An evaluation of the EWB Challenge – implications for future curriculum change.

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Abstract: *We have been evaluating the EWB Challenge in a large research-led university over the last two years. The guiding question has been "what works for whom under what circumstances?" and the aim has been to understand not just what works and what doesn't, but also the mechanisms that produce success. Data has been collected from interviews, focus groups, observations, journal analysis and cultural mapping exercises derived from Bourdieu's social theories. Changes in personnel, problem setting, and technical support over the course of the evaluation allowed for examination of the interplay between such contextual factors and the mechanisms through which students learn. This paper provides discussion of just a few of the parameters of context and mechanisms affecting outcomes from the Challenge, including the effect of the problem setting and the problem of perceptions of the real nature of engineering. We discuss what these findings mean for extending the benefits of the Challenge to other areas of the curriculum.*

Introduction

The Engineers Without Borders (EWB) Challenge is a commonly used project in first year engineering courses in Australia which sets students the challenge of designing sustainable engineering solutions in underdeveloped settings. We have previously reported (Crosthwaite, Jolly, Brown 2009, Jolly, Crosthwaite, Brown 2009) how our approach to evaluating the Challenge in our university relies on a range of data which seeks to answer the question "what works for whom under what circumstances". Using the Realistic Evaluation approach of Pawson and Tilley (1997) we have analysed the implementation into relevant dimensions of Context (C), Mechanism (M) and Outcome (O), where C+M=O. Realistic evaluation posits that we need to understand how particular details of the context of operation of any implementation, serve to provoke particular underlying mechanisms in the subjects of the implementation that lead to observable outcomes, which are not always those intended. Figure 1 provides an overview of some of the results obtained to the end of 2009, although some details have been omitted for clarity's sake. In Figure 1 the context C1 is described as being made up of aspects such as C1a, C1b and C1c which in turn are derived from themes derived from constant comparative method data analysis (in the square boxes). Similarly, the named mechanisms and outcomes and their component subparts are derived from data analysis. The insights gained from this stage of the analysis were used in some restructuring of the course, in the expectation of more consistent outcomes.

Up until this point 81% of students reported that it was important to them to work on a real-life project and 57% found the development setting motivating. A consistent complaint was lack of connection between the lecture component of the course and the groupwork sessions where the project work was accomplished. Teamwork was identified as the greatest strength of the course, as the most significant learning outcome, but also as the most challenging aspect of the course.

Figure 1 attempts to synthesise some of the wide range of data collected to the end of 2009 into the C/M/O framework. We have previously reported, for instance, that students exhibited a range of

responses to teamwork which could be labelled "in at the deep end", "mutual dependence" and "rugged individualism". That is to say, teamwork is not just some monolithic thing that can be said to work or not, but rather a strategy that provokes a range of responses in students, some of which will be more successful or provide different outcomes from others. Here we have labelled the relevant mechanism "student cohesion" since there appears to be a correlation between the degree to which students manage to cooperate and their learning outcomes. This and other mechanisms impact on the ability of teamwork to produce the learning outcomes often claimed for it.

