THE UNIVERSITY OF STRATHCLYDE
FACULTY OF ENGINEERING

Embedding Education for Sustainable Development in the Engineering Curriculum through Challenge-Based Education

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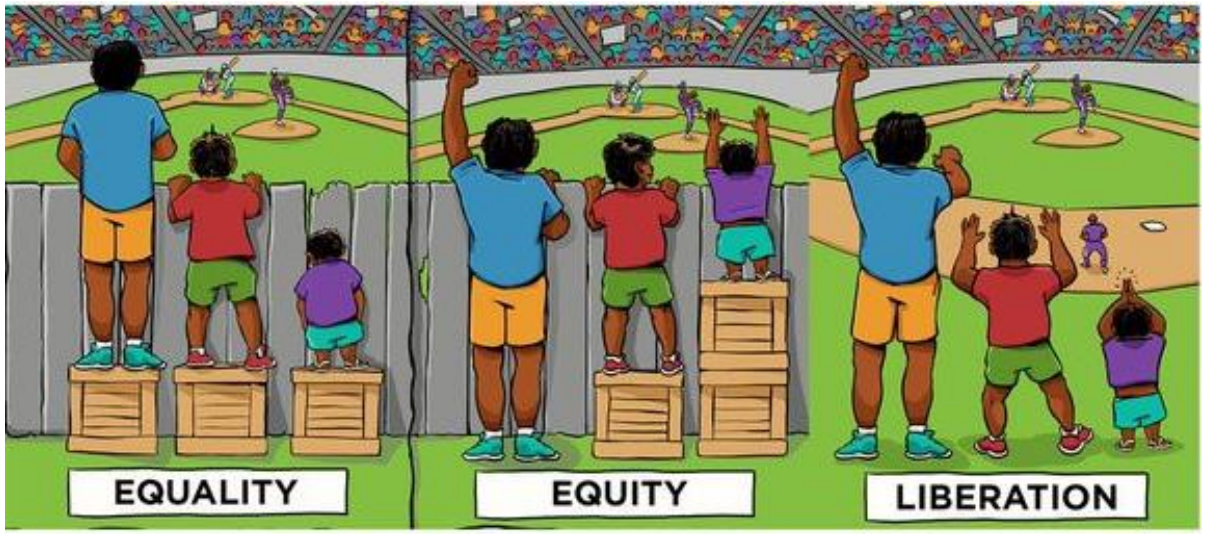
Content

Introduction

- The needs of tomorrow's engineers are changing, so must their education today
- Strathclyde EEE have embedded SD into the curriculum Engineers Without Borders (EWB) Engineering for People Design Challenge

https://unhabitat.org/about-us/sustainable-development-goals



https://twitter.com/kristopherwells/status/721158763881730048

Introduction

Context

- 230 1st year UGs, from multiple degree programmes
- Met small groups in weekly seminars

Learning Outcomes

1. Understand the role of Engineers for Sustainable Development
2. Participate in collaborative engineering projects
3. Appreciate and prioritise designing for the people and context, to ensure appropriateness and sustainability of ideas

(Demo engineering is more than maths and physics, amps and volts.)

Pedagogical Approach

Challenge Based Learning

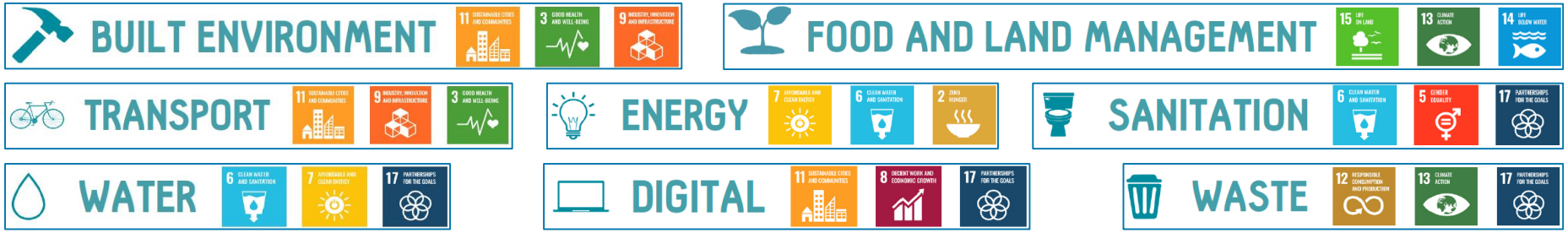
CBL builds on project based and problem based approaches

