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

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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

EQUALITY   EQUITY   LIBERATION

https://twitter.com/kristopherwells/status/72115876388173004B

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.)

EWB Engineering for 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
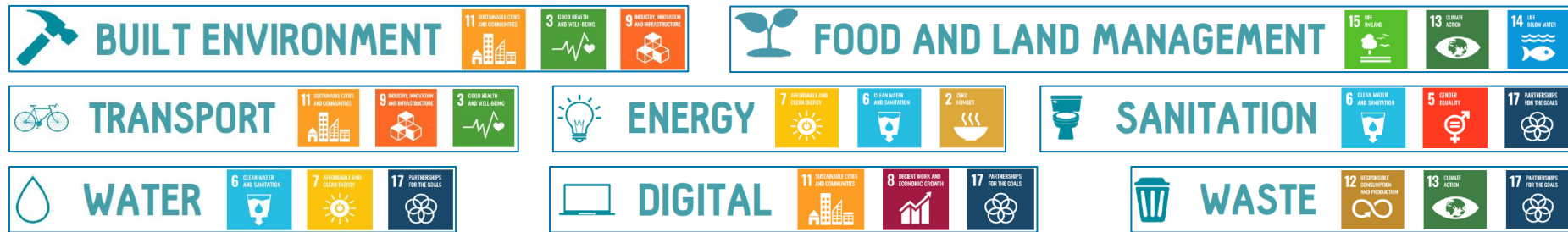
Students:

- 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 the solution must be appropriate to economic, environmental & social context