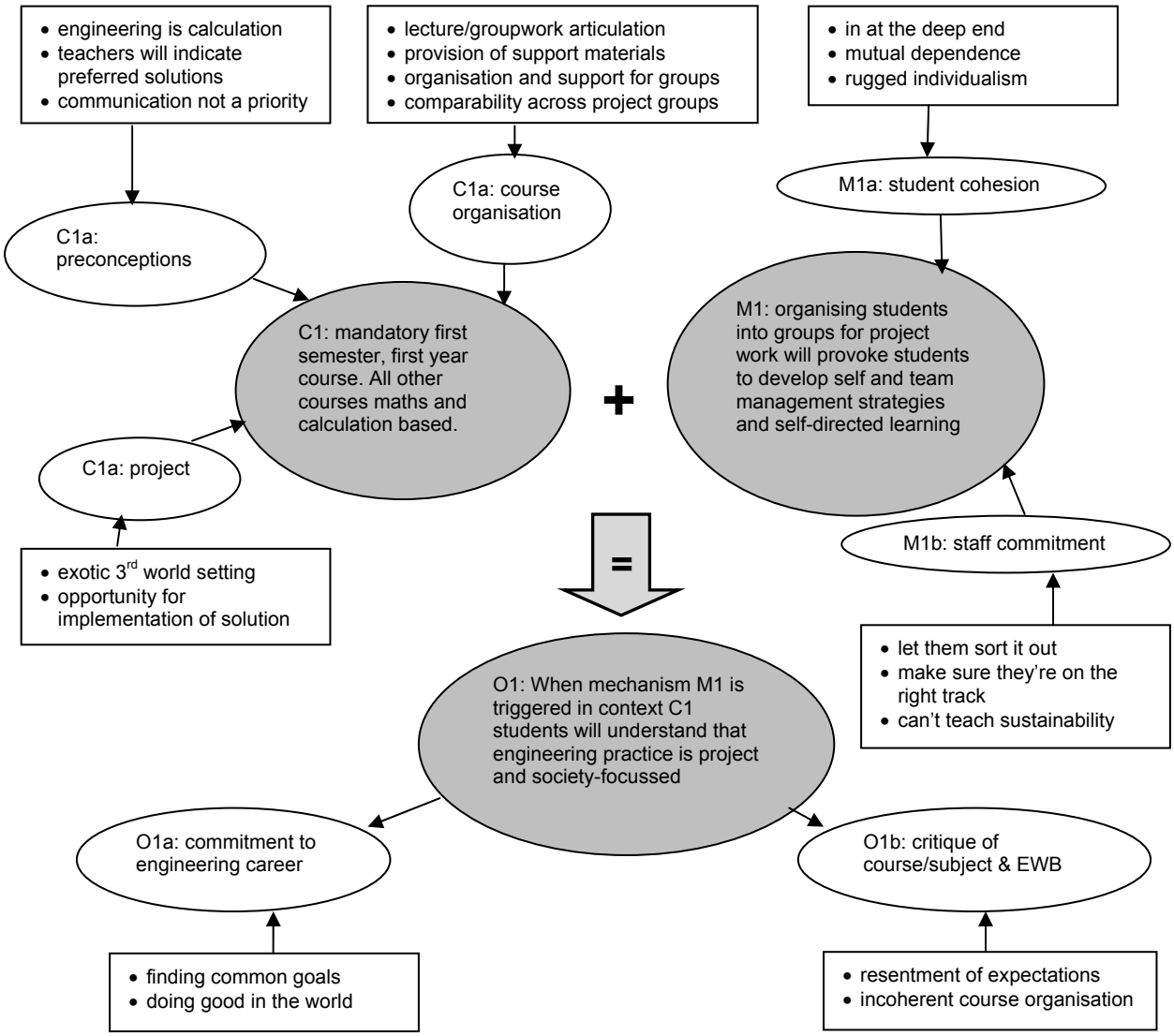

Figure 1: CMO configurations to end 2009

Confirming findings with cultural investigation

While a realistic evaluation can describe the logical connections between inputs, outcomes and impacts, it cannot tell us why those logics arise. For instance, while we know that in 2008 and 2009 the Challenge provoked a *doing good in the world* mechanism that motivated some students to work hard and enjoy the experience, it is not self-evident why this was not observed in 2010. In order to explain such phenomena we have turned to the social theories of Pierre Bourdieu (1977, 1984, 1998), in particular his concept of *capital*.

Bourdieu describes all social life in terms of how actors compete with each other to gain the best social position in whatever they are doing, from games of football to educational endeavours. The resources they bring to this contest are labelled *capital*. Bourdieu identifies several types of capital of which the most important are economic capital and cultural capital. Cultural capital is anything that carries prestige and improves the holder's social position compared to others and we can identify it in whatever people compete over. We can tell what carries cultural capital in the Challenge by asking participants about what they like, what they think others like and what they see as being rewarded.

