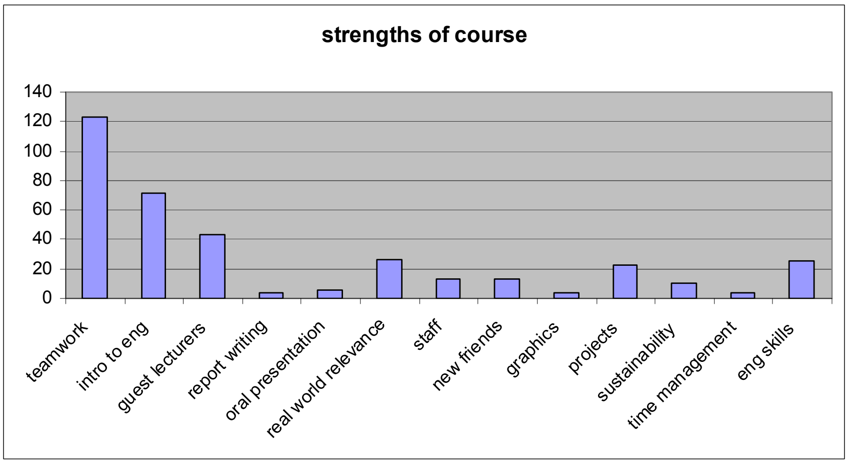

Figure 1: strengths of course as identified by students in open-ended questions (N=653)

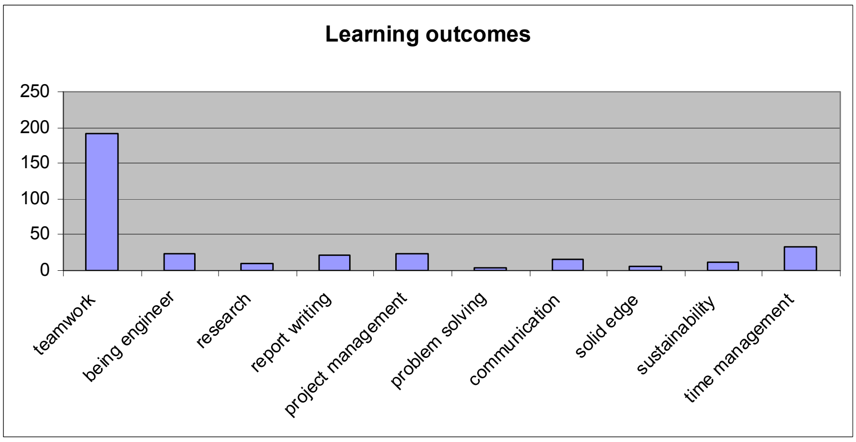

Figure 2: personally most significant learning outcomes as identified by students in open-ended questions (N=653)

Considerable effort on the part of the staff had gone into constructing the project groups according to student responses to a Belbin questionnaire which identified their preferred working styles (Belbin 1993). The staff understood this as a mechanism to draw students' attention to the fact that teams have internal function and structure while some students took it more prescriptively and were inclined to debate its applicability to their group. However, all students showed an ability to talk about how their group did or did not function and their comments helped refine our theories of the mechanisms and contexts described above:

> *They were talking about throwing us in the deep end. I thought it was all right, we had a fairly good tutor, I guess our group was motivated to do well, so we realised we were thrown in the deep end so we each went out and got all the required information about what we had to do, right down to every single mark.* Focus group 2008.

> *Working in a group had its positives and negative aspects, but overall, in an engineering context, working this way showed me how to deal with shared responsibility and delegation of tasks, as well as the value of other people's opinions.* Student journal 2008.

> *some people can't be relied on and sometimes you have to cover for another's laziness… teamwork does not work well and I can only depend on myself.* Course evaluation comments 2009.

It is clear from these comments that it is not the case that teamwork is an effective mechanism (or not) but rather that teamwork of the type promoted in this course was most successful in appropriate contexts. Those context were the ones where team members shared common motivations, where the staff were positive about teamwork and the project in hand, and where the nature of the project matched the students' preconceptions of or aspirations for engineering.

The teamwork mechanism has worked better in years where the course design included the Belbin exercise and well structured peer assessment as devices to encourage students to work together efficiently, but it was clear from our analysis that when groups failed to work students didn't know what to do about it. This is an area we can now work on improving.

Sustainability

It was comments such as the following from the 2008 online journals which alerted us to the fact that students were perhaps not taking on the learning about sustainability that we wanted:

> *We didn't really do much relating to sustainable development at all throughout this project, we just tried to find something that would work.*

In that year the open-ended discussions in the 350 journals analysed yielded 28 students who claimed that sustainability was not relevant to their projects and a further 4 who dismissed it as political correctness. These are admittedly small numbers but they raise questions about how well the course addresses sustainability which are further justified by the 2009 results. As we saw in the graphs of student understandings of their personal learning outcomes in Figure 2 above, relatively few in the 2009 cohort were convinced that they learned anything about sustainability. In fact, what students told us about their understandings of sustainability suggest that although all of the mechanisms listed above and more may be in play, their efficacy is peculiarly sensitive to context. In this case the nature of the project and the student's intended specialisation was influential. Software engineers, for instance, seem to have problems relating to environmental concerns. However, the following comments suggest that attitudes acquired before students reach the course are also important aspects of context:

> *As a power source a nuclear reactor would be the best long term solution in terms of emissions and cost but the prejudice against nuclear power meant that our tutor had us exclude it even as an option.* Student journal 2008.

