Editorial

Whether you are aware of them or not you can be sure that the UN's Sustainable Development Goals (SDGs) will shape your day-to-day life: both at home and at work. We tend to assume that the SDGs are about climate change – but they go far beyond this, focusing on issues such as reducing food waste, human rights and basic infrastructure for everyone. Goal four is about quality education. However, Malala Yousafzai is quoted as saying that *"all the SDGs come down to education."*

Therefore, this edition of Reflections covers a wide range of articles that focus on quality education and the support systems around this, both within our institution and beyond. It's a bit of a bumper edition, indeed there are too many articles to introduce them all in this editorial. However, throughout the articles you will find some connecting themes. For example, how you might embed SDGs within your courses. There are also articles that explore the link between policy and practice, including within our own institution. Many of the articles pose important questions about our current practices and behaviours and how these might be addressed.

SDGs are important to our students. As Eileen Martin and Dr Emma McKenna state at the start of their article: *"As we in Queen's University continue on our journey to embed the Sustainable Development Goals (SDGs) at all levels of activity, working in partnership with students is an area ripe for further development. Directly involving students in tackling societal issues pertinent to the SDGs using active and engaged learning is vital. There are several initiatives in the University that provide ways to do this – for example Green at Queen's and Volunteer SU offer excellent co-curricular opportunities. However, building this work into the curriculum is valuable in offering these experiences to students who may not have the time or capacity to engage in activities beyond their studies."*

I hope that you find inspiration within these pages of Reflections to help you consider the role that SDGs might play within your own teaching and research. Happy Reading!

Claire Dewhirst
Editor of Reflections

As Easy as S-D-G?

By Kieran Higgins, School of Biological Sciences

If you haven't heard the Sustainable Development Goals (SDGs) mentioned here in Queen's, you must have been living under a rock. You could be forgiven generally, as they don't get a lot of media coverage, but at our University, we are said to be "embedding" them in our work. Our Strategy 2030 document explicitly states that "our educational programmes will be increasingly focused on embracing the ethos of the United Nations Sustainable Development Goals at a local, national and global level."

The UN defines the SDGS as *"an urgent call for action by all countries - developed and developing - in a global partnership"* which is both heart-warming and deliberately vague. They are essentially 17 thematic areas of non-binding targets and indicators that should be internationally achieved so that we can say sustainable development has occurred. What this means for each country and region is not clarified, and therefore something called "localisation" must occur, even to the level of your individual lecture.

But what does that actually mean? "Embedding" has become a buzzword for higher education. McArthur (2022) warns against this jargonization, reminding us that, when a word ubiquitously enters our lexicon, we run the risk of no longer thinking critically about how we do it, why we do it, or what it even means.

Embedding means to make something integral, to the point that we can no longer really separate it from the matter that encloses it, or truly distinguish between them. The 2022 CED Annual Learning and Teaching Conference was appropriately titled "SDGs: Taking Action or Ticking Boxes?". For some of our colleagues, embedding the SDGs simply means putting a picture of them on their Canvas module or mentioning them during a lecture. If you can delete the picture, or omit their mention from the lecture, then you haven't embedded anything – you've ticked a box.

But, like a lot of things in higher education we are supposed to be embedding, we are expected to just know how to do this. Therefore, to

better understand how to embed the SDGs, we need to look to Education for Sustainable Development (ESD) for answers.

ESD emerged most prominently from the fields of Education for Sustainability (EfS) and environmental education in the early 2000s, urged on by UNESCO's declaration of the period 2005-2014 as the UN Decade of ESD (de Haan et al., 2020). This would have been in relation to the Millennium Development Goals, which were replaced by the SDGs in 2015. ESD continues to feature highly as a mechanism for achieving the SDGs by their target end date of 2030.

ESD, in its broadest sense, is about translating or localising the SDGs into educational outcomes and practices in all levels and sectors of education, and equipping our students with the knowledge, skills and values needed to empower them to tackle the growing international problems that give rise to existential fears, most notably climate change and inequality among them (Hallinger & Nguyen, 2020).

The first step to this is usually to introduce the SDGs to your students and provide content on the related thematic areas. But we all know that student engagement dips when the link to the subject is not immediately obvious. Teaching about SDG2: Zero Hunger on a food science degree appears simple, but what if you teach engineering, economics or even literature? It takes a little more creativity then. Can your students design a system for environmentally sound, high-yield subsistence farming? Can you look at the influence of quotas, tariffs, and taxes on local and global food supplies? Can you examine a text that portrays starvation and famine, looking at the wider social attitudes on hunger? You do not have to teach the entirety of the theme, nor be a subject-matter expert, to be able to set your students thinking about these issues.

Now that students have the knowledge, how do we equip them with skills and values? One of the key aspects that ESD-informed educators acknowledge is that we cannot possibly teach our students everything that they need to know. Therefore, it is important instead to train students how to think (the head), imbue them with a sense of passion and responsibility (the heart) and prepare them to take action (the hands). This head, hands and hearts approach is operationalised through competency frameworks (Giangrande et al., 2019).

These competency frameworks are variable, and change regularly, but the most commonly used competencies that make up ESD are normative competency, systems-thinking competency, future-thinking competency, strategic competency, collaboration competency, problem-solving competency (Wiek et al. 2016), self-awareness competency and critical thinking competency (Rieckman, 2018). These map well to programme-level graduate capabilities and skills, and you are probably already developing most of these competencies in your students, either explicitly or implicitly. The key to doing this is a move towards transformative pedagogies, active learning, experiential learning, authentic assessment and so on, as well as a move away from the banking model of education (Hjorth Warlenius, 2022). For further details of embedding ESD in action, particularly these competencies, please consult (Re)Designing a Module to Embed Education for Sustainable Development (ESD) later in this issue.

Of course, we do reserve the right to think critically about how and why we teach. The SDGs are not the panacea that they are often perceived to be. They are open to many criticisms: there are too many, there are not enough, or that they are the white westerner's perspective on sustainable development. Most critically, they are based in the pro-growth paradigm, favouring economic growth as the solution to our environmental and social problems. In a world that may be stretched to the very ceiling of its resources, is more growth, no matter how green, really the answer?

ESD in itself can be problematic. There is a heavy focus on empowering individuals, on igniting in them a sense of responsibility for our global problems. Why? They did not create them and will likely be unable to do very much until governments and large businesses fundamentally alter the way they operate. Perhaps though, our students might just be the little cogs that change the direction of the larger machine?

Embedding is always difficult because embedding is analogous with change. Once we have grappled with the what, how and why of that which we seek to embed, we will encounter resistance, be that recalcitrant colleagues, reluctant students or even the procedures that are designed to maintain the "quality" of our teaching. As Sara Ahmed wrote, "a system is working when an attempt to transform that system is blocked." Systems are, by their very nature, determined to self-perpetuate, and none more so than the global systems that have created the problems ESD seeks to address.

So, this academic year and beyond, your challenge is to be blocked, to meet resistance. That is how you know you are doing something right – when you feel like everything is going wrong! If one tiny change to your practice (or explicitly naming something you've been doing all along) can create the people who might very well just save the world, it will be worth a headache or two!

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Building Partnerships for the Goals: a collaborative approach to embedding the SDGs in the Queen's Community

By Sara Lynch, Head of Sustainability (on behalf of the University Carbon Change Management Group)

Our University Strategy 2030 places a commitment on the University to embed the Sustainable Development Goals across the University. The delivery of this commitment requires collaboration and partnership, which isn't without its challenges, given the size and make up of our University community.

Through the work of the University Carbon Change Management Group*, we have sought to create a number of opportunities to work beyond the scope of our individual areas and collaborate with others to embed the Sustainable Development Goals across the University.

These projects have widened staff, student and local community understanding of the SDGs and built valuable relationships across the University that continue to flourish creating further opportunities. An outline of recent projects is described below:

Carbon Literacy Training

The Change Management Group has worked with Keep Northern Ireland Beautiful to develop bespoke Carbon Literacy training for delivery to Queen's students. The training materials have been accredited by the Carbon Literacy Project.

In 2022 the training was delivered online to over 280 students from across the three Faculties.

The course is split into three modules. and involves approximately 12 hours of learning, with each module consisting of two sections -

— Self-study materials – working through a presentation in preparation for a group meeting.

— A group meeting to review learning from the self-study materials, develop ideas and work towards certification, facilitated through whole class discussion as well as online break-out sessions

The course has helped the participants to improve their knowledge and understanding of carbon and how their daily activities like travel, energy use and food consumption impact on emissions. The nature of the course allowed for discussion and debate amongst staff and students from a range of disciplines and backgrounds as well as providing time for reflection on how what they have learned could be applied in their own lives.

Further sessions are planned for 2022/23 for staff and students across the University.

Queen's Green Fund

The **Queen's Green Fund** was launched in February 2019. The University fund enables staff and students to apply for grants of up to £1,500, to help them bring their green ideas to life on campus, and support the wider objectives of the University's commitment to the environment. Over 40 projects covering a wide range of sustainability initiatives from staff and students across the University, received funding impacting on a range of SDG's. Many of the projects saw staff and students come together to co-design and deliver a project on campus.

The projects have been successful in developing a range of skills from the practical, for example how to grow fruit and vegetables, to leadership and project management skills, as well as the core aims of the initiative, to widen awareness of sustainability across the University community.

Sustainability Action Programme (Previously the Environmental Leadership Programme)

Queen's Sustainability Action Programme aims to inspire, equip, and support students to bring about positive action for both our climate and biodiversity. The programme consists of workshops and volunteering opportunities and the opportunity to implement student own project on campus.

The Degree Plus accredited programme, (previously known as the Environmental Leadership programme) has seen over 200 students from a wide range of disciplines come together to increase their understanding of the Sustainable Development Goals; create, develop and deliver solutions to a real-world on campus sustainability challenge; and develop skills in communication and understanding of behaviour change.

LEAF – Sustainable Laboratories Programme

LEAF is a sustainable lab certification programme which aims to embed good sustainability practice within university laboratories. Created by University College London (UCL), LEAF is a set of criteria that allows labs to determine if they are following sustainable practices in their teaching and

research. This includes reducing waste, sharing materials with other labs, decreasing energy usage etc.

Working with technicians across the University, 12 labs progressed through a pilot phase of the programme in 2021/22, achieving Bronze. The programme brought together labs from School of Pharmacy, School of Medicine, Dentistry & Biomedical Science, School of Biological Sciences, School of Maths and Physics and School of Chemistry and Chemical Engineering.

The programme brought technicians from across the University together throughout the year to discuss sustainability challenges within their labs and share best practice in addressing these, as well as widening their knowledge and understanding of key sustainability areas such as waste, energy and procurement.

The programme has strengthened relationships across the University between Estates, technicians and researchers, provided practice learning experiences that enhance professional skills and is enhancing understanding of our research-intensive buildings and operations.

The 2022/23 programme will build on the success of the pilot, increasing lab participants and providing further opportunity for collaboration, shared learning and embedding of sustainable practices within labs across the University.

Further information on the initiatives detailed are available on the University's website: **Sustainability | About | Queen's University Belfast (qub.ac.uk)**

*Change Management Group – Professor Peter Robertson, School of Chemistry and Chemical Engineering (Chair); Dr William Megarry School of Natural & Built Environment; Dr Emma Berry, School of Psychology; Sara Lynch, Head of Sustainability; Amy Miscampbell, People and Culture; Chloe Ferguson, Students' Union; Peter Erwin, Head of Estates Services; Dieter Pesendorfer, School of Law; David Robinson, Information Services; Anthony Schmidt, Estates Directorate; Mary-Ellen Donaghy, Internal Communications; Rachel Vaughan, Estates Directorate; Amanda Slevin; School of History, Anthropology Philosophy and Politics PCAN, John McCann Estates Directorate; Cecilia Heron, Accommodation.

Partnering with SOS-UK, Engineers without Borders UK (EwB) and Sulitest to deliver education for sustainable development in Electronics, Electrical Engineering and Computer Science (EEECS)

By Professor Stan Scott, Sustainability Champion, EEECS

The UN Sustainable Development Goals (SDGs) set out a framework for eliminating poverty, stemming detrimental climate change, and creating a more just and sustainable future for all. In EEECS we seek to enhance our education portfolio not only through the inclusion of context-based knowledge from relevant SDGs but also by augmenting graduate competencies through effective teaching practice.

To find out where we are we on our sustainability journey we first needed to map our current education provision onto the SDGs. We believe in partnership with students as a key driver for success. Accordingly, we joined forces with the student-led education charity SOS-UK and participated in their student-led SDG curriculum mapping programme. The programme has been approved for Degree Plus (Route A) recognition.

Over an 8-week period, between April and June, five PhD students in EEECS conducted a curriculum audit of 114 undergraduate and postgraduate modules. Prior to the mapping exercise, the students attended a training workshop facilitated by SOS-UK staff. They explored the SDGs, the role of education in contributing to sustainability, how to engage critically with SDGs, and how to audit module descriptions against the 17 SDGs and criteria on the wider aspects of sustainability learning and ESD pedagogy.

The methodology for the SDG curriculum audit was developed by SOS-UK in partnership with the University of Winchester and Winchester Students' Union. The audit used existing EEECS module descriptions which typically provide an overview of intended learning outcomes, an overview of content, and a summary of teaching methods/pedagogy and assessment.

The student auditors reviewed the module descriptions to identify whether the themes encompassed by the SDGs are included, whether wider aspects of sustainability learning are included, and whether ESD pedagogies are used. In each case a score of 0, 1 or 2 was assigned: 0 (nothing), 1 (a little), 2 (a lot). The auditors were encouraged to provide textual comments on missed opportunities to include sustainability within a module.

The SDG descriptors were taken from the United Nations[1]. The latter two lists are modified from the AdvanceHE/

The purpose of the curriculum audit was to provide EEECS staff with a baseline understanding of how our current programmes and modules support students' understanding of sustainability in an engineering context. And, arguably more important, how we equip students to confront, manage, and shape this century's pressing social, economic, and ecological conditions that are characterised by change, uncertainty, risk, and complexity. By way of illustration, top level results from the audit are shown in the graphs below.

Number of mapped modules covering topics related to SDGs [total number of modules: 114]
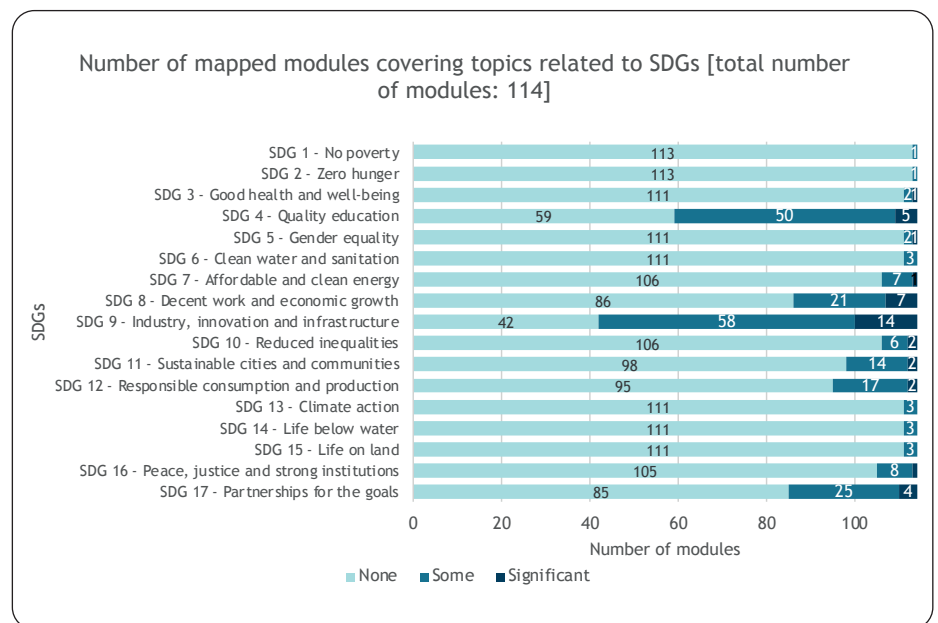
QAA ESD Guidance[2] and included the following themes.

- Wider aspects of sustainability: Take real-world action; Challenge business as usual; Critical thinking skills; Collaborative problem solving; Ethics and values; Seeing the bigger picture; Understanding sustainable development

- ESD pedagogies: Problem-based learning; Experiential project work; Simulation; Stimulus activities; Case studies

Because several students took part in the audit, and each may have interpreted the audit criteria slightly differently, there may be variations across the data. This is natural and the SOS-UK training is designed to ensure as much uniformity as possible.