We have used Bourdieu's map (1998, p.5) as a basis to map the results of investigations with first year engineering students taking part in the Challenge in 2010. However, Bourdieu's own map makes the assumption that there is an inverse relationship between economic and cultural capital and in our opinion this has bedevilled attempts to apply this analytic strategy by others. We have therefore removed that assumption and mapped cultural capital on one axis (the x axis in Figure 2) and economic capital on the other axis (y in Figure 2). This allows up to develop a description of any social space, such as the students experience of their educational program, positions of obvious agents such as lecturers or external experts, and also the relative positions of other carriers of cultural and symbolic capital such as an aptitude for maths or attendance at lectures.

Students in five focus groups were given a list of potential agents and a blank map just showing the axes. The concepts of economic and cultural capital were explained to them and an example was worked through with the group. This example was "part-time work". The group was asked first to consider whether in the context of their studies part-time work should be considered to be of high or low economic capital, taking into account opportunity costs. Every student's answer was accepted as valid since what was being sought was how individuals rate the relative position of items such as this. Then they were asked to similarly rate the relative position of part-time work on the cultural capital axis. Combining the two ratings resulted in a position for the item 'part-time work' in one of the four quadrants. Students were told that as they worked through the items in the list they should feel free to move items relative to each other as they thought about it. The relativity of the positions, rather than absolute values was emphasised and students were instructed that they could add items to the list if they thought they needed them or omit ones provided if they had no meaning for them or if they could not decide how to place them. 24 maps were collected with between 25 and 30 items rated per map. We have room to discuss only a sample of our data here.

Culture maps and first year engineering

Figure 2 shows the aggregate positions from all 24 maps for the items 'lectures' (L) and 'attending lectures' (A). These two items were separated out because we wanted to understand how students saw the worth of lectures (as something the institution provides) and the worth of actually attending lectures (as a use they made of their time). Note that the high or positive end of the x axis is to the left and all positions are relative so the size and shape of the mapped areas have no intrinsic meaning.

Ignoring a few outliers, the pattern here was very clear. Students recognised the economic worth of lectures, and the fact that they were highly prized in this university setting, but they thought attending lectures, while still economically positive (that is likely to have positive economic benefits), were culturally negative.

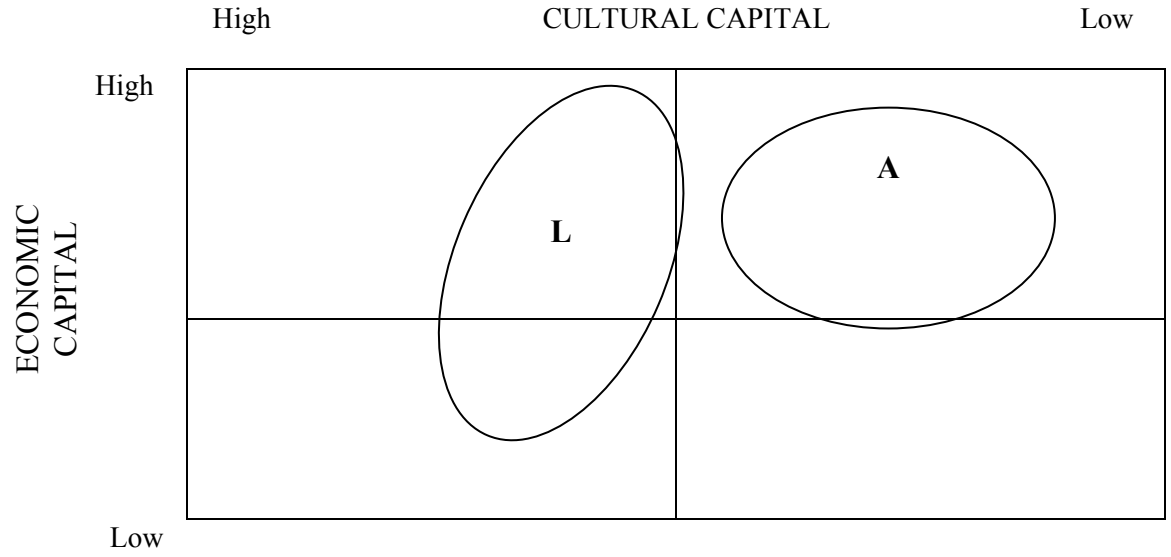

Figure 2: Relative positions of lectures (L) and attending lectures (A)

