'Perceptions of sustainable development relating to engineering programmes'

Professional bodies require that engineering undergraduates are familiar with the concepts of SD and students express a desire to learn about SD.

But...

Are they talking of the same thing?, what does the world expect of engineers? and how can these issues be satisfactorily incorporated within a range of engineering programmes?

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a) Are students interested in sustainable development?

b) What does sustainable development mean for engineering students?

c) What external factors influence engineering education?

d) How are engineers introduced to sustainable development?

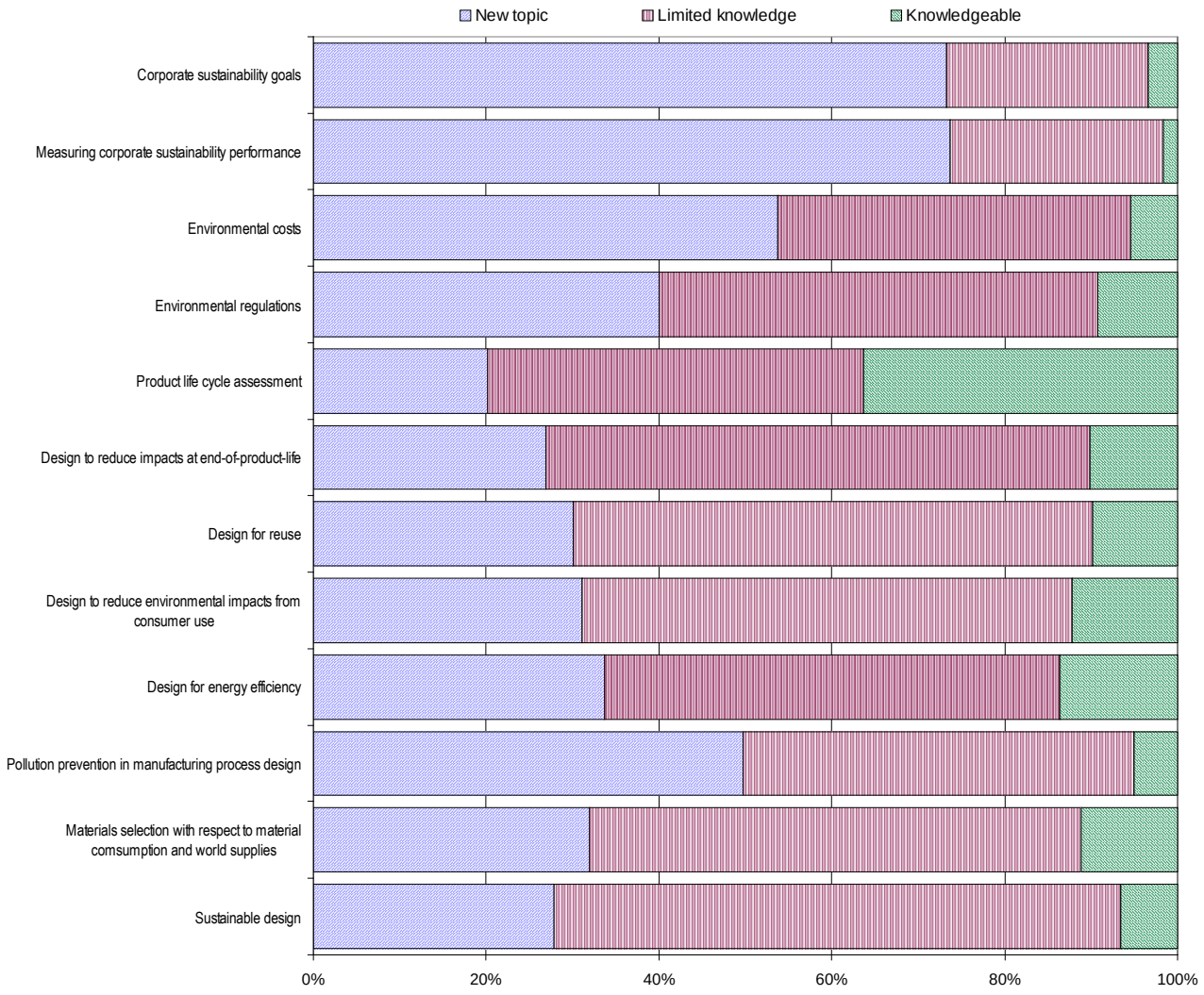
A project funded by the HEA Engineering Subject Centre has explored student perceptions of sustainable development and factors influencing the teaching of sustainable development to undergraduate engineering students in UK universities.

