The EWB Challenge: Outcomes and Impacts in the UK and Ireland

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Abstract
The global dimension in engineering education refers to the various technical and non-technical factors that are shaping engineering at the international level. Understanding of these factors is crucial to both the creation of an engineering profession that is responsive to changing global paradigms, and the development of individual engineers who are willing and able to tackle global challenges. This paper describes a design program called the EWB Challenge, developed by Engineers Without Borders (EWB) Australia and managed in the UK by EWB-UK. It was designed as a way to introduce the global dimension into engineering education. The Challenge uses real world design briefs, developed in partnership with EWB’s partner communities to teach professional and design skills required by the globally competent engineer. This paper describes the outcomes of the EWB Challenge program in the UK and assesses these against literature evaluating program outcomes in Australia. It ends by proposing improvements to the Challenge program on the basis of this analysis.

Keywords
Engineers Without Borders, EWB Challenge, global dimension of engineering education.

1. Introduction
Engineering is a global profession. The challenges that engineers will face in the next 10 to 15 years (and beyond) are international in scope and application. Primary among these are the twin challenges of environmental degradation and global poverty, which are in turn affected by powerful international social, technological, and economic forces and underpinned by the process of globalization.

Engineering education must prepare students to effectively address these issues, as they will be the defining problems of their professional careers. By the year 2030, 1 billion people will be without access to electricity; 2 billion people will be living in slums; and 4 billion people will be living in areas of severe water stress (EWB-UK, 2012). If human society continues with our current levels of consumption and production, by 2030 – that is, in 17 years – we will require another Earth to support the nearly 9 billion people that will be alive then.

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The ‘global dimension’ is a term used to describe the “...sum of the social, political, technological, cultural, and environmental issues which are shaping engineering at a global level” (Bourn & Neal, 2012). Adapted and applied to engineering education, the global dimension can be used as a tool to teach personally and professionally relevant skills and knowledge, such as the ability to work in teams, communicate across cultural boundaries and practice effective engineering in complex, interdependent, and information-limited systems. These are essential capabilities for the globally competent engineer.

This paper will examine the effectiveness of a current attempt to implement the global dimension in engineering curricula. The Engineers Without Borders (EWB) Challenge is a design program for first and second year university undergraduates. Working in teams, students come up with conceptual designs to address engineering problems identified by our partner communities in developing countries. It was created by EWB Australia in 2007 and is currently running in universities across Australia, New Zealand, the UK, and Ireland, reaching over 10,000 students per academic year.

2012-2013 marks the second year the Challenge has been delivered in the UK. By using feedback from the first two years of the UK Challenge program, as well as published research on the effectiveness of the Challenge program in Australia, this paper will present a snapshot of the strengths and weaknesses of the Challenge program in the UK. It will conclude by identifying strategies for improving the effectiveness of the program at teaching the global dimension to engineering students.

2. Outcomes of Challenge Participation in the UK

Monitoring and evaluation procedures are carried out as a part of the Challenge program to evaluate the development of skills and the acquisition of knowledge by participating students. In addition, feedback is sourced from academics and tutors involved with the delivery of the Challenge. Finally, all stakeholders are polled on their engagement with and enjoyment of the program. This information is collated to produce an overview how the Challenge operates, as well as its effectiveness in meeting program aims

2.1 Skills and Knowledge

Pre- and post-Challenge questionnaires were completed by students on the Challenge in the UK and Ireland in the 2012-2013 academic year. First semester results indicate an increase in knowledge on key topics, such as definitions of international development and understanding of the role of an engineer in society (Figure 1).

![Figure 1: Pre and Post Challenge results for understanding of key topics](image-url)
indicated a vast improvement (>60% of respondents in each case indicated “a lot” of improvement in skills).

2.2 Engagement

Interviews with Challenge stakeholders suggest a positive response to the idea of the Challenge. Selling points identified included the unique nature of projects offered on the Challenge: “[The Challenge] gave [students] an insight into water and sanitation issues they might have felt before was not in the remit of Civil Engineering.” Many academics were also in support of the ‘basic principles’ approach required of Challenge projects: “[It tries to] steer them away from ‘Well what we’ll do is we’ll buy ourselves a wind turbine.’ No, what you’ll do is you will make a wind turbine out of scrap - basic principles – and have a think about how you’re going to do it. And that was the challenge...it’s not ‘chequebook’ engineering.”

2.3 Operations

Reports from both academics and students themselves indicate that an initial reluctance to engage with the ‘real-world’ nature of the Challenge is not uncommon. Students consistently feedback that more and better information is necessary to address design briefs.

A significant piece of feedback revolves around the interpretation of the aims of the Challenge at the level of module delivery. Systematic as well as anecdotal feedback collection has brought to the attention of the Challenge management team the existence of divergences in emphasis on different aspects of the program; for example, tutors encouraging students to disregard the contextual (social, cultural) aspects of design in favour of purely technical aspects. While examples such as these are in the minority overall, they are significant because they describe situations which present the opposite message that the EWB Challenge was designed to provide.