The SDGs are an imperfect model and have been criticised for their focus on a neoliberal and capitalist economic model. Nevertheless, they are largely accepted as the 'road map' and common language for sustainability this decade and are used, in this project,

1   https://sdgs.un.org/goals
2   https://www.qaa.ac.uk/quality-code/education-for-sustainable-development

Wider aspects of sustainability learning in all mapped modules [total number of modules: 114]
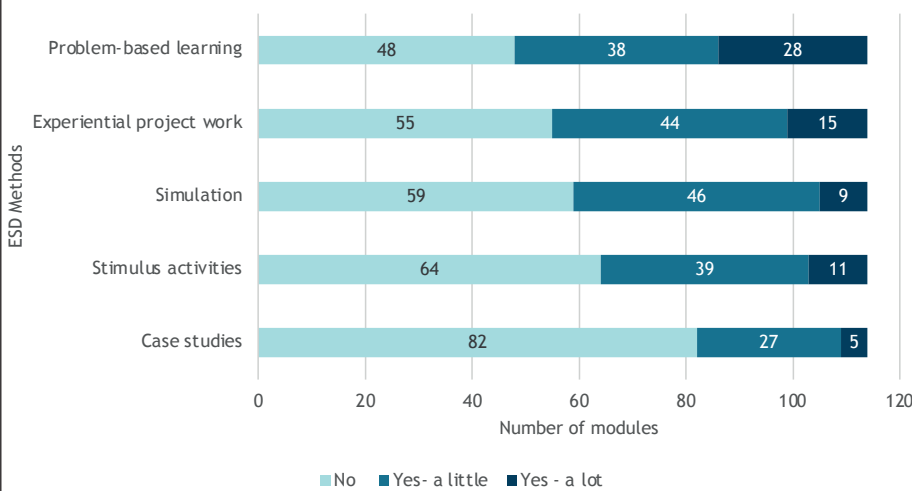
Wider aspects of sustainability learning

Aspect	No	Yes- a little	Yes - a lot
Take Real-World Action	76	20	18
Challenge Business as Usual	84	25	5
Critical Thinking Skills	16	58	40
Collaborative Problem Solving	71	29	14
Ethics and Values	84	18	12
Seeing the Bigger Picture	55	43	16
Understanding Sustainable Development	82	24	8

Number of modules

■ No ■ Yes- a little ■ Yes - a lot
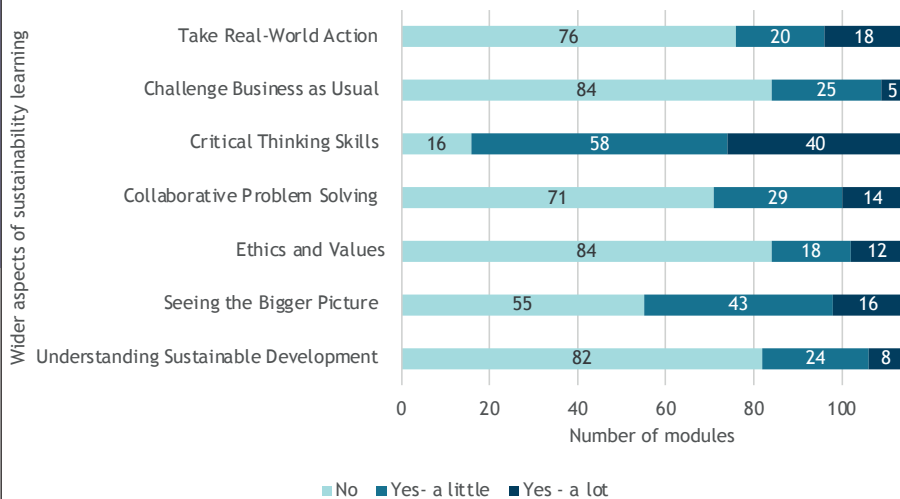
ESD methods in all mapped modules [total number of modules: 114]

ESD Methods

Method	No	Yes- a little	Yes - a lot
Problem-based learning	48	38	28
Experiential project work	55	44	15
Simulation	59	46	9
Stimulus activities	64	39	11
Case studies	82	27	5

Number of modules

■ No ■ Yes- a little ■ Yes - a lot

as a descriptor for the breadth of sustainability. The exercise has proved valuable to give an initial understanding of where we are and has highlighted many places where sustainability could be easily embedded within a module. Indeed, in some cases sustainability is already present but has not been captured by the wording used in the module description. Building on this audit, a staff led audit will be performed annually, forming part of each programme review and module review, contributing in due course to Periodic School Review (PSR) and Continuous Action for Programme Enhancment (CAPE).

Teaching sustainability in an instrumental way by calculating carbon budgets and linking projects to the SDGs that they impact is insufficient. Rather, it requires an ethical shift in mindset about how we see ourselves in relation to others and the world. Contextualising technical content within an ethical, economic, and environmental framework is needed. To progress this, we have partnered with EwB and are incorporating its *Engineering for People Design Challenge[3] into CSC2058, Software Engineering and Systems Development*, a double module with over 300 students. The Design Challenge uses a project-based learning pedagogy and is supported by a comprehensive design brief that enables student teams to investigate the challenges faced by a real community and to design a solution to meet the community's needs. The

challenges typically centre on the built environment, transport, energy, water, food, sanitation, waste, and digital communications. Importantly, the Design Challenge contributes to the Engineering Council requirements for students on accredited degrees to demonstrate understanding of the design process and have a broad awareness of the economic, legal, social, ethical, and environmental context of engineering.

To raise sustainability literacy across the School we, together with King's College London, joined the SOS-UK changemakers programme. SOS-UK staff delivered workshops to staff and students on democratising, decarbonising, and decolonising in teaching, learning and research. Additionally, we have partnered with Sulitest whose online tool is designed to raise awareness and to improve understanding of the 17 SDGs. Led by an independent NGO and co-created with a community of users and a network of contributors, Sulitest is supported by more than forty international institutions and networks including UNESCO. The test, which takes from 20 mins to 45 mins to complete, is undertaken anonymously, and consists of 30 multiple choice questions with at least one question on each SDG. Users are given the correct answers with explanations and sources to deepen their learning about sustainable development issues.

Each EEECS member of staff was encouraged to take the quiz before the start of this academic year. A related Sulitest Quiz will be used during the induction of new students. We plan to be early users of TASK (The Assessment of Sustainability Knowledge) the first certificate to set the standard of sustainability knowledge. It targets students who are about to graduate, supporting them in the transition to the job market and offering the School the opportunity to measure the impact of its ESD provision.

3   https://www.ewb-uk.org/upskill/design-challenges/engineering-for-people-design-challenge/

Engaging with the Janus face of sustainable development: A critical pedagogy on and beyond the Sustainable Development Goals

By Dr Jack Taggart, School of History, Anthropology, Philosophy and Politics

Later this year I will, as part of a longstanding engagement, attend the 2022 Summit of Global Partnership for Effective Development Cooperation (GPEDC) in Geneva. This meeting takes place at the halfway point of the Agenda 2030 and Sustainable Development Goals (SDGs). This meeting offers national, civic, and private representatives of the global community an opportunity to review the progress to date. The mood is not optimistic.

The UN's 2022 SDG report revealed that COVID has wiped out more than four years of progress on the eradication of poverty, while pushing nearly 100 million more people into extreme poverty (UN, 2022). Negligible progress towards cutting greenhouse gas emissions suggests that a sustainable transition is highly unlikely. In the immediate and short term, ever more extreme weather events become the norm. Yet our trajectory of inaction poses - in the words of UN Secretary-General António Guterres - a catastrophic and 'existential threat' to humanity and our ecology (UN News, 2018). Our continued pursuit of consumption and ever greater economic growth is increasingly energy intensive, while the gains of such growth are concentrated in the hands of a tiny elite. In 2020, the poorest 50% of the world's population owned just 2% of total private property, and there are few signs of these trends abating (Chancel et al., 2021).

Given these challenges, the embrace of the SDGs by Queen's University is laudable. It reflects the University's global orientation, burgeoning expertise, and commitment to resolving the pressing challenges of our age. The SDGs are themselves a remarkable achievement; they are the product of extensive and inclusive global consultations, and they exhibit a considerable degree of reflexivity having incorporated lessons learned from prior agenda. The SDGs may well constitute the best international agenda we currently have for addressing economic and ecological issues in tandem. Yet even under the most optimistic scenarios, the SDGs will not be enough to save us from disaster. At best, the SDGs may provide much needed relief to those suffering from extreme poverty, improving education, and gender equality, while mopping up the worst excesses of decades of consumption. However, in the worst case, the SDGs may well forestall the radical transformation of our habits, relationships, and political economies that is required to meet the scale of the crisis.

Post-graduate students in my new Global Development module will receive a thorough grounding in the contemporary state of international development cooperation, including the implementation challenges for key global agendas, along with the various public and now private agendas that comprise the field. Yet from the beginning, they will be under no illusions as to the promise of good intentions within mainstream global development agendas. We begin our exploration with the origins of international development. Here, colonial administrations such as Britain used Poor and Welfare acts to placate more radical agitations on behalf of their indigenous subjects (Cowen & Shenton, 1996). The palliative function of international development was likewise crucial in the US' - and its allies - battle with the USSR for the hearts and minds of the so-called 'Third World', while foreign aid was subsequently laden with conditionalities towards the coercive transformation of Southern countries in ways that would be conducive to Northern corporate interests.

Today, the UN's SDGs inherit these lineages, and they are ultimately based on a paradigm of economic growth; they offer perpetual and ever-greater consumption as a catch-all solution to a variety of social, economic, and ecological challenges. That is, the SDG Agenda prescribes perpetual and ever greater consumption as a remedy to the crisis, or, more of the same poison as the cure.

The challenge of critical pedagogy in the context of Sustainable Development is to equip students with this reflexive understanding as to the nature of the sector, while affording them with the critical skills that are necessary for work within reactive and fast-paced international development organisations. One of the challenges of teaching such subjects is managing the sense of despair and despondency towards the lacklustre prospects for the realisation of development agendas. Yet hope lies alongside the interests of students. While engaging with the history, evolution, and dynamics of contemporary international development organisations is an essential component of understanding the sector, the most enthusiastic engagement comes from discussions on alternative development paradigms. Foremost is the paradigm of 'degrowth' that implores a need to abandon economic growth as the driving rationale of our societies (Schmelzer et al., 2022). It instead proposes that we shrink sectors of the economy associated with unnecessary consumption while augmenting those committed to conviviality and community. In short, it offers the promise of 'private sufficiency, yet public luxury'. Just five years ago this paradigm was the fancy of the fringe and heterodox, dismissed as a utopian and hopeless fantasy. Yet as the crisis unfolds, it is enjoying a surge in popularity and serious consideration: the continued pursuit of business-as-usual is now, it seems, the fairy-tale.

But such radical alternatives will not be on the agenda in Geneva. Instead, we will discuss the very real and immediate challenges of cooperation towards the implementation of the SDGs. QUB students will be well positioned to contribute to such processes as future practitioners, but they will also be afforded the space to think beyond the confines of old and discredited paradigms. Our sustainable future may well depend on it.

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Building active approaches to the Sustainable Development Goals into your teaching

By Eileen Martin and Dr Emma McKenna, The Science Shop at Queen's University

As we in Queen's University continue on our journey to embed the Sustainable Development Goals (SDGs) at all levels of activity, working in partnership with students is an area ripe for further development. Directly involving students in tackling societal issues pertinent to the SDGs using active and engaged learning is vital. There are several initiatives in the University that provide ways to do this – for example Green at Queen's and Volunteer SU offer excellent co-curricular opportunities. However, building this work into the curriculum is valuable in offering these experiences to students who may not have the time or capacity to engage in activities beyond their studies.

The Science Shop's already existing model provides one interesting way to scaffold active learning about the SDGs, particularly in relation to undertaking research. The Science Shop provides a bridge between community-based organisations who need small scale pieces of research and QUB staff and students who want to carry out an engaged research project as part of the curriculum. They have an active database offering a wide range of community-based research projects which can be directly linked to the SDGs. Projects are available on everything from renewable energy to health, social policy to statistics.

In recent years students working with Science Shop carried out research related to 12 of the 19 UN Sustainable Development Goals from courses including Computer Science, Social Policy, Engineering, Management and Leadership for Sustainable Development. Looking at a range of issues, students examined the feasibility of reopening the Clarendon Docks for use; other students developed a framework to assess the viability of Community Gardens and provided recommendations to successfully develop existing gardens.

As part of the Erasmus+ CIRCLET project (see **www.circlet.eu**) we have also extended our model and found new ways of embedding community-engaged research and SDGs into curricula beyond our traditional dissertation model. We have experimented with full module and lighter-touch research projects where students can begin to see the impact of their research in small ways. For example, in terms of SDG3 health and wellbeing - under the guidance of Suzanne Russell and Dr. Ikhlas El Karim, students on the 'Evidence Based Dentistry' module have begun to carry out systematic reviews on behalf of community partners. Students have reviewed best practice for working with people with dementia on behalf of Springfield Charitable Association and reviewed guidance for working with children with congenital heart disease on behalf of Children's Heartbeat Trust.

In Maths, Gareth Tribello redeveloped his module 'Stochastic Processes and Risk' to engage students in modelling data on behalf of Fermanagh Community Transport to help them identify potential efficiencies. This opens students up to thinking about the importance of infrastructure (SDG 9) and sustainable communities (SDG 11).

If you are interested in seeing a much wider range of good practices from the five partner universities in the CIRCLET project, including QUB, they are available at www.circlet.eu.

If you want to know more about projects currently available through The Science Shop you can check our website list at **https://www.qub.ac.uk/sites/ScienceShop/LiveProjects/**. We work with a wide range of community organisations and projects are available across all Faculties. If you don't see something there that might be relevant to your students we are happy to discuss further to see if we can come up with something that might work for you. If you are interested email **science.shop@qub.ac.uk** to arrange a meeting.

Maths student meeting with Fermanagh Community Transport representative

A Case Study: CQC Student-Staff Partnership Project

Dr Maryam Malekigorji and Dr Caoimhe Clerkin, School of Pharmacy

Education is at the heart of the United Nation's Sustainable Development Goals (SDGs) Agenda 2030 with higher education (HE) playing a paramount role in changing values and attitudes towards Education for Sustainable Development (ESD) and Education for Global Citizenship (EGC) [1]. This role is frequently linked with the concept of internationalising HE "to benefit the wider community, at home or abroad, through international or intercultural education, research, service and engagement" [2]. Currently, there is a gap in sustainable skills learned at university and those required to function at work and in society [3].

This research investigates the impact of student involvement in curricular design and teaching delivery on students' academic performance who are enrolled on transnational education (TNE) programmes. It was determined that students who are involved in the co-design of modules were more satisfied with the module and performed better evidenced by their final year module assessment. With careful consideration of the requirements of both partner institutes, the successful implementation of a student-staff partnership will lead in the delivery of tailored bespoke TNE degree programmes worldwide.

Introduction

In 2014, Queen's first international college was established and became known as China Medical University - Queen's University Belfast Joint College (CQC), located in Shenyang, Liaoning Province, China. Here, CQC delivers two Queen's University Belfast (QUB) BSc degree programmes, namely Pharmaceutical Science and Pharmaceutical Biotechnology, to over 400 registered students. While this transnational project has been successful, it has not been without its challenges such as differences in legislation, business practices, political systems, and social culture between both partner institutes [4]. Moreover, reports suggest that Chinese students are taught primarily through large group teaching, with few one-to-one or tutorial-based sessions, leading to the development of a strong hierarchical relationship between teacher and student [5]. This style of teaching is commonly referred to as teacher-centred learning (TCL) [5], and creates a dependency on their teacher, which can limit their knowledge and the ability of fostering lifelong learning skills [7, 8], such as the development of creativity and original thinking, required to address process skills in global professional practices [7, 9]. The idea of a 'one style fits all approach" is exclusionary [10] and prevents students from retaining information, applying it more effectively and becoming greater achievers [11-13]. This is confirmed by several studies demonstrating that TCL is inferior to student centred learning (SCL) [14-18]. SCL offers students the opportunity to become self-directed learners [19], which is reported to allow students to self-regulate [20], to take responsibility of their learning and become more accountable [18]. Students will be more likely to question, justify and validate arguments through open enquiry and not just reiterate the given reasons [21].

Student-Staff Partnership Project

Since CQC's establishment, its educators have innovatively provided interactive, experiential, transformative, and real-world learning [22,23], influenced by SCL [24]. However, in 2019 and in collaboration with the Students' Union, the Student-Staff Partnership was designed to recruit learners as co-designer, to promote SCL and to understand students' expectations of their degree's learning outcomes, delivery, and assessment. All the while helping to bridge the gap between cultural disparities in education and to ensure all needs are met inclusive of student background, learning styles and potential [24].