The main student activities were a questionnaire (4 universities) and focus groups (2 universities).

Summary results;

The question 'based upon a score of 1 to 5 how concerned are you about sustainability and the environment, 5 = very concerned, 1 = not concerned' resulted in an average of 3.9.

With only four instances of a score of 1 and three of 2 from a sample of 145.


New topic
Limited knowledge
Knowledgeable
Corporate sustainability goals
Measuring corporate sustainability performance
Environmental costs
Environmental regulations
Product life cycle assessment
Design to reduce impacts at end-of-product-life
Design for reuse
Design to reduce environmental impacts from consumer use
Design for energy efficiency
Pollution prevention in manufacturing process design
Materials selection with respect to material comsumption and world supplies
Sustainable design
0%
20%
40%
60%
80%
100%

The focus group topic guide was structured to explore the following themes;

- Understanding and awareness of the concept of sustainability.
- Value and importance of sustainability.
- Are there any barriers to learning about sustainability?
- Any additional issues raised by the students.

What are your definitions of sustainability?

Responses with a discipline base brought in specifics relating to materials and design "*Thinking about the materials we use in our design. Thinking about where they come from*" or "*Trying to choose materials that have low environmental impact*".

Broader responses showed a range of levels of understanding and also engagement between the students within the group. For example very general comments "*It's about recycling*" developed into discussion within the group "*In India sustainability is very complex and hard to understand*"….. "*I disagree - some of it is just common sense*"….."*No, it's more than that, it's a very broad area. It's difficult to pinpoint what it is exactly*".

The discussions also reached the broadest issues "*It's a moral issue and a cultural one*"……"*It's a very personal thing as well, it ranges from the individual to huge organisations*".

Is sustainability important, does it worry you?

All respondents said that sustainability was very important. *"Yes, definitely. It's **the** most important thing"…….."Yes, it is hugely important to me"*.

"It's very important as we are going to run out and by the time we do run out it will be too late to do anything, for example – when all the oil runs out – what will we do about cars?" ……."Yes I do care as I want my children [when I have children] to have a good life."

The discussions regularly contrasted specific issues with the wider social aspects of sustainability *"It comes back to a moral debate really"*.

"Countries like India and China need to know not to copy America; they must find it very difficult to understand not to emulate America,"…."The West should not export their bad habits to poor or old countries".

"Technology is becoming far more efficient but it can also create new problems."

Where do you get your own knowledge about sustainability?

In general the responses from the participants made a strong case for the incorporation of sustainability teaching within the engineering curriculum. With current sources of learning suggesting that peers and the media are important.

"Peer pressure counts for a lot. It's a generation thing isn't it – the older generation ….don't really understand the concept yet."

"There is a lot of knowledge out there. We need to get it into practice, into University teaching. It simply isn't there, in the teaching."……"There were a couple of energy lectures but the importance of sustainability was never stressed."

Should Universities teach sustainability? and how sustainability is currently taught?

"Well I think so, its very important"……..

"There's a lot about it in the media – I think it's very important for engineers to know about sustainability".

"It should definitely be taught at an earlier age. In schools for example"……."Yes, I agree".

"We get a reasonable overview of it but very little depth"…….

"The knowledge is out there, but we aren't being taught it that's for sure".

Do you practice sustainability?

Although participants had expressed significant concern this was not necessarily translated into action:

"I'm just very lazy, so no"…….. "Recycling can be quite time consuming".

Approximately half said that they did try to practise sustainability;

"As much as I possibly can, yes"……"We can do a lot of easy things like switching off lights and saving energy"……."I'm a mean Yorkshireman so it's in my nature anyway to switch everything off"…….

But also recognised that communicating with others is a challenge;

"*Sustainability is quite hard to practice. People are scared to change, my dad is never going to change the way he uses his washing machine. I feel as though I'm nagging him all of the time. He doesn't understand how he and his washing machine habits can make a difference"……."Different generations have different attitudes"……"*

Do universities have a responsibility?

The responsibility for sustainable practice is seen to go beyond course content; "*Yes definitely"…….."It should be university policy to be sustainable".*

This was then illustrated by specific examples of poor behaviour for which the university is seen as institutionally responsible; "*There is a big problem with paper wastage"…….. "Well look at today, here – the heating is still on, it's boiling hot outside"……."The computers are always on, Always. That's pretty bad*".

Asked if the actions of the university would assist students in their understanding of sustainability issues there was almost unanimous agreement "

"yes, it would have untold benefits"……

"yes, but that's not the point really the university should be doing it because it's the right thing to do, not just to develop student knowledge".

