Embedding Sustainability into Computer Science teaching

Dr Neil Gordon

Department of Computer Science and Technology

University of Hull, Hull, HU6 7RX England

n.a.gordon@hull.ac.uk

www.hull.ac.uk/neilgordon

March 2022

Why and how long?

- I have been doing this since 2007, having become aware of it through the (former) subject centres (MSOR and ICS)
- Partly motivated by an interest in how to contextualize the ethical, professional, social and legal aspects of computing (as per the BCS accreditation requirements)
- In 2007 I developed a case study on embedding SD in computing
- In 2008 I led a HEA funded project looking at student views of sustainability and how that related to career development
- In 2010 I developed a set of RLOs for SD in computing (with colleagues at Leeds Becket)
- In 2011 I developed CPD for the HEA STEM subject group on "the sustainable practitioner"
- I have developed various examples, case studies and publications on how sustainability can contextualize ethics and social awareness within teaching
- ….

Sustainability in Computer Science education

Aims
- *to provide a framework for student's legal, social, ethical and professional awareness of computer science.*
- *to encourage students to work collaboratively, with a focus on environmental and societal problems, and the scope for solutions, from the domain of computer Science.*
- *Students develop their research and independent learning skills, alongside communication and team working, as they investigate issues*

Topics include

- *we consider professional practice, ethics and the SDGs.*
- *We begin by exploring ideas of responsibility and associated morality, then the British Computer Society's aims to make IT good for society: which align closely with SDGs, especially SDGs 3, 4, 8 and 9.*
- *We look at how all of the SDGs may be addressed through computing technologies*
- *We also consider how these also linked with relevant UK government plans for achieving some of the SDGs*

UNIVERSITY OF HULL

Integration and development

- This was a stand-alone module on Sustainable Computing
- Now developed as a key theme within our new professional development module
- Approach based on a framework for embedding Sustainable Development

1.Gordon, N. and Dixon, J., 2021. The United Nations Sustainable Development Goals: A Setting for Professional and Research Skills. *New Directions in the Teaching of Physical Sciences*, *16*(1), p.n1.
2.Gordon, N., 2015. *Sustainable Development as a framework for ethics and skills in Higher Education Computing courses*. In Integrative Approaches to Sustainable Development at University Level (pp. 345-357). Springer, Cham.

Computing as an enabler

Using software,
computer research and
new technological
techniques we can help:
improve pollution,
save energy,
promote reuse
and tackle other
problems

Computing

Industry

Society
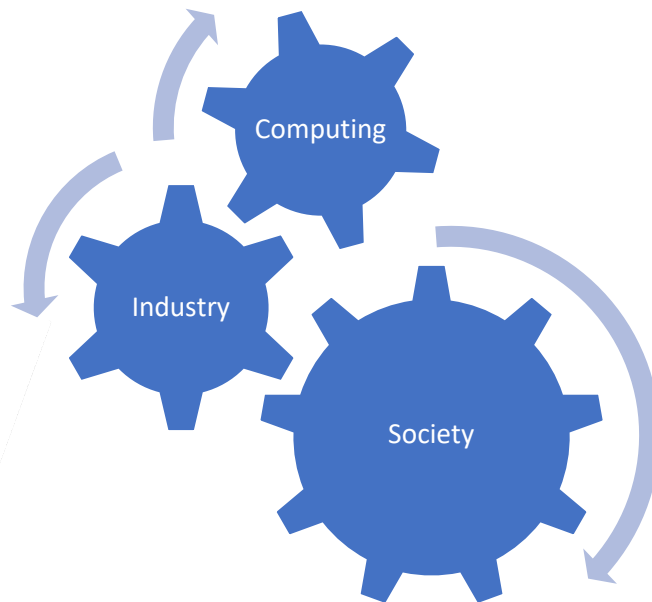
Examples...

Reduce Computer Generated Pollution	Reduce non-computing pollution
Improve usage models (standby modes, auto switch off)	Improve logistics (less wasted journeys)
Upgrade code to boost efficiency, maximise maintainability of software	Virtual meetings (video conferencing)
Virtualise/emulate to prevent the need to have lots of different devices	New manufacturing models and efficient designs (e.g. 3D printing, 3D modelling)
	More efficient buildings / intelligent buildings
Improve efficiency of components	Smart Grid (smart electricity production and sharing)

Wider Examples…

Raise Awareness	Improve the World
Create apps that help people track their sustainability	Develop smart AI to help others (e.g. healthcare, finance, safety)
Introduce timers and in-game alerts to help gamers identify how long they've been playing	Improve security to minimise the risks of illegal activity
Facilitate research (e.g. big data analysis) to help understand the problems/risks	Encourage positive societal impact (e.g. facilitate free speech, help people to share)
Open access to data (e.g. councils)	Develop technologies to help ensure financial viability of companies/individuals

Impacts

- Student awareness
- Student acceptance
- Student awards
- Case studies
- Publications

- Campus impact: strategic plans
- National impact: work with AdvanceHE
- International impact: supporting colleagues elsewhere, citations show the value in other disciplines and areas

Barriers and solutions

- Students: needing to understand why
- Colleagues: don't see the need; failure to be flexible in what we teach; reluctance to step outside of comfort zone
- Curriculum: considered overfull

- Quality processes: changing curricula or assessments can be a problem

- Provide context and rationale

- Explain benefits and provide support and resources

- Link with curriculum

- Be innovative and persevere

Get in touch: n.a.gordon@hull.ac.uk www.hull.ac.uk/neilgordon