Partners in this project are both staff and students, engaging in learning and working relationships, in pursuit of common goals [25]. Together staff and students review the current learning outcomes, the delivery methods and curriculum in an effort to understand each others' expectations for the degree. Further, this project has great emphasis on Universal Design for Learning (UDL), which supports the creation of flexible ways of learning, inclusive and equitable quality education, and lifelong learning opportunities. As a result, the programme's aims are aligned with the United Nation's SDGs and QUB's Innovative and Flexible Delivery education strand which states, "We will offer increased flexibility in pace, place and mode of study to meet the changing needs of students".

The main aims of the programme, with reference to the literature, is to support educators in engaging students as co-learners, co-enquirers, co-researchers, co-developers, and co-designers [26], to help create innovative solutions, new knowledge [27] and a generation of self-sufficient, critical thinkers who are capable of leading in the global workforce. Therefore, this research sees the establishment of an educational setting to enhance cognitive learning and academic skills through SCL for successful and lifelong outcomes [28].

Partnership

In 2019-20 Academic Year (AY), a low risk level 1 BSc module (Organic Chemistry) was targeted. Induction sessions with the students were arranged and staff and students began to foster a relationship with each other where the purpose of the project was introduced. Student representatives (SRs') were invited to take a key role in the project, by communicating

Focus groups held between staff and students at CQC in 2019.

with both educators and students, distributing surveys, collecting feedback, and attending focus groups sessions with academics, which were advised by the Megginson approach i.e., how to have successful mentoring episodes with best practice examples [29].

To analyse student opinion and feedback as course co-designers, SRs were asked to survey their peers in the areas of student voice, education, and academic enhancement. This was followed up by SRs and academics via focus groups to discuss the key themes arising from the surveys, which identified examples of strategic and sustainable practices of engaging students as partners in learning and teaching.

The project outcomes

The survey results in an Organic Chemistry module revealed students engagement and feedback on key elements for a module such as assessment methods, module content, delivery methods. Students wanted "more structured model-answers and feedback on quizzes" and "to be better notified about module changes". Students mentioned "Molecular interaction in nature is a very interesting lecture but is rather short" and wanted academics to "incorporate organic chemistry in English language in the Foundation Year", "to study the module in the first semester", and to "link the learning outcomes to the module materials clearer".

Discussions during focused groups resulted in modifications to the delivery of the module as outlined below. Some of these changes were major and were required to be approved by the Courses and Regulations Group (CRG) at QUB prior to implementation.

- Delivering continuous and more detailed feedback on module activities to support students' progress and performance
- Guide students better on how to construct their answers for final examinations
- Module changes to be communicated via Canvas announcements
- Highlight, through the course of a lecture, when lecture/module/programme learning outcomes are being met
- Changing selected formative assessments to summative assessments to enhance student engagement

- Delivering Organic Chemistry module in the first semester instead of the second semester to support other Level 1 modules.

Students' overall satisfaction in Organic Chemistry module improved from 79% to 84% in 2019-20 AY in comparison to the previous AY and the module overall performance increased by 5%. The project also improved SRs in the college as a first contact for raising issues, providing feedback, and suggesting changes. This promising result encouraged the authors to continue the project in 2020-21 AY and expand it to other level 2 (L2) and level 3 (L3) modules in 2021-22 AY, which has shown an increase in student engagement, course satisfaction and evidenced by the student feedback such as "the knowledge and skills gained from this partnership course will lay the foundation for my future work" and "the interaction between the teachers and students is excellent. The teaching and learning methods are suitable for my learning and progression". This is hoped to be confirmed by quantitative data upon the completion of the modules in this AY.

Challenges and future plans

Transcending a pedagogical research project to address the SDGs in China is fraught with its own set of unique challenges including an understanding of local issues, infrastructures and compliance to partner's educational regulations provided by China Ministry of Education. Moreover, within this collaborative project, academics and students often do not have a canonical reference point around which they base their own work to develop teaching content. In addition, the task of creating remote, flexible, and online (asynchronous and asynchronous) learning activities during the COVID-19 pandemic is itself cognitively and technically challenging. This may distract partners from genuinely considering student and teacher perspectives, and principles of quality learning design.

In summary, the future project will further investigate what changes can be implemented to the degree pathways that is in line with both partners' regulations, the impact of student involvement in curricular design on their academic progress to better understand expectations of students during their degrees, to explore the advantages and limitations of various assessment methods, and finally, to "ensure inclusive and equitable quality education", SDG 4.

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Universities for Climate Action

By Calum McGeown, PhD researcher, Professor John Barry and Louise Taylor, PhD researcher, School of Social Sciences, Education and Social Work

From the record-breaking heatwaves experienced this summer to unprecedented wildfires, flooding and droughts, scientists are now linking extreme weather events to climate breakdown with more reliability (Clarke et al., 2022), and media coverage of these events means even more citizens are now aware of the challenge. Their growing frequency and the very real threat to life and well-being they pose means that the implications of failing to take effective action on climate are becoming much clearer and more easily understood. Locally, for instance, a report commissioned by Belfast City Council on the city's vulnerability to climate breakdown found that Belfast is at risk of tidal surges, flooding and extreme heat (Madden, 2022).

Related to this, a 2021 report for the Belfast Climate Commission found that "30% of young people indicated that they had been directly affected by climate change. Of those that had been affected, 41% experienced 'anxiousness' while 13% suggested that they had become distracted from other things" (Belfast Climate Commission, 2021, p. 15). These are worrying findings and only set to worsen the more we see climate denial and delay instead of climate action. Of particular relevance to universities as institutions of learning and research is that this report also found that, "There is an issue of trust when it comes to accessing information. 95% of young people trust information from scientists while 35% trust local politicians with information about climate change" (ibid., p. 8). Meanwhile, the International Panel on Climate Change's (IPCC) latest report found that if global heating is to be limited to the 1.5oC agreed under the 2015 Paris Agreement, global greenhouse gas emissions must peak by at latest 2025 (IPCC, 2022, p. 21).

All this indicates that climate should be treated as the precondition for achieving other SDGs, and not a standalone goal. As such, this should be reflected **in everything** universities do, from teaching to research to procurement to outreach, engagement and public service. A stable climate is, after all, vital for maintaining a safe balance in the earth systems we rely on to grow food, access clean water, create and sustain healthy environments and so on. At the same time, taking effective climate action has enormous co-benefits, from cleaner air, new jobs, improved public health and a less geopolitically unstable and dangerous world. However, to deliver the scale of action required to cut emissions within the timeframe available implies deep structural changes to how we live, our economies, societies and modes of governance. This applies especially in the advanced economies of the global North, whose exceptional development was only possible through imperial plunder and colonisation, alongside their burning of enormous quantities of fossil fuels; hence, a global focus on decarbonisation and decolonisation must also be prominent in achieving the SDGs.

The extent to which these transformations imply society-wide efforts to transition to sustainable ways of living means there is a collective responsibility to ensure that it happens in the fastest and fairest ways possible. No single government policy or department, or one sector of society, can address the challenges we face in decoupling how we manufacture, consume, work, play, travel, produce food, heat and power buildings, etc. from the emission of greenhouse gases. That said, given their positions of influence and the vast resources at their disposal, universities could and should play a central role in taking, inspiring and coordinating decisive action on climate. However, this would require firm commitment which surpasses vacuous statements on the climate emergency and championing a sustainability agenda which, in failing to

produce actual change, only amounts to rhetorical 'greenwashing', dangerous climate delay and a decrease in the trust our communities and stakeholders have in them as institutions. Rather, they must embrace the opportunity to show leadership through real, strong and determined action in a time of crisis.

To understand how and in what ways universities could show leadership on climate action, it is first necessary to acknowledge the historic and ongoing role they have played in producing unsustainability. For instance, there are various campaigns which highlight practices incompatible with the notion that our universities should operate according to a sense of social responsibility, both as key public institutions tasked with preparing students for life beyond study and where much of the climate science is produced. The highest profile among these has been the divestment campaign, which calls on universities to remove their investments in the fossil fuel industry. **If it is wrong to wreck the climate system, surely it is also wrong to financially profit from such ecocidal actions?** Notably, however, although some institutions have taken this action, many are yet to do so. This is despite persistent student-led organising on the issue and strong public support for it. Other ongoing campaigns include demands to end links with extractive and polluting industries through research partnerships and graduate recruitment.

Producing unsustainability goes beyond these acts of directly resourcing the fossil fuel industry, however. In much less apparent ways, universities reproduce practices, aspirations and ways of thinking which are not only inconsistent with the systemic changes required, but may in fact actively frustrate them. For example, the relatively little attention given to climate action across higher education curricula in general fails to reflect the severity of the crisis and scale of change that is necessary across all sectors and professions to tackle it. As such, universities are not preparing their students for understanding and navigating the world they will be graduating into. After all, it has serious ramifications for public health and well-being, biodiversity, politics, economics, education, how and what we design and build, where we get our energy, the laws we make, the stories we tell, etc. Educating and training students, and young people especially, in ways which do not have them engage with the impact that these changes must and will have, is to leave them ill-equipped for the world they will inherit.

So, what can be done to confront these challenges? While the above issues might be seen as a failure to adequately grapple with the climate crisis, universities nonetheless possess a great potential which is in many ways unmatched, to make significant interventions in unsustainability both on and off their campuses. There is existing evidence of this, where there are of course examples of good practice in research, teaching and public engagement (Gardner et al., 2021). The point is, however, that we can no longer afford to treat climate action as either a marginal or 'add on' concern, or one that can be neatly allotted to one department or category of university workers, such as Estates or academic staff. Rather, it needs to be an institutional priority, to which all other university objectives are aligned. Given the resources available to them and the status they enjoy as institutions of authority and integrity, trusted by citizens, universities should not wait to be led but should tap into the long pioneering history of intellectual discovery and innovation that helped shape our societies, and again do the leading.

This should start with the obvious issues of ending support for the fossil fuel industry. Institutions of higher education cannot in good faith espouse values of sustainable development and a commitment to climate action while benefitting from investments in extractive and polluting activities. Every university should therefore at the earliest opportunity disinvest from all related companies and break, or at very least refuse to renew, links to fossil fuel interests through research and graduate recruitment. Instead, they could design 'ethics of collaboration' frameworks with input and oversight from staff, students and the wider community, to ensure as far as possible that their resources are used to the benefit of the public they serve.

Another vital action would be for Vice Chancellors to both declare a climate and ecological emergency and then immediately announce a time-limited and democratic process of engaging with staff, students, other stakeholders, supply chain partners, etc., to quickly agree and implement changes in teaching, research, procurement, on-site activities and outreach and engagement to reflect this. Higher education cannot continue in a 'business as usual' manner and will require asking difficult questions and making tough decisions. How does a university's aspirations for 'internationalisation' and the extensive air travel it implies align with the reality of a worsening climate

crisis and the need to decarbonise, for instance? Can they credibly present themselves as SDG leaders while engaging with and actively supporting activities which undermine them?

To address these contradictions and become effective leaders in delivering the SDGs, universities need to institutionalise their commitments to social responsibility. Doing so could mean, for example, investing locally to develop renewable energy or designing and sourcing funding for research which tackles climate concerns as a central focus across all departments. In doing the latter, they should seek to establish a culture of inter- and transdisciplinary working to encourage criticality, reflexivity and accountability across all departments and areas of study. These values should also be reflected in their approaches to education and student experience, with more input from students regarding the issues they feel are important and a much greater emphasis on providing diversity in education. Ultimately, our universities must engage and enthuse their staff and students by encouraging them to tackle this most pressing challenge of our time throughout the duration of their study, teaching, research and beyond.

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(Re)Designing a Module to Embed Education for Sustainable Development (ESD)

By Alison Calvert, Kieran Higgins and Alysha Thompson, School of Biological Sciences, and Tracy Galvin, previously Centre for Educational Development.

"By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development."
- United Nations Sustainable Development Goal 4, Target 4.7

Introduction

During the autumn semester 2021, a review of the BSc Food, Quality & Safety (FQSN) programme was undertaken involving academic staff, current students, programme graduates, placement providers and employers, and industry representatives. This coincided with the publication of the Independent Strategic Review of the NI Agri-Food sector (Kendall, 2021) which identified that "sustainability will become agri-food's licence to

trade". Reinforcing the review team's conclusion that sustainability had to be foundational to the redesigned FQSN programme, this presented a timely opportunity to design and create an innovative new module that would ensure future graduates have the necessary skills, knowledge and understanding to become true change advocates, tackling the sustainability challenges currently facing both local and international agri-food industry. From this, BIO1311 Sustainable Food Systems was born.

Serendipitously, the authors had an opportunity in early 2022 to be part of the Learning Design and ESD Bootcamp delivered by UNESCO and the Open University (OU). Beating out 62 other institutions, we were one of only 10 English-speaking teams that were successful in their application to take part. The overall aim of the course was to embed the Sustainable Development Goals (SDGs) and Education for Sustainable Development (ESD) through transformative pedagogies and active learning methods in a module of our choice. While some teams used a hypothetical module, we chose to apply this to the embryonic Sustainable Food Systems. The team (comprising two academics, an educational developer, and a student), along with two mentors assigned from other HEIs, collaborated synchronously and asynchronously over 12 weeks, working through the Bootcamp Toolkit. The aim of this article
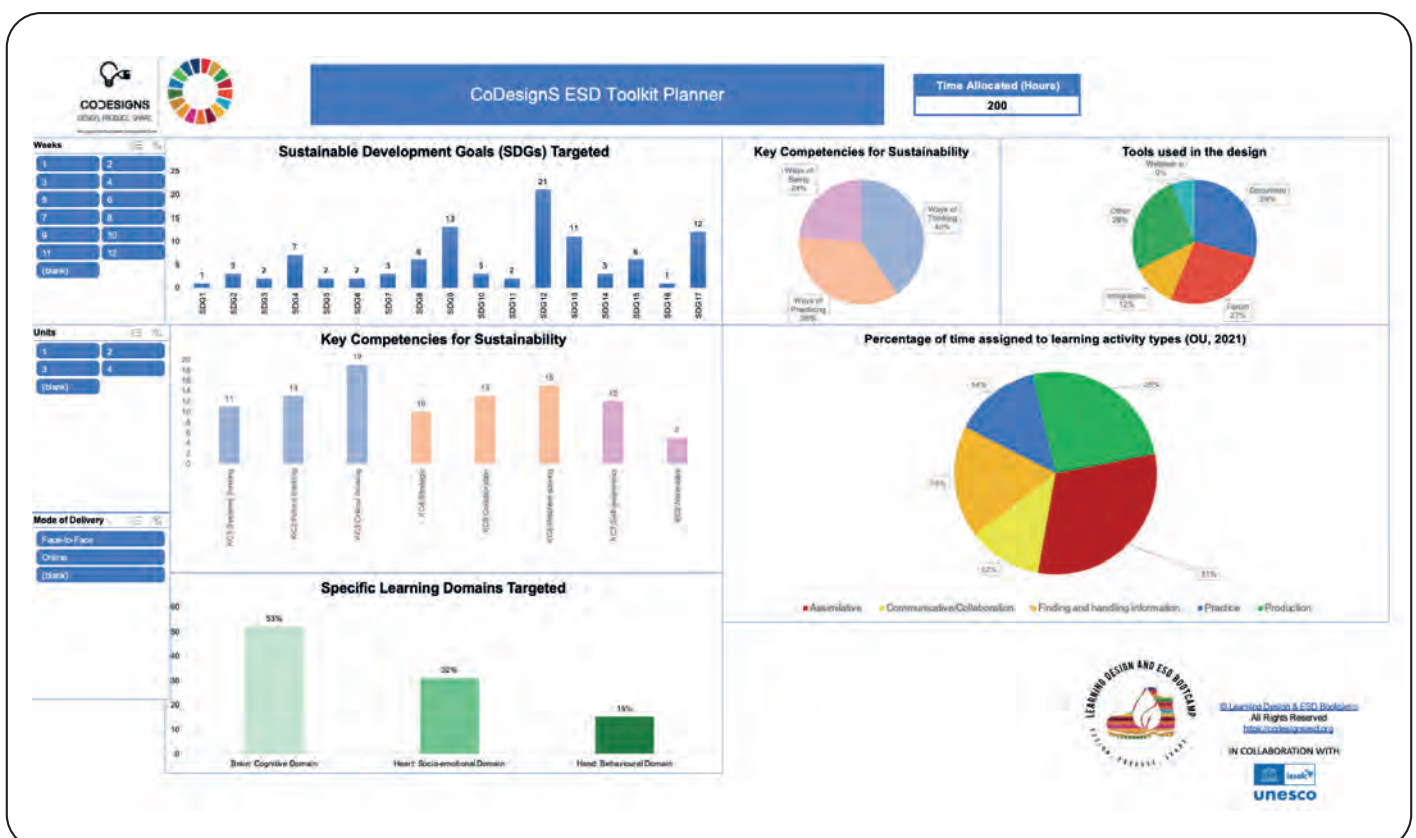

Figure 1 represents the CoDesign ESD Toolkit Planner

is to outline how ESD can be embedded into an existing or new module in a straightforward and accessible way, considering all of the SDGs and related aspects of ESDs.