> *[They] pushed the triple bottom line principle on us.* Student journal 2008.

> *My mum is a hippy I've learned all I need to know about sustainable development from her ranting.* Student journal 2008

> *in our day and age the words 'Sustainable Development' are used so often that its meaning is known by all and its influence is automatically taken into account when a design is considered.* Student journal 2008.

> *Yeah a lot of people do a course in high school, that just goes on about sustainability for 2 years.* Focus group 2008.

It is easy to see how each of the mechanisms posited above may trigger different outcomes as they meet these different aspects of context. The point here again is that understanding how this interaction produces the range of observed outcomes lets us plan more effectively for future developments and improvements to the course under consideration.

Discussion

As we begin to reveal a range of patterns in students' behaviour we need to start asking what produces those patterns. We need to look for the abstract theme running through them that allows us to connect them to explanatory theory. This stage of the present project is only just beginning, but we can offer a few preliminary thoughts here to illustrate how we expect to proceed.

One popular way of understanding student investment in a course or program is to see it as an instance of rational choice theory (Boyd et al: 1994). As we noted above, in a realist perspective any mechanism (course, program) is an example of a set of choices constrained by the capacities and resources of the participants, so this would seem like a suitable choice of analytic framework and is in fact often used by Pawson and Tilley (1997) to explain a wide range of behaviours. According to rational choice theory, we would look for evidence that students were making cost benefit analyses of their situation and acting accordingly. This might explain some of the behaviour we see but rational choice theories have been found inadequate to explain aspects of human action involving altruism, in which class of behaviours we might include some teamwork mechanisms.

In order to be able to explain the widest possible range of behaviours within the field we are interested in, we turn instead to the more nuanced theories of Pierre Bourdieu, especially his writings on education (Bourdieu and Passeron 1977; Bourdieu 1984). This is not the place to go into the subtleties of Bourdieuvian theory in detail. Very briefly, in this theory actors are conceived of as strategizing using a range of different kinds of capital (existing skills, social connections, resources like technology etc.) in order to adjust their position with regard to other actors. This helps us explain the rugged individualist as well as the mutual dependence mechanism because personal immediate advantage is not taken to be the actor's goal. Theorizing at this level is the only way, according to Pawson and Tilly (1997; 126) to make evaluations 'cumulate', that is to build up broad enough knowledge of the processes at work to have a fair chance of predicting what initiatives might have best chance of success in future interventions.

Meanwhile the world does not stand still and plans must be made for next semester. There are some low level changes that can be made straight away in expectation of immediately improved outcomes, such as providing more support to the ongoing management of teamwork as well as the initial constitution of teams. Preliminary results also clearly indicate that there needs to be better integration between the projects and other aspects of the course such as lectures, as well as between these projects and the engineering sub-disciplines students will move into in second year. It is also clear that there are many perspectives and processes at work when such a large cohort of students undertakes such a disparate suite of projects and this needs to be considered when developing the course further. There may be more than one way to do that and it may take some time to identify the best approaches. This should be done through another iteration of realist evaluation, including the theorizing stage. At another level we need to rethink what we mean when we say we want students to learn about sustainability. What should they learn about sustainability and how will it connect to later practice? But most significantly we need to have plans in place to continue the evaluation at the explanatory theoretical level where we have the best chance of discovering why certain mechanisms work in some contexts and for some students and not others. Evaluation is always work in progress.

References

Belbin, R. M., 1993. *Team roles at work*, Oxford; Boston, Butterworth-Heinemann.

Bourdieu, P. (1984) *Distinction: A social critique of the judgement of taste*. Cambridge, Mass.: Harvard University Press.

Bourdieu, P., Passeron, J-C. (1977). *Reproduction in Education, Society and Culture*. London: Sage.

Boyd, W. L., & And Others. (1994). Rational choice theory and the politics of education: Promise and limitations. *Journal of Education Policy, 9*(5-6), 127-145.

Chickering, A.W. and Z.F. Gamson, (1987) "Seven Principles for Good Practice in Undergraduate Education", *AAHE Bulletin*, vol. 39, no 7.

Department of Education, Employment and Workplace Relations (2008) *Views of Engineering Students. Report of a survey of final year engineering students in Australia*.

Lebow, D. G., & Wager, W. W. (1994). 'Authentic activity as a model for appropriate learning activity: Implications for emerging instructional technologies.' *Canadian Journal of Educational Communication,* vol. 23, pp 231 – 244.

Pawson, R. and Tilley, N. (1997). *Realistic Evaluation*. London: Sage.

Acknowledgements

This project was made possible by a Strategic Teaching and Learning Grant from the University of Queensland and support from Engineers Without Borders, Australia.