- Students engage in large real-life challenges in an active environment
  - complex, and multi-discipline problems
  - require a broad set of skills, competencies and knowledge
  - authentic to future professional practice
- Students acquire and apply a wide range of knowledge, skills and critical thinking

In Practice

EWB People Design Challenge - the heart of our approach

Every year EWB work with a partner organisation to develop an engineering brief based on real-life problems that people within their country face



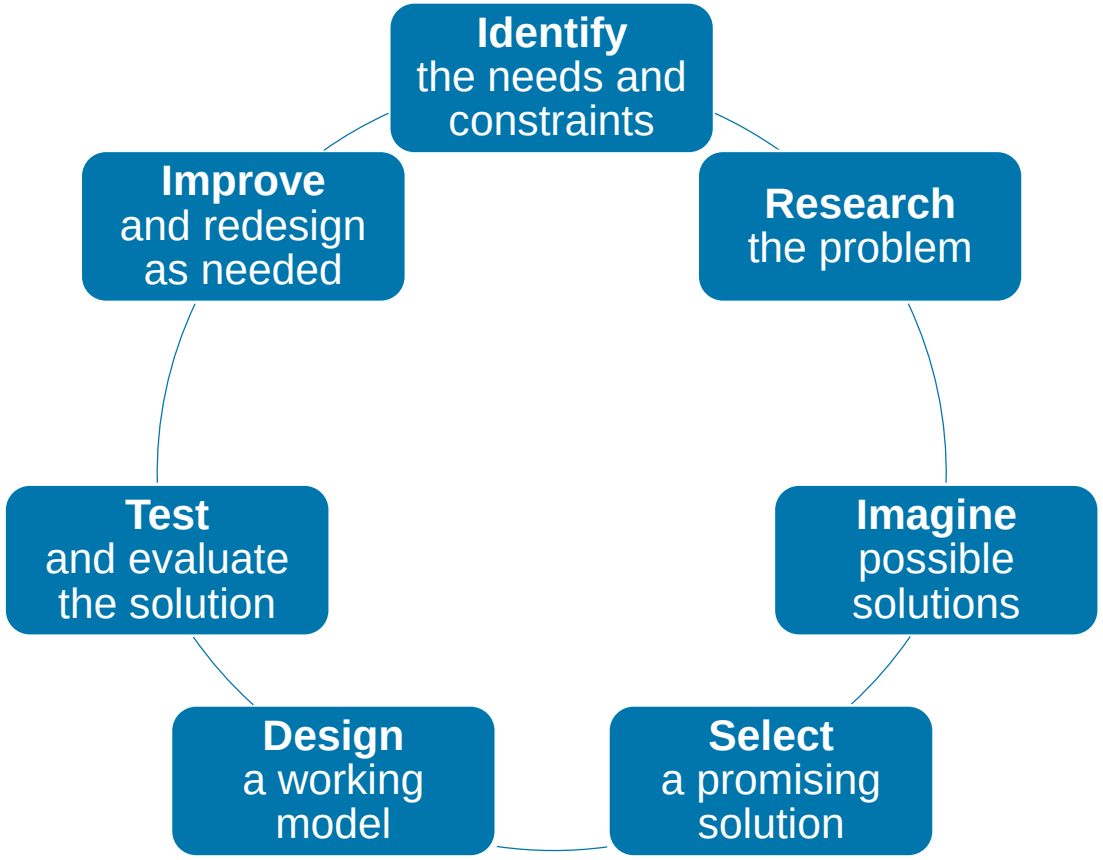
Students:

- Gain understanding of the challenge community's history and demographics
- Embed themselves in the needs of the community across the broad range of topics
- Identify a detailed **problem statement**.
- Work to **propose a solution** to the identified problem
  - Well thought through and reasoned & critically appropriate to economic, environmental & social context

Pedagogical Approach

Scaffolded Learner Journey

- Large scale challenge
- 1st year UG students with little experience of
  - Sustainable Development
  - the SDGs,
  - sustainable engineering,
  - long-term group projects
- Engineering Process to scaffold through



The engineering Process. derived from (Teach Engineering)

In Practice

Our Learner Journey

Wk	Stage	Theme	Content
1-3	**Stage 0**	**Team Building**	
4-7	**Stage 1**	**Context**	• SD activities including introduction to the UN SDGs • Responsibility and purpose of individuals and engineers to SD • How to create equitable, inclusive and appropriate solutions
8-10	**Stage 2**	**Defining the Problem**	• Tools to investigate project briefs & understand project context • How to ideate • Introduction of the EWB Challenge and Case Study Brief • Building teams (of 3-6 students) • Identification of problem statement and criteria for success