Learning (Co)Design

Traditional curriculum design often keeps students at the edge, with educators primarily making design decisions. Moving towards a model of both parties making decisions around what the intended learning experience should be in a curriculum or module can be beneficial because it allows for different perspectives to inform decision-making. Learning design would appear to be an area within the teaching and learning domain in which academic staff and students could partner more often (Gormley et al., 2022). Learning design is a decision-making process to design learning experiences for students (Conole, 2012).

The learning design used in the Bootcamp is based on the CoDesignS (Course Design Sprint) Framework (Toro-Troconis et al. 2020). What was most helpful about the Bootcamp was the use of the Toolkit Planner, an online document that captured and visualised each aspect of the learning design as we progressed through the process (Figure 1). The planner required us to break down every hour of student contact and self-directed learning time within the module, and map it to the relevant learning outcome, SDG, ESD competency and learning activity type (as can be seen in Table 2).

As in any module, learning outcomes are always made explicit to learners to establish what should be achieved, though who is responsible for determining these learning outcomes has traditionally been the educator. The idea of students as partners, change agents, producers, and co-creators of their own learning has been the subject of increasing interest in recent years (Dunne and Zandstra 2011). Co-creation can take a variety of forms across different disciplines and institutions, as well as at a local or institutional level.

Staff and students may collaborate to: "evaluate course content and learning and teaching processes; (re)design the content of courses; research learning and teaching; undertake disciplinary research; design assessments such as essay questions or choose between different assessment methods; and grade their own and others' work" (Bovill et al., 2016, p.2)

Co-designing our module was an important aspect of the Bootcamp. Information and feedback garnered from structured and informal meetings with students, alumni, employers, and agri-food industry personnel was used to develop learning outcomes and key module topics, ensuring the needs identified in the original programme review were met by the new module. Most crucially, the varied team the authors comprised, particularly including a student, helped ensure that content was varied, relevant and intentional to the learner interests.

The Bootcamp encouraged us to consider which of the 17 SDGs were most relevant to our subject area, but also challenged us to consider how all of them could be incorporated into our teaching. Though it was initially suspected that SDG2 Zero Hunger would the most salient of the SDGS, it was, in fact, the topics and skills associated with SDGs 9, 12 and 17 that were identified as being crucial to the intentions of the module and occupied most of the contact hours (**Figure 2**),

though all SDGs were covered at some point in the module, in varying degrees of depth.

Key Competencies for ESD

The SDGs are a call to action, and thus ESD must prepare our students to act. Alongside our SDG related content, we therefore also need to think about the non-subject related learnings. Learning and teaching practices therefore should focus on cognitive, socio-emotional, and behavioural domains (head, heart, and hands) to engage students in a transformative educational experience (Cotton and Winter, 2010; Sipos et al., 2008). Such a transformative experience relies on competency frameworks to identify the necessary skills required for students of ESD programmes (Giangrande et al., 2019).

Though variable across the literature, the most common competencies referred to are normative competency, systems-thinking competency, future-thinking competency, strategic competency, collaboration competency, problem-solving competency (Wiek et al., 2016), self-awareness competency and critical thinking competency (Rieckman, 2018). These competencies are defined in Table 1, and mapped to the cognitive, socio-emotional, and behavioural domains in **Figure 3**.

We had not initially entered into the Bootcamp with a preconceived idea

Figure 2 represents the SDGs 9, 12 and 17

The Key Competencies of ESD (Rieckman, 2018; Wiek et al. 2016)	
Normative competency	The ability to understand and reflect on the norms and values that underlie one's actions and to negotiate sustainability values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions.
Systems-thinking competency	The ability to recognize and understand relationships, to analyse complex systems, to perceive the ways in which systems are embedded within different domains and different scales, and to deal with uncertainty.
Future-thinking competency	The ability to understand and evaluate multiple futures – possible, probable, and desirable – and to create one's own visions for the future, to apply the precautionary principle, to assess the consequences of actions, and to deal with risks and changes.
Strategic competency	The ability to collectively develop and implement innovative actions that further sustainability at the local level and further afield.
Collaboration competency	The ability to learn from others; understand and respect the needs, perspectives, and actions of others (empathy); understand, relate to and be sensitive to others (empathic leadership), deal with conflicts in a group; and facilitate collaborative and participatory problem-solving.
Problem-solving competency	The overarching ability to apply different problem-solving frameworks to complex sustainability problems and develop viable, inclusive, and equitable solutions that promote sustainable development.
Self-awareness competency	The ability to reflect on one's own role in the local community and (global) society, continually evaluate and further motivate one's actions, and deal with one's feelings and desires.
Critical thinking competency	The ability to question norms, practices, and opinions; reflect on own one's values, perceptions, and actions; and take a position in the sustainability discourse.

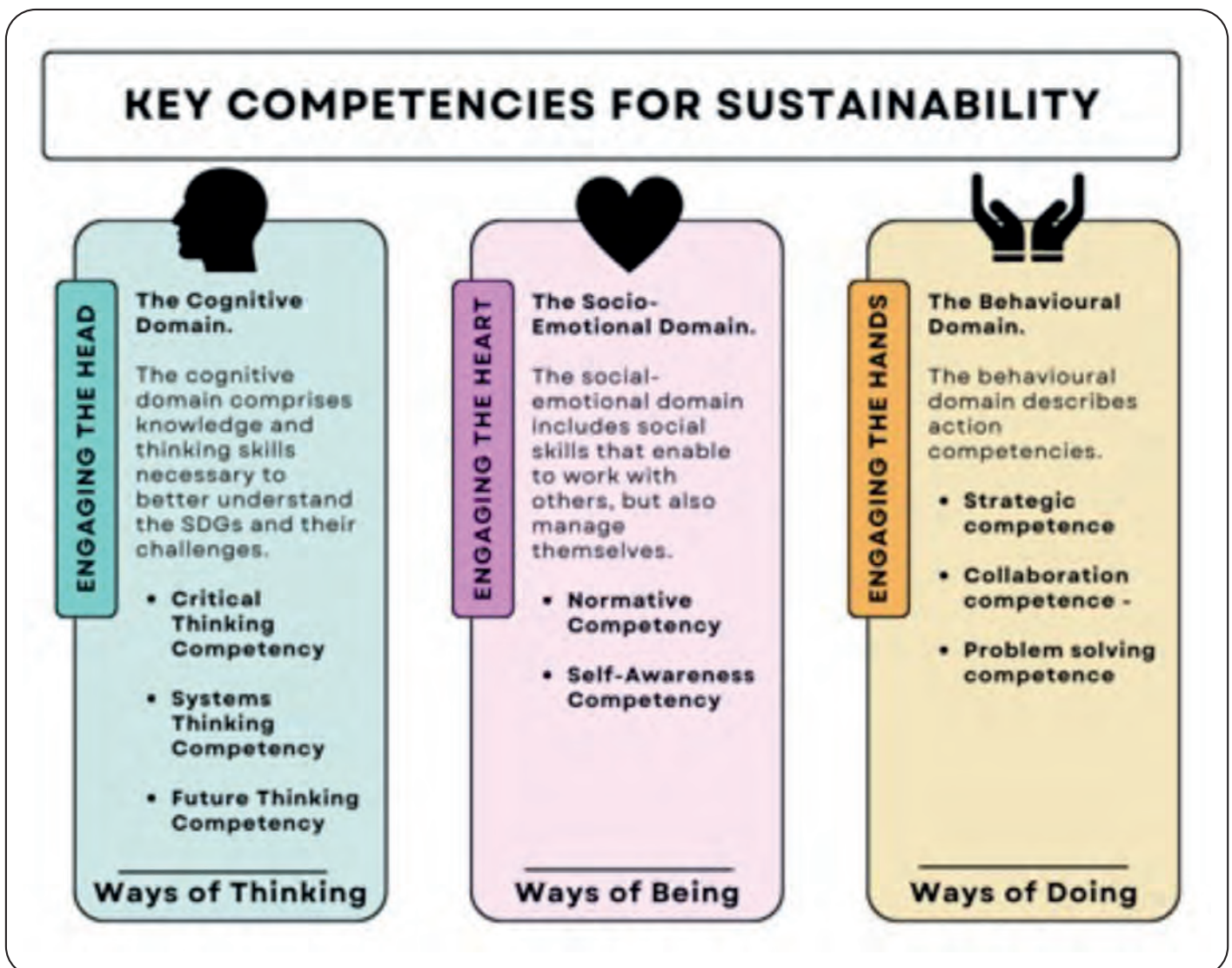**Table 1 represents the Key Competencies of ESD**

Figure 3 represents the key competencies for sustainability

of which competencies to address. As we progressed through the Bootcamp, we saw that critical-thinking, problem-solving and collaboration competencies emerged as the most prevalent ones for the Food Science module. This was determined to be appropriate for us as critical thinking is a core graduate attribute, and our industry partners determined problem-solving and collaboration were key skills for their employees.

Transformative Pedagogies and Active Learning

For active learning to be effective and transformative it cannot be seen as an add on but embedded into the curriculum design. UNESCO (2017) outlines how ESD is recognised as a key enabler of all SDGs and achieves its purpose by transforming society where transformative education covers the content and learning outcomes, pedagogy, and the learning environment itself. Transformative pedagogy according to Tasler and Dale (2021) takes place in the overlap of learning landscapes that is enabled by identity negotiation and dialogic relationships between teacher-learner-places where all of this takes place in a wider educational and cultural context with invisible socio-political actors. From the learner perspective the focus is on their biographies, expectations, and experiences as learners. The teacher's perspective is on their biographies, expectations, their experiences as learners and professional identity. Finally places where the focus is on purpose, design, ergonomics, and accessibility (ibid).

Active learning is any instructional method that engages students in the learning process … [it] requires students to do meaningful learning activities and think about what they are doing." (Prince, 2004, p.233). During active learning, curriculum knowledge is constructed, applied, and evaluated through activity, which might include physical, mental, and emotional acts of learning (Taylor et al., 2019). According to Pratt-Adams (et al., 2020) active learning is about providing opportunities to practise the application of knowledge. The aim is to engage students in a "series of activities which require them to produce observable evidence of their learning. Where possible, these individual, pair and group tasks aim to develop higher order thinking skills, emotional connection with content and tactile or physical engagement with the environment" (Gowers et al, 2022, p.3).

Learning Activities

Having determined our learning outcomes, SDGs, and ESD competencies, we needed to think about how exactly we would deliver these for maximum impact. The Toolkit is aligned with the OU Activity Types Framework (Table 2) used to define and visualise how learners engage with study materials, tools and technology and the study community (OU, 2021). These are: Assimilative, Communicative, Finding and Handling Information, Productive, Practice and Assessment.

Though we maintained a focus on active learning, we did find that the module had the greatest focus on Assimilative activities. We felt this was appropriate for a first-year module so that core subject knowledge would be developed in preparation for future years, but the visuals of the planner helped us avoid an oversaturation of information transmission where possible.

We also wanted to ensure that our assessment was considered authentic. While perspectives on authentic assessment differ depending on the stakeholder, it aims to "replicate the tasks and performance standards typically found in the world of work", and has been found to have a positive impact on student learning, autonomy, motivation, self-regulation and metacognition" (Villarroel et al., 2020, p. 840) and "create[s] space for students to integrate their values, capabilities, and their future aspirations" (Tai et al. 2022, p. 9). We focused on authentic assessment not only from a world of work perspective but philosophically through a lens of "transformative social change, where students connect work, well-being, and society, where the link to social and situated forms of learning is essential" (McArthur 2022, p.5). Authentic assessment naturally encourages flexibility and creativity. For example, what could have been a typical laboratory report on carbon footprinting has now become a more reflective piece, encouraging the students to reflect upon the link between their personal food choices and the wider carbon budget. The development of reflective practice is central to this new module as it is not only a key aspect of ESD but was considered a highly sought-after graduate skill by the employers consulted. For each learning outcome, we detail below examples of the activities that were used.

Learning Outcome 1: Define food systems and understand their position within a global food context.

As part of this learning outcome, we wanted students to understand the ethical dilemmas that are inherent to food systems (Kaiser et al., 2021) because, as industry professionals,

The OU Activity Types Framework (OU, 2021)	
Assimilative	Attending to information (reading, watching, listening, thinking about, accessing).
Finding and Handling Information	Searching for and processing information (listing, analysing, collating, plotting, finding, discovering, using, gathering).
Communicative	Discussing module related content with at least one other person (communicating, debating, discussing, arguing, sharing, reporting, collaborating, presenting, describing).
Productive	Actively constructing an artefact (creating, building, making, designing, constructing, contributing, completing).
Practice	Applying learning in a real-world or simulated setting (practising, applying, mimicking, experiencing, exploring, investigating, experimenting, trialling, improving, modelling, simulating).
Assessment	All forms of assessment, represented as a blend of the activity types above, but specifically designed to measure learning.

Table 2 represents the OU six Activity Types

they will have to make trade-offs between these issues regularly, and always work to reduce the impact of their actions. This, therefore, related heavily to building normative competency in students. Drama was chosen as a teaching tool because it is engaging, conveys subject knowledge in an embodied way, and also aids their personal development through confidence building (Göksel, 2022). We plan to ask students to briefly perform scenarios containing ethical dilemmas. These will be scripted by the lecturer to avoid placing the students under unnecessary pressure and ensure key points are addressed. Afterwards, we will analyse the ethical scenarios together using the Potter Box (Christians et al., 2001), allowing students to both experience the issue first-hand, and then consider their response as an emerging food professional.

Learning Outcome 2: Identify and discuss the challenges associated with the sustainable production, processing, and manufacturing of a range of food commodities and describe relevant approaches to mitigate impact.

As the team progressed with the bootcamp, approaches to delivery and content were challenged as a truly student-centred focus resulted in creative and transformative ideas and approaches. Traditionally, food processing knowledge was heavily abstracted and dependent upon laboratory practicals. However, it was felt an alternative approach was required. According to Tasler and Dale (2021) when the interactions between student, teachers and place of teaching are considered there is increased potential for active learning to take place, when the setting and additional participants (such as industry personnel) can be expected to significantly add value (Sefton-Green, 2012) to the learning process. Smith (2007) reported the use of place-based learning, that focuses on real-world problem solving, can impart to the learner a sense of their own agency and collective capacity to alter communities and society.

Consequently, the incorporation of place-based learning (Cruz, 2022) in food processing facilities will provide opportunities for students to see first-hand the sustainability challenges facing the food industry and engagement with industry personnel will encourage development of systems thinking, critical thinking and strategic thinking competencies.

Learning Outcome 3: Demonstrate an understanding of new data collection, analysis, and interpretation methods and how these can be used to monitor and improve sustainability.

Employer feedback stated that our students lack a "digital mindset", which contrasts heavily against the myth of the "digital native" in higher education (Kirschner & De Bruyckere, 2017). Given that industry is capturing data at an exponential rate and attempting to analyse this data to inform business decisions and mitigate their impact, our students need to be able to work confidently with relatively new software platforms and handle large datasets. This relates to problem-solving competency, which therefore makes problem-based learning (Cardon et al., 2022) an ideal solution. It was therefore decided that setting students the task of visualising the data in the way that could describe and explain a sustainability issue would effectively address this. This would be completed following an introductory practical on understanding and working with data, and this task would form part of their assessment for this module. However, we wanted this assessment to be as authentic as possible so that it would provide an opportunity to encourage our students to negotiate how to demonstrate competencies well beyond university life (Dawson, 2021).

Therefore, we hope to obtain a dataset donated from industry, such as a factory's records of daily energy use vs average refrigeration temperature. Instead of a report that may never be read again beyond the assessors, students will instead produce a Microsoft Power BI Dashboard that

visualises the data in a way that can best illuminate the problem and aid decision-making, as they might be asked to do in a real-life setting, also equipping them with experience in an industry-relevant application.

Concluding Reflections

On completion of this Bootcamp, we were left with a number of reflections on Education for Sustainable Development, and on learning design generally. The Bootcamp was individually challenging but enriched our practice as a group through encouraging us to integrate our multiple perspectives. Working as a sole practitioner may have led to a much smoother design process, but perhaps a not as rewarding one. Learning design in this way can be a very time-consuming activity initially, but ultimately a very worthwhile one when designing any module, as it pays dividends in later delivery.