After the mapping exercise, a short discussion was held to clarify matters arising from the maps and from previous research. Students were critical of lectures in the subject containing the Challenge and, when asked to describe the best lectures they had attended, described sessions where teachers worked through examples on the board and/or gave clear detailed itemised procedures to follow to solve a problem at a later date. The lectures in the Challenge course were geared to general engineering concepts and the discussion of a variety approaches and therefore contained limited direct instructions for how to go about the project work. It may be therefore that the persistent problem with lectures that previous analysis put down to lack of integration of lectures and teamwork, may actually be caused by students lack of familiarity with discursive lectures rather than drilled problem solving. The questions therefore arise as to the worth of such lectures for engineering students and, if they are deemed to be valuable, how to change the student's expectations.

Cultural agents that fall near each other on cultural maps can be presumed to have more in common, and hence to function together to improve or decrease a social actor's position. The separation between lectures and attending lectures indicates some dissonance. If we want students to value attending lectures (and hence get them to attend lectures) we do not need to convince them of the economic value of attendance (that is that they will get something out of attendance). They are telling us that this value is obvious to them. What we need to convince them of is the cultural value of attendance.

One of the ways in which subjects containing the EWB Challenge are different from others is in their emphasis on teamwork, communication, social and cultural responsibility and liaising with external experts such as EWB staff and industry representatives. This contrasts with the maths-heavy nature of many other courses undertaken in the first year. Figure 3 shows how students regard these two sets of skills. Maths is understood to be of high economic value, indicating an assumption that their future careers will depend on their ability to calculate. In discussion all students told us that they expected their professional careers to be a matter of calculation and design above all else. By contrast, people skills, which had been explained to students as the ability to work in teams, communication and so on, were understood to be rated highly in the university culture but students were divided on their economic usefulness. Exactly as many students rated them as of high economic capital as rated them of low economic capital but no student rated them of low cultural capital. Interestingly, project management was offered as another category and it was rated as falling in top left hand quadrant – high economic and high cultural capital. The relative positions of these skills probably tells us

something about students' expectations of their future roles in project management. The question here is how have we managed to communicate the value of project management and can we apply this to communication skills?