11-14	**Stage 3**	**Exploring Options**	• Ideation
			• Interrogating ideas
			  ○ against problem statement and criteria for success
			  ○ for inclusivity and appropriateness

15-19	**Stage 4**	**Justifying your choices**	• Design Development including technical detail • Implementation and maintenance considerations and strategies • Final presentations and reporting
20	*Feedback and next steps*		

Pedagogical Approach

Authentic and Patchwork Assessment

- Engineering process to ensure the students' practice is closely aligned to professional practice (authentic)
  - Milestones and Deliverables

- Patchwork Assessment
  - Continuous assessment pieces act as *patches* & brought together to form final deliverables
  - A larger picture from individual pieces

In Practice

Our Assessment Approach

Wk	Stage	Milestone	Deliverable
1-3	**Stage 0**	Team Building	
4-7	**Stage 1**	Understanding of SD	
8-10	**Stage 2:**	Understanding of challenge area	
11	**Stage 3**	1st Draft Problem Statement	Problem Statement Presentations
12			
13		Problem Statement++ & initial ideas	Problem & Interim Solution Presentation
14		Interrogated Design Solution	Design Brief & Initial Design Description
15	**Stage 4**		
16			Implementation & Maintenance strategy
17		Skeleton Report and Presentation	
18		*Draft* deliverables	
19		Completed Reporting	Presentations & Final Reports
20	*Feedback and next steps*		

Peer, Self & Staff Feedback

What the students created

EEE 1A
@EEEStrathclyde

Our project group sought to improve thermal efficiency of aging houses in Govan so that residents' heating bills could be decreased. We had to consider the community's needs, a method which would allow maintaining the historical aspect of buildings and a method which wouldn't be disruptive to residents. We decided to implement a window film to keep heat in the houses.

EME 2A
@EEEStrathclyde

For the EWB project. The main focus for us was connectivity and transportation. So the solution is, a little card that connects Nextbike, busses and subways. Where the people of Govan can have a discount on transport, which will save them a lot of money.@EEEStrathclyde @EWB

BME 8A
@EEEStrathclyde

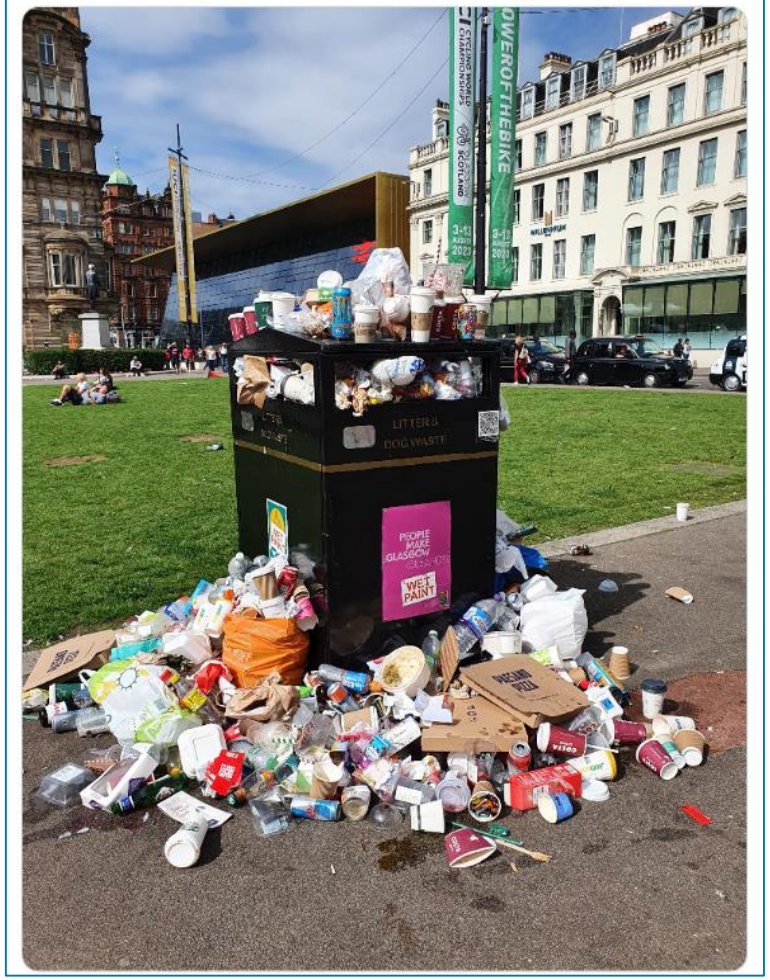
We were tasked with solving food insecurity in Govan and our solution was to create a 'Community Group' in the library where people can come and share food ideas, ingredients, and recipes from their culture whilst we help reduce cost of food in the area by bulk buying, sharing coupons and finding the best deals. @EEEStrathclyde and @ewbuktag 🍇.