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*	

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

6

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 🍇.
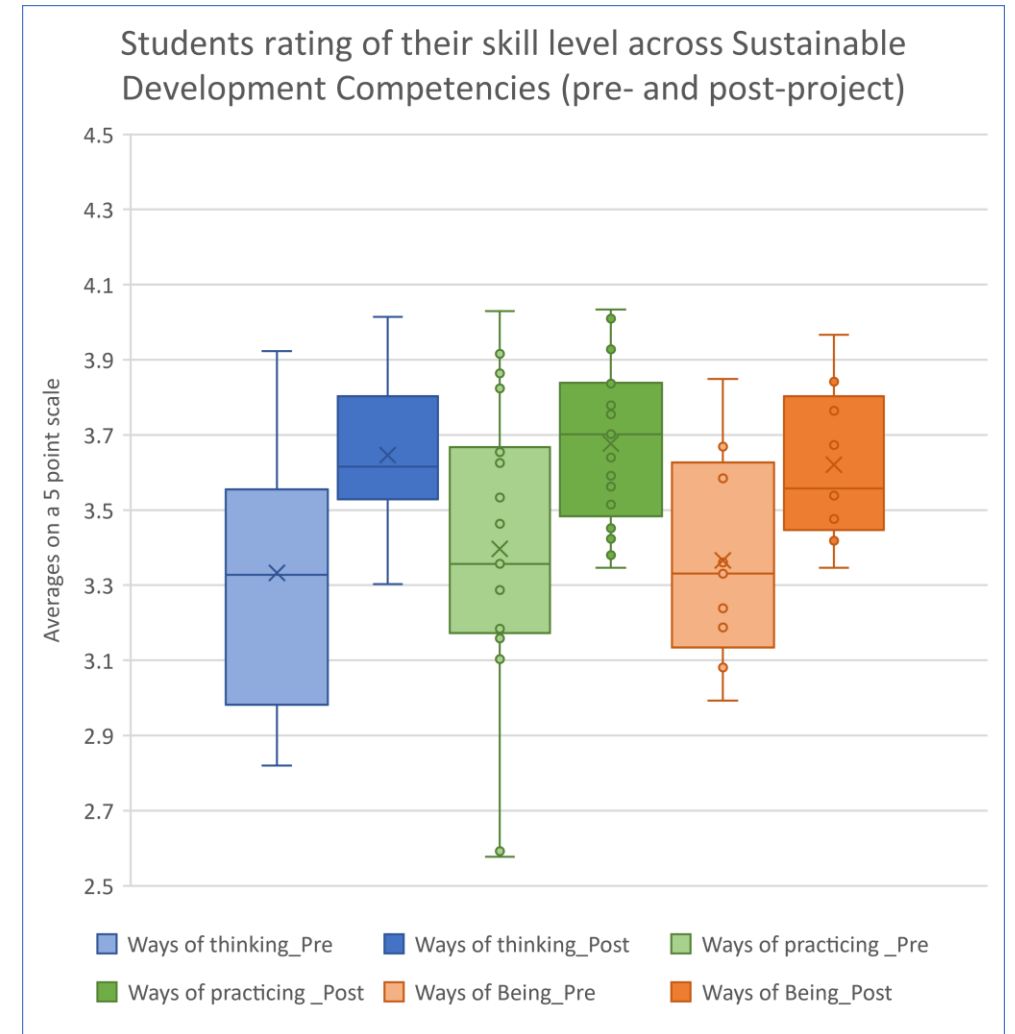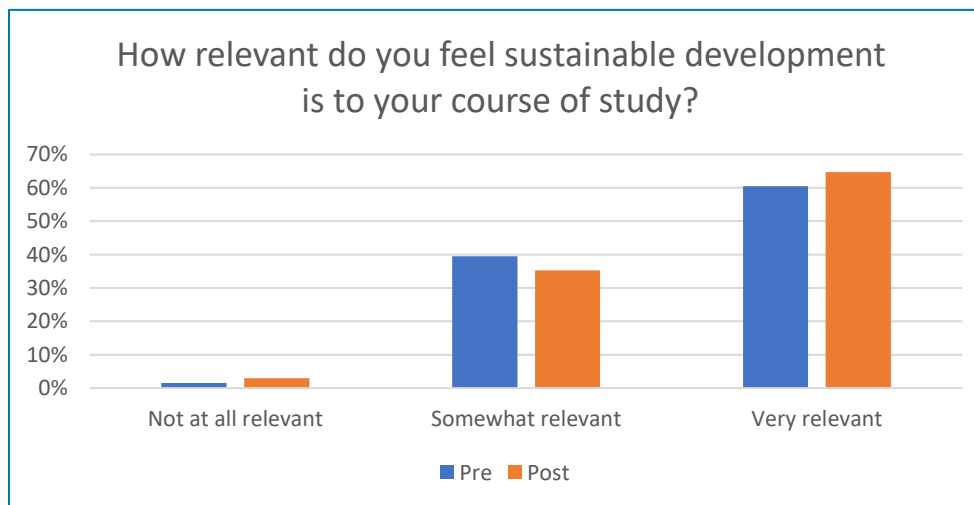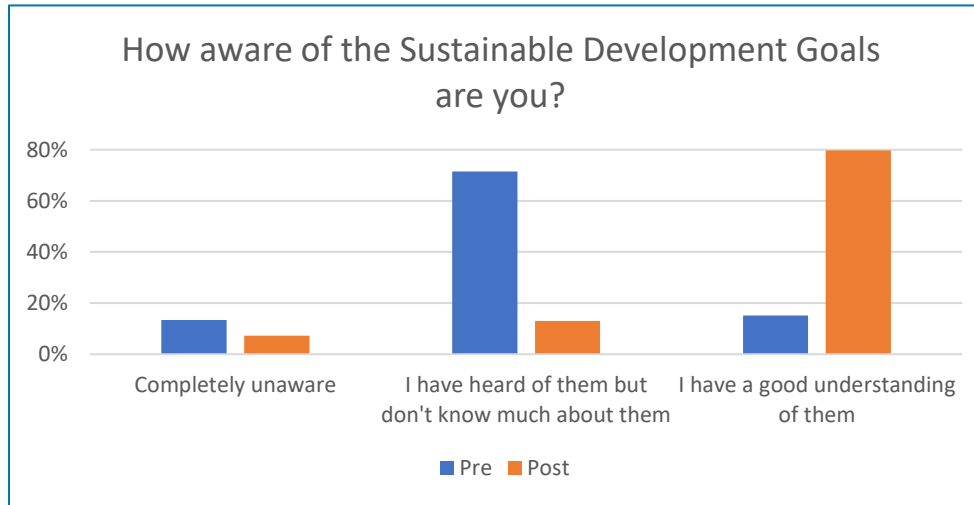
EME 3A
@EEEStrathclyde

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

Student Impact

How aware of the Sustainable Development Goals are you?

How relevant do you feel sustainable development is to your course of study?

Students rating of their skill level across Sustainable Development Competencies (pre- and post-project)

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 & demonstrated