One of the key learnings that shocked us was when our mentor encouraged us to consider planning the entire module. Initially, we had only planned the 36hrs of contact time, but he asked us to consider non-contact time too, since we agreed students, especially 1st years, do not often understand what independent study should be like. This module is worth 20 CAT points. Unusually, each CAT point is supposed to represent Guided Learning Hours (GLH) of 10 hours. Therefore, our module should equal 200 GLH in total. It was easy enough to plan the 164 GLH of self-study and assignment preparation, but we realised that was excessive. If strictly adhered to, our students should be spending almost 14 hours a week in independent study. Replicated across the other two 20 CAT modules taken at that stage, then in a 168hr week, allowing time for eating and sleeping, it does not give much time for anything else. Students are not just students anymore. They may also be parents, carers, working full time and have other responsibilities or may be vulnerable themselves. We are aware

of the impact of students working too many hours in a week, but sometimes they might be the sole providers in the family home. Therefore, this experience suggests to us that we need to rethink our structures around learning, and our expectations thereof.

As we progressed through the Bootcamp, we also began to encounter some signs of resistance. Some of these were systemic. We wanted to include the forthcoming students in the co-design process, but our quality assurance processes mean that the learning outcomes and assessment were largely fixed a year in advance. Active-learning and place-based learning take time, but the timetable had no flexibility this year. Even something as simple as room layout posed a challenge. It is difficult to facilitate active learning in fixed-seating, tiered lecture theatres, but flexible teaching spaces are hard to come by.

Some of these were much more interpersonal. We had different knowledge, backgrounds, and opinions on teaching within the group, and reconciling this into a module was not always easy. However, this also made the final product much richer, reflecting the diversity that should be inherent in ESD. Because of the structure of the Bootcamp, we found ourselves designing sessions for our colleagues which we knew would not be delivered in the way that we planned

due to differences in teaching styles and workloads. This was disappointing, but it reinforced the iterative nature of co-design, and we were able to comfort ourselves with the knowledge that any amount of ESD embedded in the module was a victory.

And of course, this is all still theoretical at this point. The module will undergo first delivery in January 2023. Maybe our students will love it, maybe they will hate it or maybe they will just find it too much work. Student resistance is one of the top barriers to active learning (Nguyen et al., 2021).

This article aimed to share our learnings and experiences as a team that took part in the UNESCO Learning Design and ESD Bootcamp. It was challenging, personally and professionally, but was overall a positive experience which reinforced our desire to see sustainable development embedded in the curriculum at a deeper level and in a more intentional way. We have outlined how we co-designed a food science module in the School of Biological Sciences, of which the learning outcomes, learning activities and assessments were aligned with the principles and practices of ESD, notably the SDGs and the key competencies. The key takeaways from this can be applied to virtually any module, as can the challenges. It occurs to us that, though the focus is very much on staff to review their module through an ESD

and co-design lens, that the time and workload pressures staff face pose an immediate barrier to this. Therefore, it is important to highlight that, for any meaningful, intentional, and sustainable change to occur, institutional support in the form of structures, training, and workload allocation is crucial, as well as a partnership approach that draws on the expertise of staff and students across the institution, is aligned with research and operations, and engages with the public in an outward facing way.

However, the journey of a thousand miles begins with a single step, and therefore it is fitting for us to offer our quick tips on how staff can get started with ESD. We also invite you to read Alysha's vignette, demonstrating the power of students to be global citizens and active change agents, and the wealth of insight they bring as partners in the teaching and learning experience.

How to Get Started with ESD.

- **Choose an SDG** to align your content with. Include up-to-date statistics which are available from: **https://unstats.un.org/sdgs** and **https://sdg-tracker.org/**.

- **Identify a key competency** that you wish to develop in your students or, better yet, ask them which key competency they would most like to work on.

- **Look at your learning activity types.** Is it mostly Assimilative? Can you incorporate a more active approach to your session, perhaps by having group discussions or making use of the flipped-classroom design?

- **Consider your assessment.** Can it be anything other than an essay, presentation, or exam? Is there an opportunity for it to be done in groups? This builds collaboration while also reducing marking!

- **Think about how co-design can be implemented** in a very basic and risk-free way. In your first session, ask students about questions they have in the module or topics they are interested in. You could then, for example, reserve one session as "student choice seminars", and invite them or guest lecturers to give short presentations on these topics of interest.

Alysha's Experience:

Alysha Thompson, PhD student in Food Science, 1st Class Graduate of the MSci in Food Science and Food Security with Professional Studies.

Though I felt somewhat out of my depth, taking part in the ESD Bootcamp provided me with the opportunity to experience 'real life' module development. It has been truly eye-opening to see the sheer magnitude of work under considerable time pressure that goes into preparing and developing module content at university level, which students just don't see! Now I see the work that academics, educational developers, and other staff undertake for student benefit, and a co-design approach might just be the way to make it visible.

I feel my contribution to this Bootcamp has been essential to better reflect student interests and maximise overall engagement for this module, which will enhance and improve the learning environment for all students on the Food Science and Nutrition programme.

Overall, this experience has highlighted the importance of collaboration across disciplines and has equipped me with a better understanding of how to embed the SDGs into everyday learning, to form part of a future-facing developmental shift where sustainability across agri-food systems can be achieved.

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You can't be what you can't see? Being the change of pioneering geothermal energy projects

By Professor Mark Palmer and Joseph Ireland, Queen's Management School

The oft repeated phrase, "you can't be what you can't see", is particularly salient when facing the challenge of tackling the net zero emission targets and decarbonisation of our economy.

Research shows that visuals are better at evoking emotions, capturing attention, creating involvement and bringing about complex market change. In this article we would like to share some of our thoughts on working on SDG 7 – Affordable and Clean Energy which aims to ensure access to affordable, reliable, sustainable and modern energy for all. Our SDG 7 work is in relation to building the geothermal energy sector in Northern Ireland. In that respect, we discuss what a sustainable university should/could be in relation to building the of geothermal activity. We begin our article with perhaps one of the least visible aspects of energy market transitions – institutions – or as we refer to them as the 'silent social practice' and elaborate a little on why institutions matter for attending to the SDG 7 initiative and more generally programmes of net zero change. Rather than a mere backcloth for science and technology application work, inhabited institutions can powerfully mobilize and persuade social action. On the other hand, we know from statements such as "this is how it always has been here" that institutions can also serve to constrain, limit or thwart any sustainability initiative or specific SDG programme of change. Institutions can ensure that existing interests endure and anything new is given short shrift. The status quo is preserved in the face of much-needed climate change. The evidence that geothermal project examples exist outside Northern Ireland and elsewhere internationally where the technology is mature shows that the challenge is one of bringing about institutional change. Therefore, foregrounding the science or the technology application only tells part of the story of the SDG 7 transition challenge.

We take a different approach towards our work on SDG 7 – an institutional aesthetic one and that which draws inspiration from the immanent science and technology philosopher Professor Bruno Latour. Our ongoing work with the Department for the Economy, the Geological Survey of Northern Ireland and the Geothermal Association of Ireland has advanced the idea that sustainability transitions also rely on visible stories, visible project examples, visible leaders or, in the most basic form, visible images – the aesthetics – that inform us about where we are at, what is doable and what is needed to transition the energy market. Visual imaginary is a significant part of the aesthetic of science reporting and it also

Figure 1 – Sherwood Sandstone core sample

helps us find perspective in market transitions. For example, at the recent inaugural Northern Ireland Geothermal Energy Week (#NIGeothermalWeek), held between June 13th – 17th 2022 at Riddel Hall, Queen's University Belfast, we handed out samples of the Sherwood Sandstone formation found at depths of up to 2km in Northern Ireland to help stakeholders visualise, touch and smell the main target rock formation for deep geothermal projects (see Figure 1). This particular core sample is from a depth of 600m in the Limavady basin.

Undoubtedly, subsurface characterisation presents some unique challenges in terms of visualisation, making it difficult for decision-makers, regulators and policy-makers to comprehend from their office desks. Therefore, starting with initial scoping research commissioned by the NI Department for the Economy entitled **"Net Zero Pathways: Building the Geothermal Energy Sector in Northern Ireland"**, we consulted widely with a range of geothermal sector experts in Northern Ireland and elsewhere in the UK, EU and the USA to deepen our understanding of geothermal sector building. Launched as part of Northern Ireland Geothermal Energy Week, the report offers detailed recommendations for the way forward and focuses on the confidence-building actions needed to unlock the opportunities for energy from geothermal heating and cooling (Link to report: **https://www.economy-ni.gov. uk/publications/net-zero-pathways-building-geothermal-energy-sector-northern-ireland**). The wrap around report cover shown below in Figure 2 illustrates the vision for building the geothermal energy sector across Northern Ireland, from North to South and East to West.

Figure 2 – Building the Geothermal Energy Sector in Northern Ireland report wrap around cover

Amongst other findings, we highlight that there was a remarkable lack of research, and an absence of awareness of geothermal technology in Northern Ireland. We also find evidence of;

- Over four decades of comprehensive geoscientific geothermal resource assessments and two decades of political discussions on geothermal interest amongst NI

elected representatives, without policy-led action 'on the ground.'

- Omissions in stakeholder-evidenced workshops recently held on heat decarbonisation in Northern Ireland where the role of the geothermal resource is treated as an invisible Cinderella technology.
- Limited end-user awareness on geothermal deployment outside geologists, technical geoscientists and geo-consulting specialists.
- A small patchwork of existing geothermal energy projects in Northern Ireland that are mostly of an early-stage nature and difficult for the "show and do". Some projects are at an early feasibility stage, some at planning, some awaiting connection, while others are simply hard to find.

In effect, we find the work of existing institutions thwarting geothermal activity. One of the most interesting findings to note is that our university has led out on geothermal technology within the university estates and also remarkably has a Geothermal Living Lab consisting of three tests borewells on campus. See Figure 3 and the following link below.

Figure 3 QUB Geothermal Living Lab

https://www.qub.ac.uk/directorates/EstatesDirectorate/Services/SustainabilityatQueens/LivingLabs/).

The University Estate leadership has shown institutional foresight shifting away from existing fossil fuel energy and led out on geothermal projects, effectively acting as an institutional pioneer of geothermal energy for both heating and cooling in Northern Ireland. Geothermal energy is deployed within the McClay Library for heating, within the School of Biological Sciences (SoBS) for the cooling of the laboratories (see Figure 4 below) and in the new Riddel Hall Management School building where 40 boreholes are awaiting connection to provide geothermal heating (see Figure 5 below). The two heating projects both incorporate a closed loop geothermal collector system harvesting energy from the earth through borewells over 100m deep that supply a ground source heat pump system, and the cooling project consists of a duplet well abstraction/ reinjection system, again from borewells over 100m deep. This pioneering work and Geothermal Living Lab site is arguably a 'lonely secret', with little, or any, public and end-user awareness outside the geological community. Elsewhere, other universities are deploying geothermal across their estates – Cornell University in the USA and Trinity College Dublin as well as Technical College Dublin.
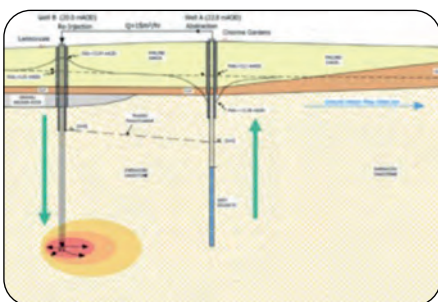
Like many institutions across the world, Queen's University Belfast is currently developing the next stage of their carbon strategy. It foregrounds science and showcases technology application on its estates. In this respect, we believe that strategic geothermal technology showcasing on the Queen's University estate could be stepped up and undertaken in a more holistic and aesthetic visual way and this might include;

Showcasing university estates stories from experiences. The reporting of geothermal technology deployment in a narrow technical sense does not provide adequate insight into the scope of the technology applications and where the technology has worked well across contexts. We believe that adopter/end user experiences need to be showcased across multiple estate contexts (e.g. heat networks in student accommodation, high precision temperature laboratories). We believe that there is an opportunity to undertake R&D data stewardship at the geothermal estate locations and the Geothermal Living Lab site. We believe that this would showcase civic leadership within Queen's University Belfast. Others follow institutional pioneers and want to listen to their experiences.

Press Releases of new capital developments . In addition to the showcase build opportunities, we believe there is an opportunity to contain more references to the sustainably work of the university within their Press Release announcements, especially on all capital work programmes. We believe that this would showcase civic leadership and the contribution of the university more generally within Queen's University Belfast built environment.

Event day . We believe that spanning the technical conversations is an important challenge and opportunity for the university. International event days are important to mark and pivot from such activities. Geothermal Day and Earth Day can provide an international setting against which local university activities are promoted and conversations are opened and openly discussed each year. We believe that having a visible QUB Sustainability day would draw attention to the range of sustainability activities within Queen's University Belfast.

Post-installation . One of the merits of geothermal technology is that once installed it is fairly invisible above the ground. Observations from the flagship geothermal flagships on the ground within the University estates reveal little, if any, visible promotion of the geothermal technology. With demonstrations, thousands of end users walk in and around the geothermal heated or cooled buildings without any awareness of the geothermal technology. The Energy Performance of Building Regulations (Northern Ireland) mandates Display Energy Certificates (DECs) to help consumers make an informed choice by providing information regarding the specific heating/cooling and related environmental standards. We believe that this is a showcasing opportunity for the geothermal plaques to showcase the University's commitment to sustainability.

Visible geothermal and subsurface stories. There is little evidence of any persuasive storytelling to showcase the geothermal activities – in effect, to emotionally engage, to bring in history of geothermal heating or cooling, mythology-making and the extent to which the Northern Irish communities can be transported into the geothermal narratives. Showcasing stories and mythology are evident throughout the Northern Ireland landscape and

Figure 4 - Subsurface drawing of SoBS

Figure 5 - Riddel Hall geothermal project

most noticeably at the geology of the Giant's Causeway. We believe that further consideration of how to showcase geothermal as part of everyday student community life experiences is required around sustainability initiatives. An example of this narrative would be Miss Molecule and her 'Geothermal Mission' at the United Downs project in Cornwall, UK to travel down the borewell on her surf board, collect hot water from the subsurface for power generation at surface and then re-transport the cooler water back again for re-heating.

Figure 6 - Miss Molecule on her Geothermal Mission to collect hot water for power generation

Global research institute. Visualising all of the sustainability research undertaken across the University is imperative for change. All institutions need a home and one that is
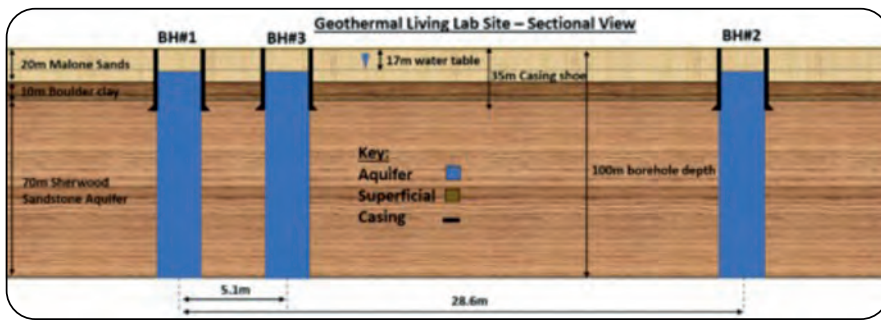

Figure 7 - QUB Geothermal Living Lab

welcoming to all disciplines. We believe that the net zero challenge aligns with our University ambition to build world-leading global research institutes across disciplines and sectors in partnership with industry, government and communities. Without a coordinated global research institute, however, there is a substantial risk that this 'sticky institutional problem' is only addressed through narrow disciplinary lens. We believe that stronger supporting institutional mechanism is required, pulling together, for example, the Geothermal Living Lab (see Figure 7), all of the interesting work within Sustainable Energy Research Group at Queen's and the Bryden Centre, Centre for Advanced Sustainability Energy (CASE), the British Ecological Society (BES), built and natural environment geospatial approaches to repurposing wind turbine blades commercial wind farms, hydrogen technologies in public transport systems, as well as understanding the deployment of those technologies in public engagement and acceptance. We

believe that institutional change expertise is a pre-requisite to understanding SDG transitions.

Without a range of institutional visualization activities, we are left unaware and unable to be that which we cannot see. As the frequently used phrase at the outset – "you can't be what you can't see" – attests, without geothermal project and visible sustainability projects more generally, we are left with no 'obligatory passage point' (a term coined by Bruno Latour for technology application) by which others can refer to Queen's University Belfast in sustainable leadership terms.