EME 3A
@EEEStrathclyde

For our project with @EEEStrathclyde and @ewbuktag, we chose to design a new electric bus route that would go from Govan Bus Station to Buchanan Street Bus Station. This would include a free bus pass that would be available to people seeking asylum and those with low incomes.

EME 2A
@EEEStrathclyde

Had a great time attempting to solve Govan's waste problem with a upcycling program @ewbuk @EEEStrathclyde



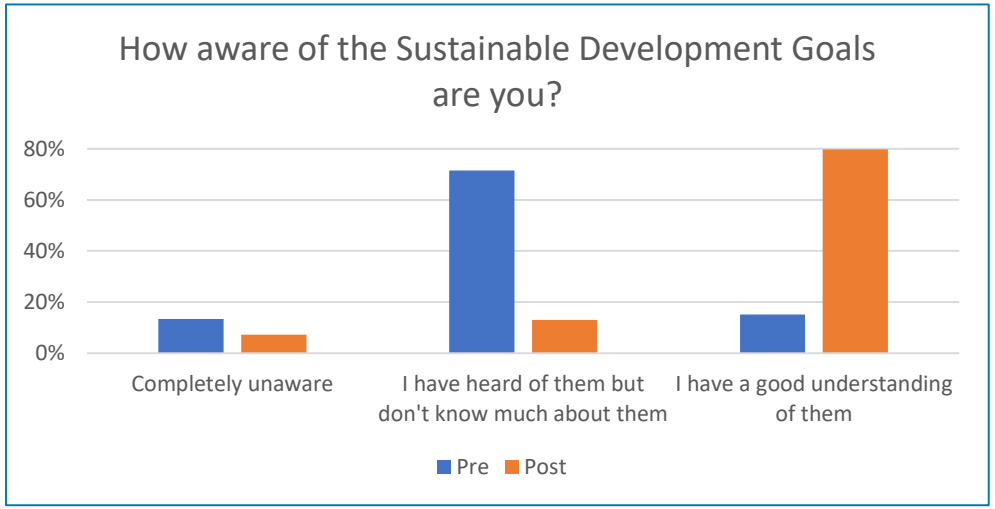
What the students say

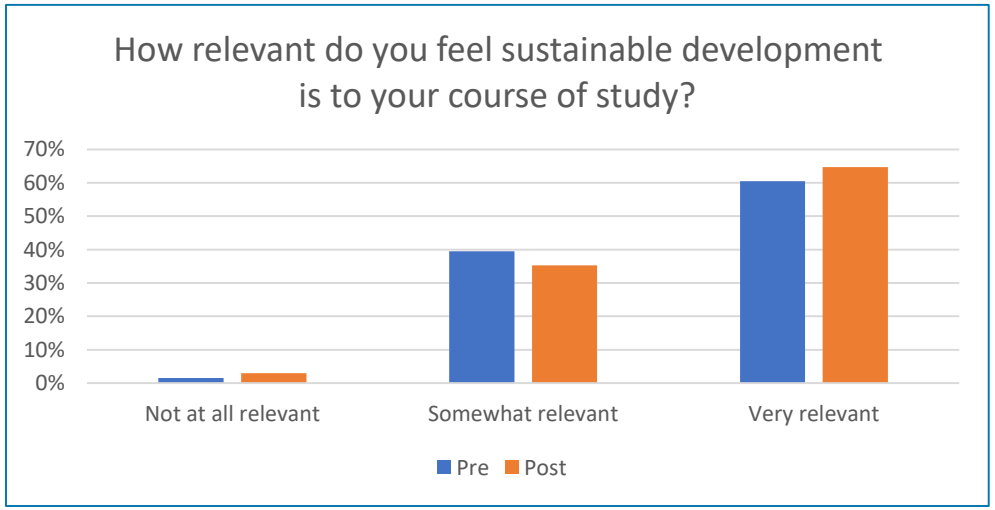
@EEEStrathclyde @ewbuktag Thank you for opportunity for allowing us to participate in this course and letting us come up with ideas to better the life of those in Govan.

