

Guide to ESD in practice

Collaborative sustainable engineering design project that develops multiple ESD competencies

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1. Intended outcomes

1.1.1 Specific module outcomes

The module aims to enable students to:

1. Understand and appreciate the social, economic and environmental implications of engineering decisions at a local and global level, and thus the importance of globally responsible (sustainable) engineering development.
2. Identify and explain how and why context-specific factors (including social, environmental, ethical, economic, and commercial considerations) affect engineering judgement and design, including implementation and operation.
3. Demonstrate how context-specific factors are considered and implemented in engineering design, including how the problem statement and design criteria are defined, how design options are evaluated, how the final design is developed, and how implementation and maintenance pathways are planned.
4. Work together effectively as a group, and communicate clearly and individually (in oral and written forms, and through visual forms including sketches, drawings and presentations) the technical, social, environmental and economic aspects of proposed designs with reference to context-specific influencing factors.

The module supports students to realise their potential and become part of, and drive, the change for a fairer future for all. This is a group experience built on students working together towards a shared goal. Students learn to critique and give feedback to fellow group members and to other groups to help build and strengthen their social relations as well as develop feelings of value and belonging.

1.1.2 Broader outcomes

The module is framed around Challenge Based Education, using the Engineers Without Borders (EWB) Engineering for People Design Challenge, which encourages students to deliver context- appropriate sustainable engineering design to a brief focusing on a specific locality. The Design Challenge aims to inspire and upskill students to put global responsibility at the heart of engineering, equipping students with skills they will take into the workplace when they graduate. The Design Challenge also aims to support students to find their voice in terms of the value that they bring, and to challenge narrow thinking and develop better solutions. The activity supports students to consider responsibility and purpose as individuals and as engineers. Students are particularly motivated by participating in a national competition, and the opportunity to be selected to the Grand Finals.

2. Participants

This is a group-based activity. To successfully run, a minimum of four students and one member of teaching staff are required. However, at Strathclyde, the activity currently runs with large student cohorts in two ways (as detailed below).

3. Activity/project

3.1.1 Student cohorts

1. Within the module 'Engineering for Global Development' (Semester 1, 10 credits, year 3, Civil and Environmental Engineering (CEE)). The module is taken by 90 to 120 students a year and is organised and delivered by one member of staff and one assistant, with contributions from several guest speakers from industry and third sector organisations. Other academic and research staff can be involved in aspects of the assessment.
2. Within the module 'Electronic and Electrical Techniques and Design' (Semester 1&2, 20 credits, year 1, Electronic and Electrical Engineering (EEE)). The activity is delivered as one of three projects in the credit-bearing first year module. It sits within the module alongside empirical electrical engineer lab projects – centralising ESD in year 1 of learning and demonstrating the importance of ESD. The module is taken by around 220 students a year and the design activity is organised by one member of staff and delivered via 20 EEE staff mentors, each leading weekly small group seminars (of 10-15 students) and supported via a number of cohort-wide activities over the two semesters.

3.1.2 Module formats

Both modules are 100% coursework based. Prior to the launch of the challenge each year, EWB holds a short series of events to support the educators involved in running the Design Challenge, including community building. In recent years EWB has also developed a problem-based learning toolkit with suggested activities that align to the design process and aim to develop key insights that will support students' progress in the Design Challenge task.

Students work in groups of four to five to identify problem statements and then design context-appropriate solutions for the given design areas in a community that are set by EWB. The activity's emphasis is on student-led enquiry, research and design, with the students choosing the problem area they wish to tackle for their project, developing the problem statement and design criteria, developing conceptual designs, choosing and applying an approach to evaluating those designs, and developing the final designs including implementation and operation. The stages and timeframes for the students' learner journey are summarised in Figure 1.

The module leads support student learning via regular and structured workshops, tutorials and lectures. Lectures (asynchronous) and resources focus on design process and evaluation approaches, and are available to students throughout the semester for review as needed. Staff and teaching assistants help support students in weekly group work sessions.

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Student groups also work independently on tasks between classes where groups have specific tailored support from staff and online checklists that aim to help students manage their work and track their progress. In the CEE module guest speakers give examples of people-centred and place-based design, on topics selected to be relevant to the design community. As well as supporting the students to develop knowledge and understanding, the guest speakers showcase a range of careers and career paths in sustainable development that are relevant to civil and environmental engineers. As well as identifying and hosting the guest speakers, the class lead supports the pitch and scope of their sessions and provides the thread to link the content to the Design Challenge and previous and future speakers.