Our initial report work provided the basis for dialogues for stakeholder discussion at Northern Ireland Geothermal Energy Week. The opening photo in Figure 8 below shows from left to right: Professor Mark Palmer from Queen's University's School of Management; Queen's University's Vice-Chancellor Professor Ian Greer; Mr Joseph Ireland from Queen's University's School of Natural and Built Environment and Queen's Management School; Economy Minister Gordon Lyons; Dr Niall McCormack, Chief Executive and Managing Director of Causeway GT and Chair of the Geothermal Association of Ireland and Dr Marie Cowan, Director of the Geological Survey of Northern Ireland (GSNI).

The Vice-Chancellor opened and welcomed the attendees to Queen's University and outlined how Queen's is an institutional pioneer in the adoption of geothermal heating and cooling technology solutions. His address was followed by the NI Economy Minister Gordon Lyons who announced £3.5 million for demonstrating the geothermal projects in Northern Ireland. It brought together the leading International Geothermal Trade Associations – International Geothermal Association (International), European Geothermal Energy Council (European Union) as well as Geothermal Rising (USA).

Figure 9 - #NIGeothermalWeek VC, Professor Ian Greer opening remarks

Figure 8 - Open day of #NIGeothermalWeek

Figure 10 – Minister Gordon Lyons opening remarks

Geothermal Energy Week also comprised a panel of guests including, Richard Rodgers, Deputy Secretary, Head of Energy, NI Department for the Economy; Kevin Hegarty, Director of Green Growth and Climate Action, NI Department for Agriculture, Environment and Rural Affairs; Dr Marit Brommer, Director, International Geothermal Association; Dr Miklos Antics, President, European Geothermal Energy Council; Dr Will Pettitt, Executive Director, Geothermal Rising. Images from the panel session and morning talks are shown below in Figure 12 and Figure 11.

Underpinned by the theme of partnership and an inclusive approach, Northern Ireland Geothermal Energy Week provided policy makers, industry and research communities with the opportunity to come together, and co-create the conditions for round table dialogues for defining the vision for geothermal energy in Northern Ireland (see Figure 11 below).

Figure 11 - #NIGeothermalWeek round table dialogue session

**Figure 12 - #NIGeothermalWeek field trip to Scrabo Quarry**

The week also involved a geothermal policy fieldtrip by bus to Scrabo Quarry, Area of Special Scientific Interest (ASSI) to understand more about the Sherwood Sandstone Group with key decision-makers within government estates, policy-makers and Chief Executive of the NI Utility Regulator and members of his team (see Figure 12 below). There was a further general online engagement panel event for members of the public to engage with, learn and build understanding on the role of geothermal energy in delivering a just energy transition for communities across Northern Ireland.

After Geothermal Energy Week, Professor Mark Palmer, Joseph Ireland and Professor Min Zhang from Queen's Management School and Dr Ulrich Ofterdinger from the School of Natural and Built Environment have been working on a new report for the Department for the Economy and the Northern Ireland Geothermal Advisory Committee.

The second report, **"#NIGeothermalWeek: Defining the vision for geothermal energy in Northern Ireland. Department for the Economy"**, outlines the vision for geothermal energy in Northern Ireland; revolving around communities, people, customers, environment, investment and operations. The wrap around report cover shown below in Figure 15 illustrates the

vision for geothermal energy sector with key stakeholders gazing up at the 50m section of Sherwood Sandstone exposed at the Scrabo quarry and also the round table dialogue sessions. This co-created vision aligns with the NI 10X economic vision, the World Energy Council's energy trilemma vision, local geology as well as geothermal energy sensory experiences for heating and cooling. The report is due to be published in September 2022.

Figure 13 - "#NIGeothermalWeek: Defining the vision for geothermal energy in Northern Ireland report wraparound cover
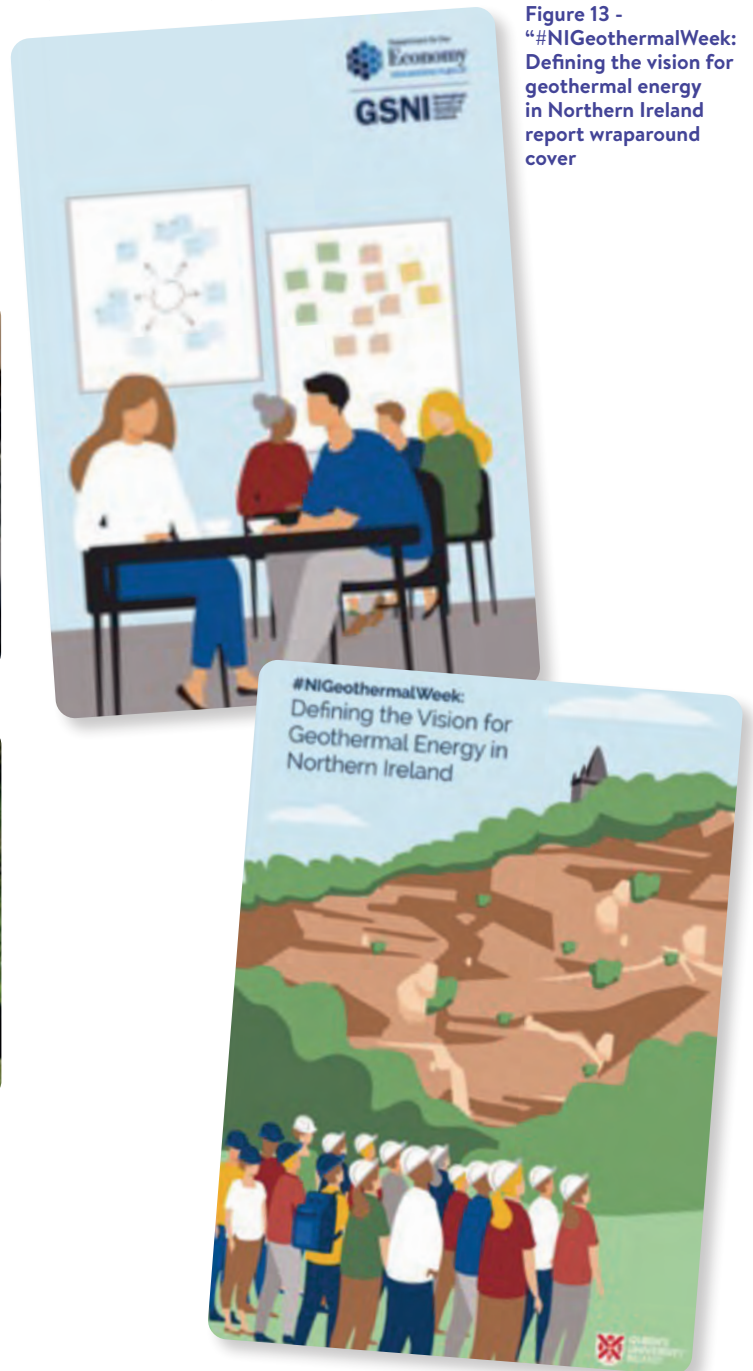
Looking forward, the challenge now is to commission, run and deliver demonstration geothermal projects at Stormont and Antrim, showcasing their results to the general public with a simple geothermal value proposition, while also cocreating a policy roadmap to deliver our future geothermal vision for Northern Ireland. As an institutional pioneer, Queen's University Belfast has done much to visualise how geothermal energy can be part of solution mix in the net zero pathways. In all our institutional sector building work we have endeavoured to use geothermal energy as the linking bridge – the lingua franca - between geoscience and social science. Just like the taken for granted nature of institutions, geothermal heating and cooling deployments are invisible. Perhaps that in needs to be made more visible to make SDG 7 change happen?

Taking the Plunge with Sustainable Development in the School of Electronics, Electrical Engineering and Computer Science

By Dr Ian O'Neill, School of Electronics, Electrical Engineering and Computer Science

The United Nations 17 Sustainable Development Goals (SDGs, https://sdgs.un.org/) are intended to protect the planet and help people live healthy, dignified and fulfilled lives. Making sustainable development part of the curriculum now forms part of school plans across the University. The School Plan for EEECS (Electronics, Electrical Engineering and Computer Science) states:

"The School will focus on Education for Sustainable Development (ESD) and will be guided by the 2021 QAA/Advance HE guidelines and practice guides. We use the term 'sustainable education' to mean the production of graduates who can confront, manage, and shape this century's pressing social, economic, and ecological conditions that are characterised by change, uncertainty, risk, and complexity."

How will technically specialised modules support the UN's sustainability goals? Some modules may be fundamental to a particular field of study, but only when the skills and techniques that they foster are applied in a broader, practical context, will their relevance to the SDGs become apparent. With other modules, the practical context is key and the connection with the SDGs therefore more obvious. Such modules provide an excellent opportunity for Schools to involve both staff and students in an examination of the SDGs and a discussion of how their work can help support them.

In EEECS, CSC2058 Software Engineering and Systems Development is helping establish a context for, and an approach to, SDG-related work. It is a full-year, 40-CAT, core module taken by all students on the Computer Science and Software Engineering pathways – around 330 students last year.

Fundamental to software engineering are sets of techniques, practices and notations that support a managed development process from real-world problem to real-world solution. This methodical approach to analysis, design, implementation and testing encourages a particular way of looking at the world that goes beyond the specific skills needed for an academic discipline (whose aim, in this case, is to help developers create software systems that meet their customers' needs). Students are required to evaluate development challenges critically, taking not just 'functional requirements' into account (does this calculation produce the right answer?) but non-functional requirements too (will this solution work to its end-users' satisfaction in the context for which it is intended?). That second kind of requirement, which in some form will be found in many disciplines, is particularly relevant to the SDGs: students need to be aware that, as professionals in their field, they need to be not just technically competent, but also sensitive to the societal, economic and environmental goals and constraints that will direct and ultimately limit the solutions they propose.

In *Software Engineering and Systems Development*, the students tackle a particular problem as part of a group project. In recent years they have developed a software adaptation of a board game. The game format already simplifies a real-world problem into components (players, squares, attributes of the squares, and so on), so that the software development challenge is appropriate for the skills that the students are expected to have at this stage of their careers. Importantly, though, the theme of the game can be very flexible, and rather than be competitive, the game-play can encourage collaboration between the players with a view to achieving a goal for which all take credit.

For the last several years we have chosen a variety of themes for the game: developing research capabilities in a university; saving endangered species and habitats, even – in a Master's version of the module – planning a mission to the moon in the manner of NASA's Artemis project. In other words, the project theme can be highly topical, and already there is an expectation that the students, given some high-level guidance, will add authentic detail (for example, by examining NASA's Artemis website to work out what the main components of a space launch system are).

This year, then, the structure of the module and the nature of the software deliverable will be similar to previous years, but the aim will be to simulate a 'journey through sustainable design'. As in previous years, the implemented and tested software mechanism that underlies their game will demonstrate system development skills and techniques ('agile', 'object-oriented', 'version-managed' ...) that are core to this module. However, to give authenticity to the manner in which the game unfolds, the students will be asked to identify and describe a real-world, sustainability-related problem, design a solution, and show how the design is to be realised: the evolution of the design – the 'journey through sustainable design' – will be the subject matter of their game.

In order to identify a problem and a solution, the students will critically examine a set of real-life case studies. These are supplied by Engineers without Borders (EwB, **https://www.ewb-uk.org/**) as part of its Engineering for People Design Challenge, which Queen's has entered this year. EwB is a world-wide movement that not only provides engineering skills pro bono in areas of need, but that increasingly is changing the way engineering disciplines are taught. The case studies for the Design Challenge are set in a specific geographical location (Govan in Scotland this year), and are directly relevant to themes of sustainable development. EwB provides challenge participants with educational support – including a pre-recorded introductory lecture, and on-line interactive workshops in critical thinking.

In our Software Engineering module, the distinction between 'real-world design' and 'implemented game' is deliberate. While creation of the game will follow a closely managed software development process commensurate with the students' technical skills, the design of a solution to the real-world problem can be much broader, and can encompass questions of funding, awareness-raising, recruitment of volunteers, dealing with legal hurdles, acquiring hardware, accessing infrastructure while preserving the environment – to name but a few! An ability to identify, express and find ways of accommodating these 'non-functional' requirements is an important mark of the software professional. This is an opportunity for the students to consider these aspects carefully but with the freedom of knowing that – for now in any case – they are not expected to implement the full solution 'in the real world'.

It is relatively easy to see if a requirement of the implemented game has been accurately described and tested; or if the documented design of the game corresponds reasonably closely to the way it has been implemented in code. These are well understood aspects of a 'conventional' engineering process and lend themselves well to close and objective assessment. However, the students' broader analysis of the real-world problem and the viability of the proposed real-world solution that underlies their game will have to be assessed against correspondingly broader assessment criteria. In this we will be guided by the marking criteria of the Design Challenge set by Engineers without Borders, which emphasise 'appreciation of context' from its social, environmental and economic perspectives, and encourage a 'reasoned solution' that has taken options and potential difficulties into account along the way to implementation.

As participants in the EwB's Design Challenge, five top teams from Queen's will be invited to submit their sustainable design for review by an expert judging panel. At least one of the teams considered by the panel will go forward to the Grand Final for the UK and Ireland, with a chance of taking the Winner's, Runner-Up or People's Prize (these usually take the form of an educational bursary). So as well as using their knowledge of sustainability issues to help them complete a module on their academic programme, the students also have an opportunity to gain recognition for outstanding sustainable design from a national and even international audience.

The model adopted here won't suit every School and every module. Indeed, at EEECS we won't know ourselves how successful we've been until we've seen how our plans unfold in practice. However, we believe we've found a way of introducing the theme of sustainable development into an existing, substantial module and well-established degree pathways, without – for the moment at least – having to undertake a major programme redesign. Such a redesign might, of course, be required later, especially as the theme of sustainable design is integrated into other modules, across the different year groups. Accommodating that wider interest and engagement will be a welcome challenge.

Sunrise on the north coast: sustainable development is everyone's concern.

Gender Justice in a time of climate breakdown: How universities can help to empower women and girls to help tackle the climate crisis and the role of academics in the struggle for gender justice and climate justice.

By Louise Taylor (Ph.D. candidate), Professor John Barry and Calum McGeown (Ph.D. candidate)

The Paris Agreement stated that for climate justice to be achieved the most developed nations must acknowledge and work to eliminate or significantly reduce gender-based inequalities (including gender-based violence) and make concerted efforts to support nations who are most vulnerable to the catastrophic impact of climate breakdown. It was agreed that women and girls across the world were in danger of further oppression, exploitation and harm based on their sex and gender and that wealthy nations must act as a matter of urgency on these issues, particularly as they are a pre-requisite to meaningful and sustainable global climate action. Similarly, the Intergovernmental Panel on Climate Change (IPCC) found that the extent to which ambitious mitigation and low-emissions development pathways 'imply large and sometimes disruptive changes in economic structure, with significant distributional consequences' opens considerable opportunities for integrating gender equality and justice into climate action (IPCC, 2022, p. 47).

In her 2018 TEDx talk, Greta Thunberg spoke about how the Paris Agreement called for equity and reparations as important components of meeting the SDGs (Sustainable Development Goals). However, as she rightfully acknowledged, there is widespread apathy to the importance of these concepts in governments and political leaders of developed countries in the Global North. Some writers argue that politicians and political parties, like the Conservative Party, are committed to ignoring the agreements made and therefore placing the lives and wellness, as well as human rights, of millions of women and girls at risk (Horton, 2022).

Academics and scholars, particularly those interested in green politics, economics and climate science, agree that there cannot be climate justice without first addressing socio-economic and other pervasive and persistent social and political inequalities (Barry, 2012, Preston et al., 2014). There is undoubtedly great work happening at Queen's University Belfast, with a growing number of scholars connected and working with the Centre for Sustainability, Equality, and Climate Action that is committed to creating opportunities to engage in interdisciplinary discussions and learnings. In November 2021, while COP26 was taking place in Glasgow, the Centre put on 10 events open to all University staff and students. These events generated many interesting and inspiring discussions and while most academics agree that the climate crisis is unfolding at an alarming rate and that our politicians are not doing enough, few academics seem to be thinking about how to use this knowledge and their intellectual abilities to apply life-sustaining pressure on our political representatives. If the University is to engage seriously with its commitment to gender equality, then it must be prepared to encourage and actively support academics in speaking openly and honestly to those with power about how their actions or lack of, are a real and increasing threat to life and particularly, the lives of children and future generations.