3. Lessons from the Australian context

A significant amount of literature has built up around the EWB Challenge in the Australasian context, where it was first developed and has been run since 2007. This section will examine aspects of that literature as it relates to program challenges in the UK and Ireland.

3.1 ‘Real world’ problems and resource access

Borrego, Cutler, and Loden conducted a mixed-methods review of the EWB Challenge at Western Australia universities in 2010. Through focus group interviews and quantitative survey feedback they identified ‘access to resources’ as one of the main barriers to Challenge engagement among students. This was partially attributed to the difficulty in general terms of sourcing reliable contextual information on a remote community. However, the authors also discuss this frustration as a manifestation of the learning process which accompanies the transition from “traditional structured problems, where all the necessary information is provided...to an ill-structured real world problem” (Borrego, Cutler, & Loden, 2010). This analysis is in agreement with related research into ‘well-structured’ and ‘ill-structured’ engineering problems; namely, that ill-structured problems, characterized by possessing “multiple solutions or solution paths...multiple criteria for

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1 Quotes given in italics represent feedback sourced directly from Challenge academics. Interviews conducted face-to-face or via email by the authors.

2 This addresses the Royal Academy of Engineering’s recommendations to universities to emphasize within their courses the “ability to understand and apply theory to real problems,” the so-called “fundamentals” of engineering work (The Royal Academy of Engineering, 2007).

3 Similar problems were encountered in Australia: see Abuodha, Layton, and Goldfinch (2011).
evaluating solutions,” and require “learners to make judgments and express personal opinions…about the problem,” are more like real world engineering problems than traditional ‘well-structured’ problems (Jonassen, Strobel, & Lee, 2006).

3.2 Operations and outcomes assessment
Leslie Jolly and colleagues have conducted numerous evaluations of the EWB Challenge program in Australia using a ‘realist evaluative’ framework. This analytical framework starts from the position that the context of an intervention (in this case, the implementation of the EWB Challenge) provides participants with a range of ways to respond (termed ‘mechanisms’), which influences the outcomes of the intervention. Thus, similar outcomes can come about through a range of different contexts and mechanisms, and similar contexts can produce a range of different mechanisms and outcomes.

The principle lesson from the evaluations found that participation in Challenge activities was not enough to ensure that program aims were met: “content inputs are important to outcomes but they are not the only relevant considerations” (Jolly, Crosthwaite, Brodie, Kavanagh, & Buys, 2011). Contextual factors, such as the attitudes of staff and the focus of the course (i.e. on developing professional skills versus engineering design) influenced how the Challenge was interpreted by students and thus what learning outcomes were produced.

Exercises to manipulate context to provoke the desired mechanisms in students (and thus, the desired program outcomes) have been carried out in different Australian contexts. Stappenbelt and Rowles (2009) detail the Challenge implementation plan developed for the University of Western Australia (UWA), which included “thorough training of the teaching staff…achieved through a series of…training sessions which included instruction regarding the design process, teamwork, team management and cultural sensitivity.” From the perspective of achieving Challenge learning objectives, results were positive: survey responses, using a scale ranging from 1 (strongly disagree) to 5 (strongly agree), student awareness of “non-technical issues that challenge professional engineers” increased from 3.61 to 4.27 from the previous year’s results (Stappenbelt & Rowles, 2009).

4. Conclusions and Implications for the UK Challenge
The feedback obtained in the UK context, coupled with research from Challenge evaluations in Australia has led to several outcomes for improvement of the Challenge in the UK:

1. EWB-UK recognizes steps it can take to improve the availability and type of resources for participating students, especially non-engineering students such as architects or computer science students. To improve resource availability, we are working with like-minded organizations in these areas, such as Architects Sans Frontieres UK, to tailor resource packages for these students. We are also currently developing, in conjunction with EWB Australia, a new, more user-friendly international Challenge website with a re-designed discussion forum, aimed at improving the flow of information between students and the community and students themselves. However, we believe that a fundamental strength of the Challenge is the real world design context, and that working through these difficulties in the academic environment will more effectively prepare them for their professional careers.

2. Recognizing the strength of the realist evaluative analysis of the Challenge conducted by Leslie Jolly and colleagues in Australia in providing a comprehensive portrait of Challenge operations, a similar set of research will be encouraged in the UK context.
This will be done through partnerships with academics interested in engineering education (for example, through the EWB-UK Academic Network) and Masters and PhD level students interested in associating their research with EWB-UK.

3. In the short-term, we will work towards addressing some of the most significant obstacles to achieving Challenge outcomes. One of these obstacles which can be readily overcome using existing EWB-UK resources is the misrepresentation of the purpose of the Challenge at the level of delivery, resulting in a skewed message being promoted through the Challenge framework. To combat this, we will be introducing an Academic Training Day and inviting all involved in the delivery of the EWB Challenge in the UK. The aim of this day will be to increase academic confidence in both the validity of and personal capability to deliver the ‘global dimension’ aspect of the Challenge.

Works Cited