What external factors influence the teaching of sustainable development to engineering students?

The main influences are professional bodies through the process of accrediting courses to provide the academic component of a graduates professional registration as a Chartered Engineer [CEng] a process overseen by the Engineering Council UK and articulated in their document - UK-SPEC (UK Standard for Professional Engineering Competence)

Section E3 of UK-SPEC;

Undertake engineering activities in a way that contributes to sustainable development.

This could include an ability to:

- *Operate and act responsibly, taking account of the need to progress environmental, social and economic outcomes simultaneously*
- *Use imagination, creativity and innovation to provide products and services which maintain and enhance the quality of the environment and community, and meet financial objectives*
- *Understand and encourage stakeholder involvement.*

The Royal Academy of Engineering have defined twelve principles of sustainable engineering;

1) Look beyond your own locality and the immediate future
2) Innovate and be creative
3) Seek a balanced solution
4) Seek engagement from all stakeholders
5) make sure you know the needs and wants
6) Plan and manage effectively
7) Give sustainability the benefit of the doubt
8) If polluters must pollute….then they must pay as well
9) Adopt a holistic, 'cradle-to-grave' approach
10) Do things right, having decided on the right thing to do
11) Beware cost reductions that masquerade as value engineering
12) Practice what you preach

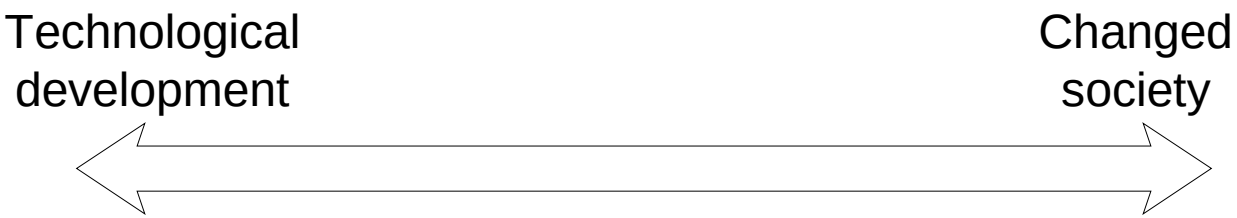
In addition to the above the Royal Academy of Engineering have placed a requirement to justify decisions relating to sustainability in a wider social context with their Statement of Ethical Principals;

"Respect for Life, Law and Public Good….

Minimise and justify any adverse effect on wealth creation, the natural environment and social justice whilst ensuring that all developments meet the needs of the present without compromising the ability of future generations to meet their own needs.".

What may be concluded about integrating sustainable development into engineering education?

1) engineers need to decide where their responsibility lies
2) society needs to decide what it expects



Aspects of Education for Sustainable Development for Engineering Education

	✓ if engineering issue only, otherwise blank	Rank by priority for engineering graduate
Sustainable design		
Material selection with respect to material consumption and world supplies		
Pollution prevention in manufacturing process design		
Design for energy efficiency		
Design to reduce environmental impacts from consumer use		
Design for reuse		
Design to reduce environmental impacts at end-of-product-life		
Product life cycle assessment		
Environmental regulations		
Environmental costs		
Measuring corporate sustainability performance		
Corporate sustainability goals		

Definitions

Select from the list below which components should be incorporated within a statement defining sustainable development for professional engineers.

	required	desirable
Acting both globally and locally		
Understand and encourage stakeholder involvement.		
Operate and act responsibly, taking account of the need to progress environmental, social and economic outcomes simultaneously		
Use imagination, creativity and innovation to provide products and services		
maintain and enhance the quality of the environment and community, and meet financial objectives		
to go beyond the role that engineers would traditionally have		
not compromise the ability of future generations to fulfil their aspirations		
to lead technological development contributing to competitiveness and human development		
use professional knowledge to help strike a fair balance		
ensure their work produces lasting benefits		
ensure the needs of the poor are met		
understand the wider consequences of their decisions		

Your suggested definition;

As guiding aspects of engineering education for sustainable development become broader in their scope the aim set out by Pritchard and Baillie becomes a recognised aspiration;

> *"So, let us start this educational experience with the aim of fostering a seamless interface between engineering and society and consider the attainment of a global, socially just society as our desired end point and work back from that to consider what systems, structures and education can support such an outcome."*

Pritchard J, Baillie C. How can engineering education contribute to a sustainable future? European journal of Engineering Education. 31. 5 (2006) pp555-565

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Northumbria Centre for Excellence in Teaching and Learning - Assessment for Learning