Gender violence is a term that refers to acts of coercion, intimidation, violence and terrorism that are committed because of gender. They include domestic abuse, rape, child marriage, arranged marriage, sex trafficking, female genital mutilation, forced prostitution, sexual assault and include any form of exploitation of women and girls (Harvey, 2020). It has been estimated that women do 2.6 times the amount of work that men do as they continue to do a disproportionate amount of the reproductive, domestic and childcare tasks throughout the world (UN, 2017). This work is generally exploited and often made invisible and unimportant within capitalism (for example this non-monetised work does not appear in official GDP 'economic growth' statistics), which prioritises production and profit as essential, and care work and mothering roles as events happening outside of universities and not absolutely central to keeping staff and students healthy, well and able to work/ be productive. For universities to do more to tackle these issues, there must be discussion and debate on them. However, this is not happening, and this delay is costing lives, as the rates of femicide remain worrying high internationally and climate is responsible for many deaths too (Blunt, 2019, Harvey, 2020, Vohra et al., 2021)

At the same time, we have to recognise that universities have been locations and sites that have perpetuated inequality and advanced and profited from unsustainable and inequitable practices and processes. Reparations and equity may involve apologies from institutions and much greater efforts to elevate the voices of black women, female global activists from the Global South and other less privileged voices and experiences. Through scholarly and community and international collaboration, solutions and alternatives may be created that must involve the voices of indigenous women, black women, queer women and disabled women being heard, and concerted efforts being made to empower those who are suffering and attempts made to repair the historical and generational harm universities and other patriarchal institutions have created.

QUB has several gender initiatives and projects in place, including the successful and reputable Athena Swan project which has made efforts to increase the and representation of women in universities. Another

5 GENDER EQUALITY

UN Sustainable Development Goal- Achieve Gender Equality and Empower All Women and Girls

important step would be a return of degree programmes such as gender studies and feminism. This would involve funding empowerment programmes to help women and girls to be more economically independent and self-sufficient as financial and economic independence is often a determining factor to success. As well as having direct benefit to the women and girls concerned, we know that one of the most effective climate strategies is to empower women and girls, especially in relation to family planning, reproductive rights and education (Project Drawdown). To address this issue, there is a need for greater intellectual and academic clarity as to why these social and cultural issues remain prevalent and how and in what ways universities should show leadership and address these issues through community engagement, empirical research and robust interdisciplinary academic and intellectual debate and discourse. It seems that it would be through the critical lens of feminism and feminist scholarship that answers and solutions may occur most naturally and succinctly, and we simply do not have the subjects nor currently the depth of academic understanding or interest to create the change needed by the Sustainable Development Goal.

It would be hopeful to see Queens University and other leading universities in the Global North highlighting and acknowledging the intersectional nature of climate-related discrimination. Understanding and providing solutions to the climate crisis cannot be gender blind. It is irrefutable that good work is happening at many universities, but the prevalence of issues relating to gender violence and crime that are endangering the lives and health of millions of women and children is demanding additional attention and few universities seem to have the time or funding to address these issues adequately within the current educational structures and within the curriculums and degree programmes provided and delivered. Climate academic leaders like QUB's Dr. Amanda Slevin should be leading

gender-equitable academic initiatives within this university. International scholarships and exchange programmes could also be offered to students from the Global South and more could be done to ensure that the voices of women and girls from all sections of society and the world are represented, respected, and valued. We need more , representation and leadership in universities from black women, disabled women, and queer women, and these voices need to be amplified and elevated. Young climate activists such as Vanessa Nakate, who are living on the frontline of the climate crisis, should be keynote speakers at academic conferences and great lengths should be taken to ensure that reparations for historical injustices relating to colonialisation and imperialism are placed central to discussions relating to climate mitigation and adaptation. Many environmentalists, indigenous activists and cultural critics have accused universities of maintaining and promoting unsustainable lifestyles and inequitable societal conditions, and far too often focusing on avoiding or downplaying the political and ethical dimensions of the climate crisis by promoting a technological 'green business as usual' mindset in teaching and research. It is this avoidance or downplaying of ethical and political dimensions which, partly, explains gender blindness; which has the result of reproducing not challenging and changing gender injustices. For ethical, ecological and climate effective progress to be made, all voices must be heard, and those voices must include a lot of the women and girls suffering because of the dangerous political and economic choices, historically and immediately, made by developed and wealthy countries. A sustainable future is dependent on academics in developed countries using their voices and their privilege to help those less able and to do that the academic community, particularly those in senior management and leadership positions, must do a lot more to empower women and girls, both locally and internationally.

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Towards Sustainable Communities: Open Botanic

By Dr Agustina Martire and Dr Laura Michael, School of Natural and Built Environment

In 2020-21, Architecture and Planning staff and students in the School of Natural and Built Environment joined forces with QUB Estates, QUB Engagement and the Department of Infrastructure (DfI) as part of an SDG Seed Funded Project from the QUB Research Policy Office called 'Open Botanic'. This project explored the transport activities surrounding Botanic Avenue, one of the busiest streets in the University Quarter of Belfast. The key considerations which motivated the project were the disconnectedness of the city's cycle network from the University area, and the predominance of cars, which were affecting the air quality, safety, and accessibility of the area for all other street users.

The project sought to understand and measure travel activity and behaviours on the street itself, which included traffic counts, parking observations and qualitative surveys with visitors, business owners and organisations on the street. The findings of this small research project were revealing. We found business perceptions of modal share, as seen in many other cities, focused on car users (57%), while the reality was that only 18% of people arrived by car. We also found that there were over 10 times more pedestrians than cars parked at any given time. This led to an evidence-based, phased and design-led recommendation to create a more sustainable community (SDG 11), looking at the reallocation of road space to those walking, wheeling and cycling with the view to creating a more equitable and sustainable neighbourhood for all. These were well-received by the then DfI Minister, Nichola Mallon, and became an important connecting point between DfI and DfC (Department for Communities) in terms of shared priorities that might be achieved through some of the proposals.

While the project is novel and brings together a range of various groups and interests both inside and outside the University, it is an important working example of the opportunities, and indeed, necessity, for SDG research and practice to be place-focused, cross-disciplinary and linked directly into the student learning experience. Furthermore, the mandate for the University to be meaningfully interacting with stakeholders in the immediate local area, and for those relationships to be nurtured remains a key priority.

To engage meaningfully as a University on the SDGs, we need to be committed to iterative processes, making the most of every opportunity that arises as a result of collaborative work. The project has led to further meaningful engagement in the adjacent Shaftesbury Square area in 2022 with local communities/community partnerships, with input and resourcing from the Department of Communities, allowing the team to consider wider spatial complexities of the area which also contribute to delivering sustainable neighbourhoods. We are now working through a series of engagement exercises, workshops and events to demonstrate the need to create safe spaces for families through the reallocation of road space. A pinnacle of this activity to date will be the closure of the street to traffic for one afternoon, allowing families and businesses to use the road space more freely, from which we hope to gain further valuable data which will instil confidence in local government departments to make more radical and sustainable changes for local neighbourhoods.

While these smaller engagements can sometimes prove challenging from an operational perspective, engaging in smaller projects with a shared vision and having a place-based focus can allow us as a University to be responsive and relational with our surrounding neighbourhoods, and grants us flexibility to invite students to be a part of meaningful and rich activities that enhance their learning experience.
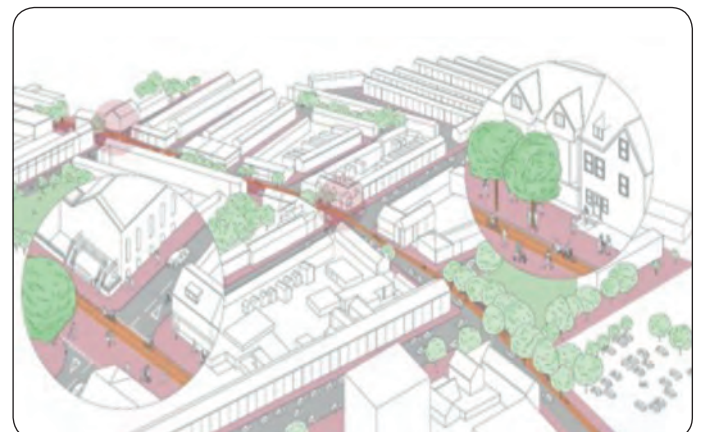
Architecture student impressions of a pedestrianised Botanic Avenue including parklets and a cycle lane.

Co-Creating an audio podcast to promote nursing and midwifery student understanding about the United Nations Sustainable Development goals.

By Gary Mitchell, Susan Carlisle, Patrick Stark, Gail Anderson, Clare Hughes, Kevin Gormley, Jane Killough, Stephanie Craig, Sophie Crooks (all School of Nursing & Midwifery, QUB), Laura Steele (Queen's Management School), Sara Lynch (Head of Sustainability, QUB), Jesús Sánchez Martín (University of Extremadura, Spain) & Francisco Zamora Polo (University of Seville, Spain).

Nurses and midwives have a crucial role to play in helping to achieve international goals to improve health and well-being and protect the environment (RCN, 2021). Despite this, many nurses and midwives are not aware about what the UN's Sustainable Development Goals (SDGs) are and how they can contribute (Rosa, 2017).

In January 2022, the School of Nursing and Midwifery established a new Special Interest Group (SIG) focused on the shared interest of enhancing education and awareness about sustainable development goals amongst the student population. The SIG comprises 28 people who represent current students, service users, clinicians and academics. Notably, more than 50% of the group membership is made up of students.

The flagship activity for this SIG was to co-create an audio podcast for Nursing and Midwifery students about SDGs. The aim was to provide explicit education about the UN's SDGs and how all 17 of these goals apply to nursing/midwifery students. The podcast would also inform students about the practical things they could do to help achieve SDGs. For example, for SDG1 (poverty) we provided students with a case-study about how nurse family partnerships in urban neighbourhoods can help support families with low income. For SDG5 (gender), we considered how nurses and midwives could reduce HIV stigma, for SDG7 (energy), we considered the impact of air pollution and rates of pneumonia and for SDG12 (Consumption/Production), we considered the implications of inappropriate disposal of syringes.

The SIG co-created this podcast throughout the summer of 2022. The audio podcast followed the following format:

1. An introduction to the podcast (*Susan Carlisle*)

2. An introduction to the SDGs (*Laura Steele*)

3. A synopsis of each of the 17 SDGs & how nurses and midwives are contributing to these (*14 students, 2 clinicians, 1 service user discuss one SDG at a time*).

4. An overview of the QUB contribution to sustainability (*Sara Lynch*)

5. Close (*Gary Mitchell*)

The audio podcast lasted approximately 60 minutes and has been designed to be listened to on-the-go (i.e. there is no requirement for students to make notes or complete tests/quizzes on content). A current link to the podcast can be found here: **https://tinyurl.com/QUBSDGPod**

An evaluation of this podcast, using a pre-test/post-test methodology, was carried out amongst year one Nursing and Midwifery students in September 2022. Ethical approval was obtained from the Faculty of Medicine, Health and Life Sciences (MHLS22_113). The team adapted a previous questionnaire about SDG knowledge, attitude & self-efficacy amongst students in higher education (Zamora-Polo et al. 2019) and administered this to students before and after listening to the podcast. Permission to adapt the original questionnaire was also obtained.

258 Nursing and Midwifery year one students completed a 42-item questionnaire before and after listening to the podcast. The questionnaire measured three outcomes about Sustainable Development Goals: awareness of the 17 SDGs, understanding of the role of nurses and midwives in achieving the 17 SDGs and personal responsibility for achieving the 17 SDGs. After listening to the podcast, awareness of SDGs improved from an average of 50% to 86%, understanding of the role of nurses and midwives in achieving SDGs improved from 70% to 88% and personal responsibility for achieving SDGs improved from 66% to 82%. All three improvements were statistically significant as indicated by paired sample t-tests ($p<0.001$).

These findings illustrate that after listening, students recognised that nurses and midwives, as the primary providers of healthcare to all communities in all settings, are key to the achievement of the Sustainable Development Goals (SDGs). SDGs are linked to everyday clinical issues; national public health emergencies; and other nursing issues, such as leadership, shared governance, and advocacy (Senor et al. 2021). According to the literature, SDGs are often not covered explicitly in nursing/midwifery curricula and there is a paucity of investigation on educational interventions to support student understanding in this area (Dossey et al. 2019).

This project demonstrates how students, service users, clinicians and academics can work together to co-create innovative educational interventions about SDGs that are directly applicable to their profession. Nurses and midwives have long been leaders and agents of measurable change in the advancement of physiologic, social, environmental and economic health determinants. It has been noted that nurses and midwives have the potential to make vital contributions toward achieving the SDGs and we hope that the provision of this educational podcast could support our students to take their own steps to helping society achieve the goals.

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Sustainability in Pharmacy Education: Embedding the SDGs within Taught Programmes

By Stephen Kelly, Dan Corbett, Maurice Hall and Lezley-Anne Hanna, School of Pharmacy

Stephen Kelly

Dan Corbett

Maurice Hall

Lezley-Anne Hanna

The United Nations is committed to ensuring the Sustainable Development Goals (SDGs) are embedded across all streams of society, including business, government, industry, and education. With regards to the latter, it is incumbent upon Further and Higher Education (FHE) institutions to ensure their students are fully aware of the SDGs and their importance, and are empowered to help contribute to the success of the goals during their undergraduate courses and future careers. Pharmacists and other healthcare professionals are ideally placed to promote sustainability and should be supported to maximise this impact throughout their professional practice. SDG3 (Good Health and Well-being) is the most immediately obvious goal pharmacists contribute towards. However, given the interconnectedness of the SDGs, other goals comprise health-related determinants, meaning integrated implementation across SDGs is needed for the achievement of Agenda 2030.

FHE institutions have committed to working in partnership with the UN and other stakeholders to create a more sustainable future, with many becoming signatories to the University Global Coalition (UGC). Indeed, Times Higher Education releases annual Impact Rankings to assess universities against their commitments to implement SDGs. FHE organisations have taken a number of approaches to embed the SDGs within their undergraduate programmes, alongside boosting and awareness of this work. This has included the production of videos and podcasts (University of Exeter), the creation of SDG integration working group (Glasgow Caledonian University), and the creation of a course on Climate, Health and Sustainability for all first year students (UCL Medical School).

Within the wider healthcare sphere, nursing has identified the undergraduate curriculum as an opportunity for initial exploration of their role in impacting the SDGs. It has been suggested that a critical approach to teaching, such as that seen in Freire's critical pedagogy, is required to create the transformation needed for student nurses to be educated on the SDGs. In a practical sense, this means transforming learners from being "passive recipients of education", to supporting students to recognise oppression and power imbalances through a process of conscientization. This approach to embedding SDGs within the curricula also involves co-creation of SDG knowledge rather than transmission, as well as liberating and empowering students with opportunities to undertake meaningful and impactful projects to further the SDGs and transform society.

Other research exploring environmental sustainability education for health professionals has focused on preparing students for the health impacts of climate change, and highlighting the role of health professionals in mitigation strategies. Assessing students through formative, portfolio-based and student-led tasks that promote reflection may prove most effective, such as student debates around health service sustainability or consideration of how environmental sustainability issues affect clinical practice. The UN's Sustainable Development Solutions Network (UNSDSN) have outlined a number of key ways in which universities can accelerate education for the SDGs. This includes a roadmap for implementation beginning with mapping what is already been done to support students, followed by taking a whole institution approach to identify priorities and gaps in support, with ongoing monitoring and evaluation of progress.

Previous work in FHE settings has shown a low level of prior knowledge of the SDGs and the 2030 Agenda among first year undergraduates, with most students never attending related educational activities up to that point. However, student expectations that their university would guarantee an education on the SDGs was high, both for personal wisdom and in the context of their future professional careers. Commensurate with this research, current awareness of the SDGs among the undergraduate Pharmacy student population is expected to be low initially. This is an important barrier which students must be supported to overcome, given the important role pharmacists can play in SDG implementation. The UNSDSN report highlights a number of other challenges in supporting students in this area, such as individual student mindset, lack of resources within institutions, and capacity issues within curricula. Furthermore, given the relative newness of the UN SDGs, there is still a lack of standard methodologies and conceptualisations for teaching them.

Queen's University is committed to implementing the SDGs to ensure its educational offering prepares students to become global citizens and provide tangible societal impact. As part of Strategy 2030, we have committed to "embracing the ethos of the United Nations Sustainable Development Goals at a local, national and global level", as well as incorporating the goals within our strategic research priorities.

It is apparent given the increasing prominence of the UN SDGs in policy and wider society, alongside the important role of pharmacists in their attainment, that undergraduates in the School of Pharmacy require an increased level of support and learning opportunities in this area. The School is committed to providing this support

and has adopted a targeted approach to raise awareness of sustainability and embed the SDGs throughout its teaching. This programme began with a full review of the School of Pharmacy's educational offering, undertaken by the Directors of Education. This was followed by the development of a Sustainability Action Plan and appointment of a School UN SDG Champion. The initial phase of this initiative involved raising awareness and of the SDGs and sustainability more broadly, and began with the creation of a UN SDGs section within the School's information module on Canvas. This resource allows students to become familiar with the SDGs and explore what each goal entails, as well as highlighting the University and School's commitment to sustainable development alongside Pharmacy-specific examples. SDGs symbols are also on display in prominent locations around the School.