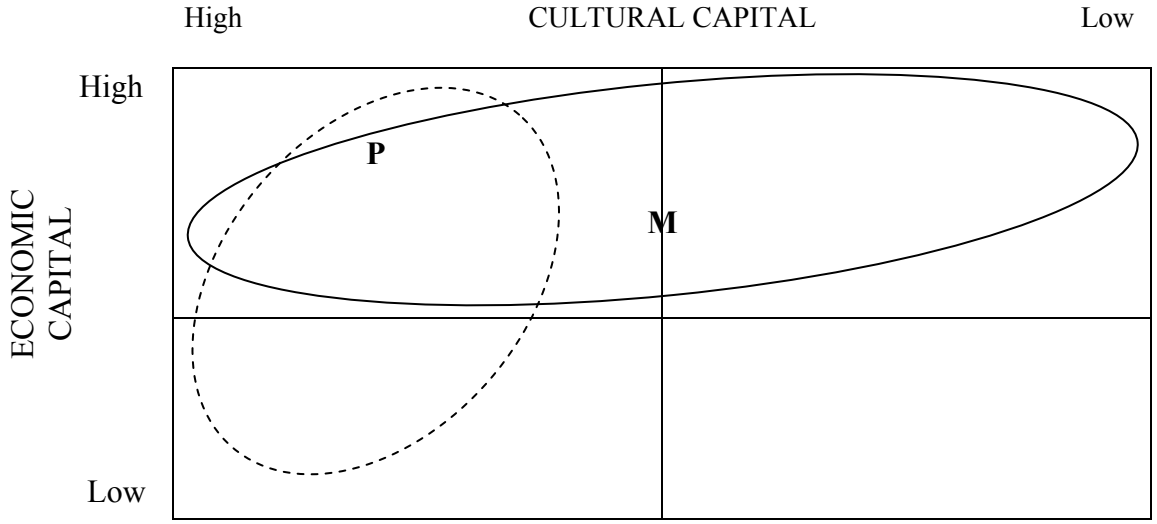

Figure 3: Relative positions of maths ability (M solid line) and people skills (P dashed line)

Contextual changes complicate the evaluation

In 2010 a new course coordinator took over and decided to make changes to the lecture component that were hoped would meet the students' previous complaints: assessment was tied in to the challenge: lectures were given in the context of professional engineering, the availability of tutors was increased, and continual feedback was given beginning much earlier in semester. At the same time a number of other changes outside of the scope of the university to control took place.

Whereas previous projects had been set in places such as orphanages in India or poor villages in Cambodia, in 2010 the target community was an Australian Indigenous group. This was a major change. While the target community no doubt needed development ideas badly and have certainly suffered disadvantage and dislocation, Australian students find it hard to see them as 'in need' in the same way as Cambodian villagers or Indian orphans. The contrast can be illustrated with comments from students in 2008, when the project was set in Kendal Province, Cambodia:

> *This was very exciting for us as we knew that our option was a solution to a real problem for real people in need and by a small chance, our solution could be used to actually help these people.*

and in 2010, when it was set in Aboriginal Australia:

> *For the past 12 years of my life, at every other turn I've had someone saying Gallipoli this and Aboriginals that and I don't care anymore. It's just as simple as that. I've been told so many times that I don't care I thought I was getting out of that when I was getting out of high school.'*

While other projects were mediated through NGOs who had a history of working with the target community and had built up considerable background resources, this did not apply in the case of the Aboriginal community. This made it difficult for students to access appropriate resources and the situation was further complicated by the teething pains of a new organisational EWB webpage. The students also indicated that they were uninspired designing solutions for an on-country community of just 6 people and were de-motivated when they discovered that much of what they were designing had already been implemented in the community.

If we consider the EWB Challenge to be the same thing in 2010 as it was in 2008, we would need to posit changes in the student population to explain the change of attitudes indicated here. It is only

when we take into account how context works to provoke mechanisms in the subjects that we can understand why the 'same' implementation can work much better in one year than another.

Conclusions

This evaluation has been based on the premise that it is not sufficient to ask students for their responses to a course alone. If we want to understand why aspects of the course work for one subgroup of students and not others, or why it is successful in one year and not another, and especially if we want to take lessons away from a course innovation to apply it elsewhere, we need a very detailed understanding of what students experience, the basis on which they make decisions about whether or not the course has worked for them, and how they mange both success and failure. We have therefore based the wider study on a mixture of methods including regular course evaluations, the analysis of reflective journals, class observations, focus groups and surveys (Jolly, Crosthwaite, Brown 2009), and analytic culture maps. This paper has concentrated on the way in which the cultural analysis has been used to probe earlier findings. By mapping out the ways in which cultural agents are understood and valued by students we can begin to explain why we see the pattern of responses that we see.

This analysis equips us better in answering the earlier questions of how to increase lecture attendance and increase the perceived value of communication skills. While the ascription of cultural value is hard to influence from the top down, there is a clue to one successful strategy in the data on maths and people skills. This indicates a high value for those skills. Attendance at lectures could be moved to the left on the culture map by convincing students that the only way to develop those skills is by attendance. And in fact when students describe 'good' lectures they talk about instances where they have come away knowing how to do something they didn't know how to do before. The culture map shows us where value lies so if we want to make changes or understand responses we can identify the associations that are motivating behaviour.

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