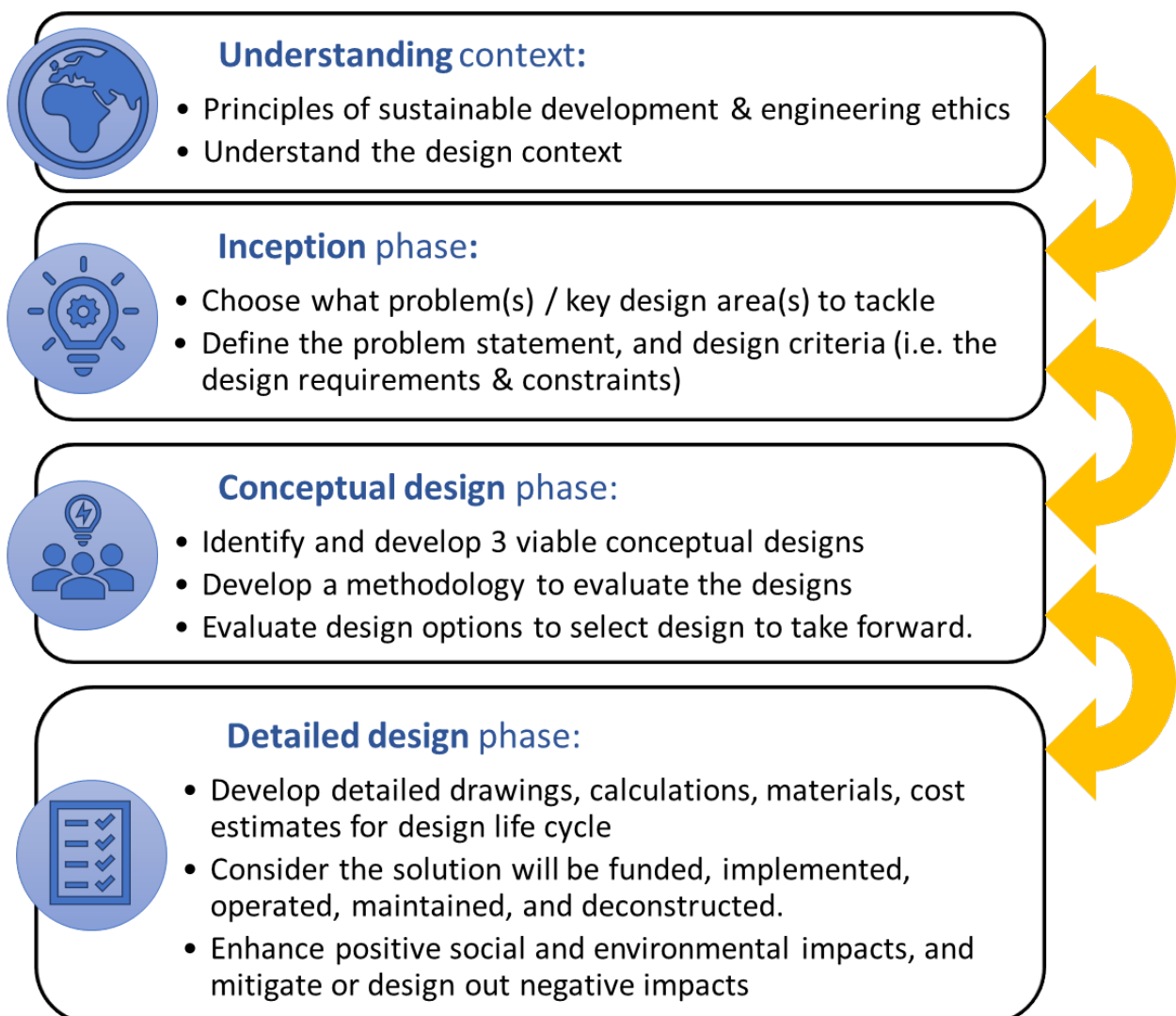


Figure 1. Overview of activity phases

4. Assessment or evaluation

Both modules are assessed entirely through group assessment, which includes interim and final group presentations (oral, with slides/props) and a final design report. Feedback received from the interim presentation is reflected on and actioned in group work so that the students can improve presentation skills and the quality of their project work. There are three main themes to assessment and feedback:

1. Assessment and feedback from staff, tutors and mentors.
2. Anonymous intra-group peer assessment and feedback is part of the final assessment, designed in part to understand how the group worked together but also to invite student reflection on different roles in group working.
3. A peer review of presentations allows students to familiarise themselves with the assessment rubrics while giving feedback on two other groups. We found that anonymity is important – without it, students find it challenging to be critical, even constructively. Further, we found students find it valuable to receive feedback on the peer review that they provide other groups to support development of their evaluation skills.

The top five student groups from each university participating in the Engineers Without Borders (EWB) Engineering for People Design Challenge go forward to the national competition near the end of the academic year. The submissions are reviewed by a panel made up of members from industry, academia, and the community partners. A minimum of one group from each participating institution is selected to go forward to the Grand Finals. The Grand Finals is a one-day event held end June or early July, and those selected to participate are typically offered formalised support to prepare for the event from EWB, and informal support from class leads with the option to connect up with student finalists from the previous year.

The EWB Engineering for People Design Challenge enables students to develop multiple ESD competencies. Students engage in integrated problem solving through project work that tasks them with developing viable, inclusive and equitable solutions to complex, real-world problems. Students enhance their systems thinking and anticipatory competencies as they are challenged to understand and evaluate the linkages between different design areas and sustainability objectives. This includes identifying and reducing potential negative impacts and enhancing the positive impacts of their design decisions. Students are supported to question their assumptions and the influence of their cultural, social, political and economic backgrounds on their approach. The collaborative aspect of the project means that students can learn from each other and it also presents further opportunity for group working skills development and learning how to overcome the associated challenges.

The ESD practice described here puts student competencies at the heart of their learning journey. The development of a students' critical thinking, normative and self-awareness competencies is key to the success of their projects, rather than being a secondary learning outcome.

5. Useful resources

1. EWB (2023) '*Engineering for People Design Challenge*'. London: Engineers Without Borders. Available at: www.ewb-uk.org/upskill/design-challenges/engineering-for-people-design-challenge/
2. [Template for student peer review](#) (formative)
3. [Final report marking rubric](#) (summative)



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