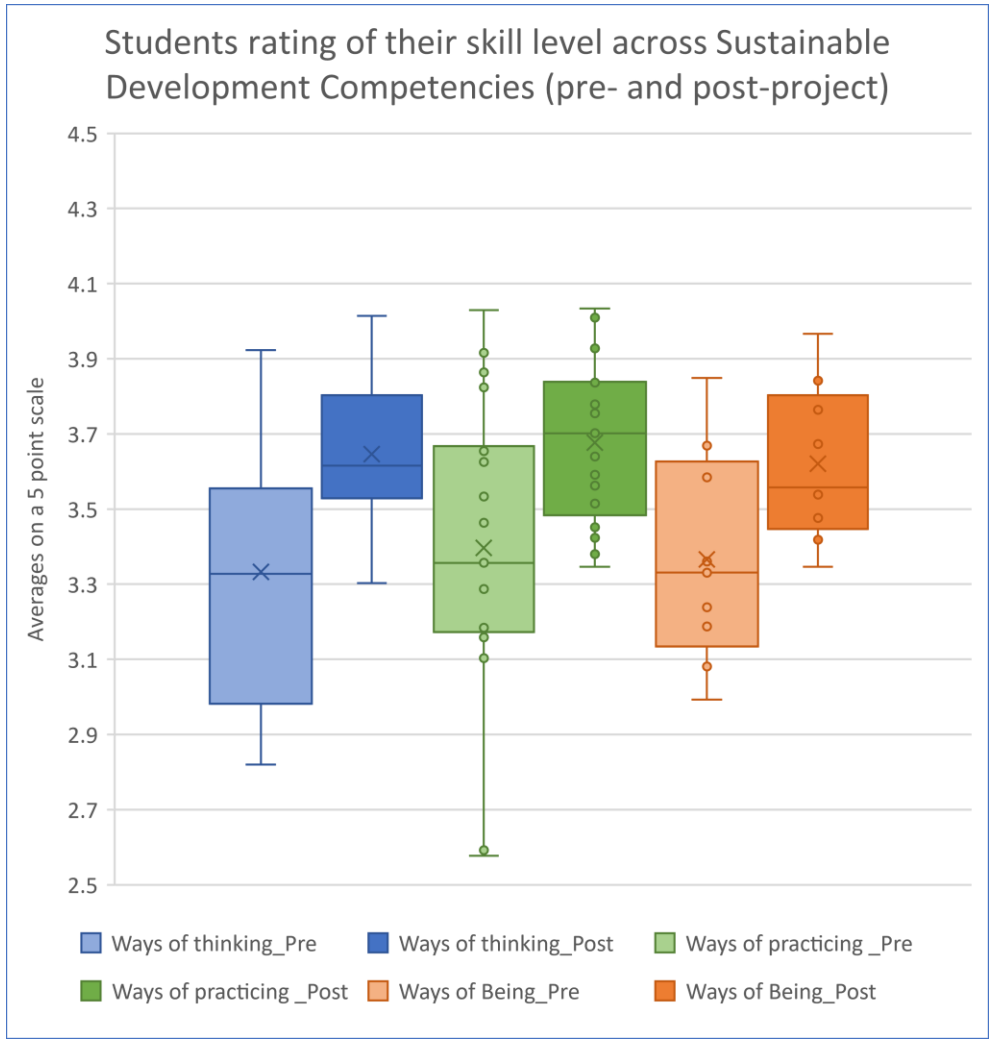
In the @EEEStrathcylde department we spent the year brainstorming solutions for Govan's transport issue in association with @ewbuktag. This process made us think critically and analytically and we have definitely learned a lot. Thank you to @ewbuktag for this opportunity!

- Students have moved on from this project to the VIP4SD programme – an opportunity to engage in challenge and research based ESD in every year of their degree.

Student Impact







Challenge Based ESD framework

Benefits for learners

1. Authentic approach to assessment students
   - Assessment for learning
   - Assessment has active role in learning
2. Centralising agency of the student
   - Collaborative learning
   - reflective self-assessment processes
3. Assessments structured and aligned
   - Scaffold students through learning
4. Gaining ILOs is an inevitable consequence of taking part

Challenges for teachers

1. Making room for ESD
   - Curriculum development
2. Staff proficiency in ESD
   - Staff development needs
3. Assessment and feedback literacy
   - For students and staff
   - Clear assessment guidance
4. Preparing students for self- & peer-assessment
   - Opportunity to gain literacy
   - Benefits explained and demonstrated

Conclusions

Offered a framework to integrate ESD through CBL

- Important that all in HE consider how to integrate ESD into our students' curricula.
- Make opportunities for all students to engage in experiential learning opportunities of challenge-based ESD

Offering a high-quality SD learning experience for our engineering students today, the engineers of tomorrow.

University of Strathclyde Engineering