At module level, the School's Digital Education Lead has spearheaded the development of new homepages spaces on Canvas to highlight the relevance of each module's contribution to promoting sustainability, and emphasising the SDGs which are most pertinent to this area of the course. Pharmacy education, like the SDGs themselves, is a wide-ranging yet interconnected discipline, and this is reflected in the profile of SDGs most relevant to each module. While SDG3 (Good Health and Well-being) is a mainstay across the portfolio of modules, other examples range from the importance of clean water and sanitation in the Pharmaceutical Microbiology module, the need for climate action and to reduce inequalities in Pharmacy Practice, and the need for peace, justice and strong institutions in Pharmacy legislation elements of the course. Standardisation of content not only streamlines access for students, but has also been beneficial in supporting staff with their own teaching by providing a consistency of approach and examples of good practice. Teaching material continues to be updated to reflect the relevance of sustainable development in individual topics, such as the display of SDG icons in lecture material and by encouraging innovations relating to sustainable healthcare in the students' entrepreneurship workshop.

The academic year 2022/23 also sees the inception of dedicated sustainability teaching in the form of a Sustainability and UN Sustainable Development Goals workshop. This will be delivered each year to incoming Level 1 students across all undergraduate degrees as part of their introductory skills

module. It focuses on introducing sustainable development and the SDGs by highlighting the important role Pharmacists and Pharmaceutical Scientists have in contributing to their success. This workshop addresses subjects including the delivery of healthcare for all, public health and education, how the profession regulates itself for a sustainable future, and the role of the pharmaceutical industry in environmentally responsible production and healthcare inequality reduction across the globe. Students are provided with Pharmacy-specific exercises to help appreciate the importance of sustainability in all areas of the profession. This workshop will provide a formal introduction to the SDGs and bolster existing training involving sustainability, such as barriers and facilitators for inclusive societies, including unconscious bias.

Achievements to date in this area represent a productive start in bringing sustainability to the forefront of Pharmacy education. Ongoing efforts will see this initiative expanded to include full mapping of the SDGs across all modules and degree courses offered by the School of Pharmacy. A School statement outlining our contribution to the SDGs and how we are reducing our carbon footprint will be developed, as well as student partnership initiatives such as the creation of UN SDG student ambassador roles.

Pharmacy is a trusted profession, occupying a critical patient-facing niche in the hospital, GP practice and on the high street. We owe it to patients to help them understand the health effects

of climate change and the importance of sustainability. Similarly, we owe it to our undergraduates to arm them with the knowledge and tools to help create a sustainable future and ensure good health and well-being for all.

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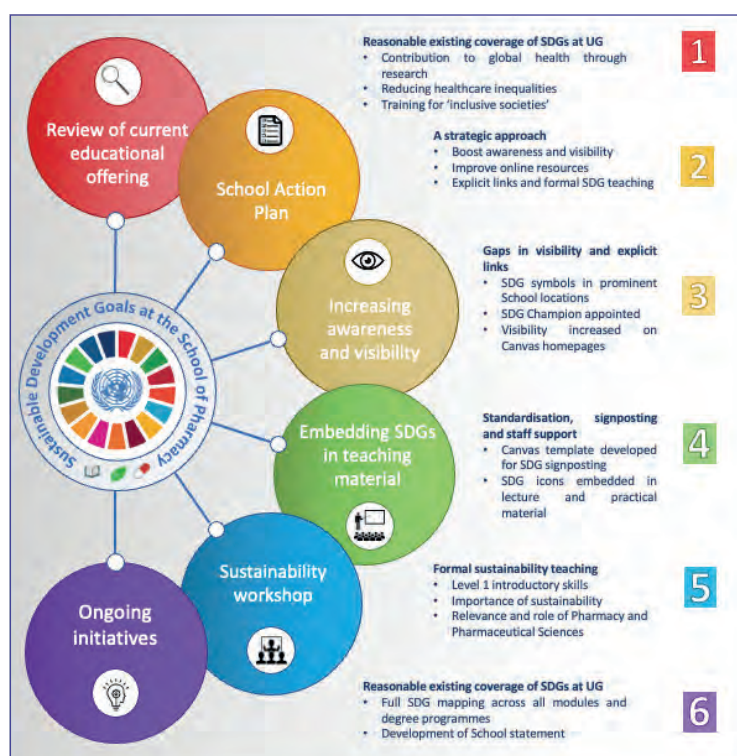
Exploring Visualisation in Teaching and Research

By Dr Eiman Abdel Meguid, School of Medicine, Dentistry and Biomedical Sciences, and Dr Joe Allen, School of Social Sciences, Education and Social Work

In this reflection, we are addressing Goal 4 of the 12 SDGs __THE 17 GOALS | Sustainable Development (un.org)__. Aligning curricula with the need for technological innovation can be achieved by applying Visualisation approaches to the areas of Biomedical Sciences, Anatomy and Embryology, as well as the representation of complex research ideas in the Social Sciences. It is far more relevant to change the way we present curricula rather than change the fundamental knowledge and the research concepts themselves. This approach will strengthen both face-to-face and digital online learning by making them both more inclusive and effective. Today, innovations, in the context of the 4th industrial revolution, are needed to fulfil the sustainable development goals. Here we highlight the use of advanced visualisation techniques to guide the evolution of inclusive quality education in line with SDG (Goal 4).

This article is based on a published book chapter by Dr Abdel Meguid on "Exploring Visualisation for Embryology Education" in the Biomedical Visualisation Book Series Volume 11, by Springer Publishing, as well as a short course by Dr Allen on Creative Thinking for PhD candidates. This was held in the Autumn 2021 in the School of Social Sciences, Education and Social Work (SSESW) and the findings of a research paper based on collage were presented at a conference in Trinity College Dublin by Brenda Brady a PhD candidate in SSESW.

Educators around the world are usually interested to use innovative technologies to make their sessions more interactive. In the pre-pandemic period, the utilization of such technologies was optional, however, COVID has changed the situation dramatically as what was optional earlier became a necessity. During the pandemic, educators had to implement various technologies in their online sessions to make the subject more visual and interesting.

What is Visualisation?

Visualisation (VIS) is the junction/intersection between technology, science and visual arts. It is conveying complex information by using a series of images by using visual methods. Visualisation demonstrates the numerous options we have in using technology to enhance, support, and challenge education, clinical settings, and professional training. This approach engages the learners and guide their understanding. The scope of implementation of visualisation and collage encompass most of the educational and clinical fields' subjects such as medicine, radiology, surgery, dentistry, veterinary medicine, allied health professions, biomedical sciences,

microscopy, engineering, social sciences, and life sciences. The utilisation of these advanced innovative technologies has grown at an exceptional rate over the recent period as the way we view and examine data currently differs completely from what has been done in previous years. With the development and innovations in imaging and data visualisation and collage techniques, attracting students' attention became much easier through interaction and engagement. This in turn has made teaching and learning much more effective than it has ever been.

Not only were these technologies been used to facilitate visualisation, but also to engage our future leaders with their educational environment. Never have we had such a variety of innovative technologies available to engage our students. Therefore, this is a perfect time to display and highlight the effect of its implementation to improve student's education, understanding and engagement.

Visualisation in the Medical Sciences

Teaching is commonly taught in large groups, via didactic lectures, however, this approach is not recommended as it is not engaging. When studying, learners face significant challenges in understanding complex, multiple, and simultaneous events which are likely to increase student cognitive load. Moreover, some subjects such as embryology, its content is nonlinear, and this makes its teaching challenging. The rapid development of the embryo increases the difficulty in discovering the level of details in every stage. However, by using visualisation, this becomes much easier and clearer as understanding embryology requires 3D visualisation of multiple events that occur rapidly and simultaneously within a brief period. Consequently, a visualisation tool such as the HDBR atlas have been embedded in some schools within tutorials to supplement student understanding of the three-dimensional morphological concepts in embryology once knowledge-based learning outcomes have been addressed by other means.

The core theme enclosed in this reflection emphasizes the creation of effective visual tools to covey complex data and ideas. Additionally, it highlights the revolutionary technological advances that have led to innovative discoveries in teaching, research, and health care. It spans from microscopic level all the way to patient care. Furthermore, it demonstrates how we can view information in a much more accessible, innovative, and engaging way through visualisation. This cutting-edge visual technology not only creates and integrates platforms for teaching and education, but also visualises biological structures and pathological processes, and aid in visualisation of the historical arenas as well. It is fascinating to see that science is now starting to take visualisation seriously, putting techniques to the test, to find out what happens when we visualise.
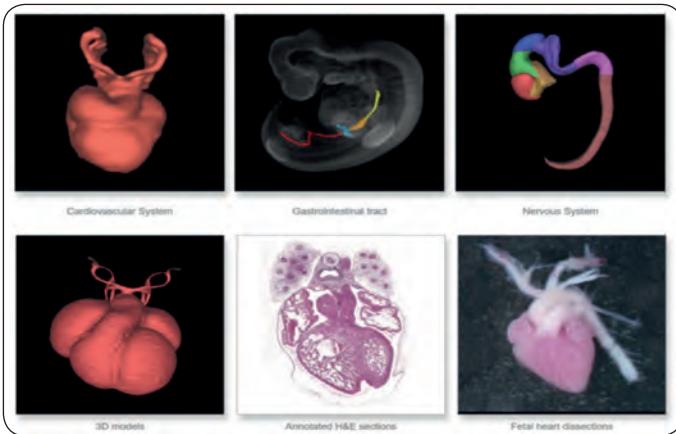
Reprinted with permission from Springer Nature Customer Service Centre GmbH: Nature/Springer, Biomedical Visualisation Book Series, Volume 11, Exploring Visualisation for Embryology Education: A Twenty-First-Century Perspective, Eiman M. Abdel Meguid, Jane C. Holland, Iain D. Keenan et al, 2022.

HDBR Atlas 'Organ Systems' visual menu (**http://hdbratlas.org/organ-systems.htm**l) (pictures in the top row) and HDBR Atlas 'Development of the Heart' visual menu (**http://hdbratlas.org/organ-systems/cardiovascular-system/heart.html**) for embryology teaching (pictures in the lower row) (Website Resources for Visualisation in Embryology)

What is Collage?

While the term "collage" refers to any combination of found images, paint, text, and three-dimensional objects, this discussion will focus on two specific forms of collage. The first one is an arrangement on a piece of card or paper of random words and images from magazines and newspapers. The second type of collage is an electronic document produced in Microsoft PowerPoint which allows the creator to gather several images and words on a specific theme on one page.

At the beginning of the Creative Thinking course, a series of ambiguous images, with the themes of searching and journeying, stimulate discussion on the complexities of developing a PhD and the processes of discovery involved. This is the first of a series of activities which encourage metaphorical thinking and the capacity to explore research questions and themes from a range of perspectives. One of these activities involves using the Japanese poetic form of Haiku to represent the research theme or question. Haiku consists of three lines, with five syllables in the first and third lines and seven in the second one. The conciseness of Haiku supported students in capturing their central research ideas, as in the two examples below from the creative thinking course in 2021.

Buildings tell	**Clean hydrocarbon**
Stories of the city	**By using unique solvents**
Dividing its spaces	**Improving process**
(Community Research)	**(Environmental Research)**

Introducing collage-making as a form of visualisation for the expression of complex research questions seemed an appropriate way of offering students more opportunities to engage with images as a means of articulating their research ideas. The course also built on the notion that collages have the capacity for modelling ideas about and conceptualising research (Holbrook and Pourchier, 2014).

The use of arts-based approaches in research draws from authors such as Yuen (2016), who identified creative methods which allow researchers to access the intuitive processes involved in research. The visualisation of complex research ideas using the collage technique was found to be a highly valuable experience by the students on the Creative Thinking course.

Collage 1. Arts based Approaches to the Treatment of Mental Illness
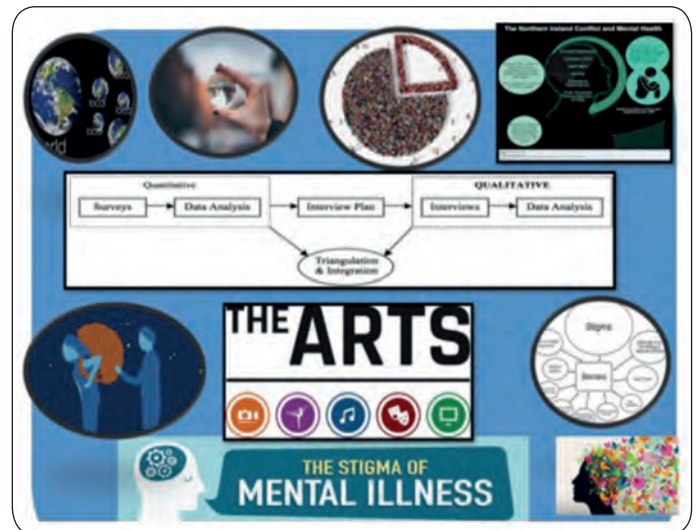
Collage 2. Stigma of Mental illness

The two electronic Collages 1 and 2 above were on the theme of Mental Health and Arts Based Approaches and were presented at a recent Conference at Trinity College Dublin (Brady and Allen, 2022). This collage is typical of most of the electronic ones in its rectilinear structure and its gathering of images on the theme. They present as posters, which illustrate the themes rather than using the images as instruments of analogy and metaphor, as was evident in the paper-based collages. Most of the electronic collages had no text added besides that already included in the images.

In the process of making paper collages such as in Collage 3, students were able to use and find words which represented ideas from their research, while pictures were used in the main for the electronic collages. The predominance of words in the paper collages suggests that the students were using the process of collage-making to theorise and to uncover their thoughts and feelings about the subject. Their attitudes to their final work, as conveyed in their presentations of their collages to the group, seemed to be more emotive than those of the students who made electronic collages. The paper collages gave more of an impression of layers of exploration and meaning making. However, the contrasts between the two forms of collage did not detract from the impact of the collage making process on either group.

Collage 3. Exploration of women's suffrage in Northern Ireland

Animation versus Static Pictures

Research confirmed that animation is not considered superior to static pictures, as it may impede learning by increasing the extraneous cognitive load, whereas static pictures on the other hand offer time to review information if it is needed. Additionally, it increases the long-term student knowledge retention. Several description-based publications have reported on the immense value of the highly visual resources that have been used to facilitate teaching and learning (Yamada et al., 2006; Evans, 2011).

Merits of using visualization/collage

By implementing visualisation/collage, educators can effectively develop the course content, by adopting the twenty-first-century interactive resources to support the learner-centred teaching methods. Undoubtedly, visualization of sciences can be improved with strategic adaptations that utilizes technology and media. The pandemic has simply provided insight into the pros and cons of these technologies and innovations. Certainly, the continual integration of technology into education is essential to improve the learning outcomes and to address the cognitive burden associated with the volume of education and training (Gaur, 2020). The judicial use of technology and the creative adaptations are imperative to ensure timely, effective, and impactful delivery of education despite the constraints evolved during or even after the pandemic (Saverino, 2020).

To aid student learning, we need to further develop our pedagogical approaches and interactive resources by implementing the power of visualisation/collage to facilitate students' learning. To improve student performance, we recommend that more time and effort should be devoted to the creation and implementation of the visualisation-based digital technology through photos, videos and simple animations. Technology-enhanced learning strategies and modalities that support the understanding of the three-dimensions, have the potential to develop deeper understanding.

For twenty-first-century students, visual learning would contribute to increased interest, interactivity, engagement and understanding of the educational content. The transition to incorporate visualization/collage is becoming essential as the global educational environment at present is moving towards 3D visual tools for the sake of clearer presentation that would facilitate student understanding.

To conclude, using visualisation and collage resources and approaches can be used to explore and to effectively express ideas at a deeper level complex process.

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Goal 4 of the 12 SDGs **THE 17 GOALS | Sustainable Development (un.org)**

School Engagement Projects as Authentic and Empowering Alternatives to Research-Led Honours Projects

By Colin D. McClure, Matthew Hudson & Kieran Higgins, School of Biological Sciences

The UN Sustainable Development Goals highlight the importance of more effective and inclusive education for all. However, much of the knowledge-generating research undertaken at Universities often stays within the boundaries of expert communities, while undergraduate students, i.e. our fields' future, are infrequently provided with sufficient opportunities to develop the values and skills to disseminate novel science.

Here we introduce School-Engagement Projects (SEPs) as an alternative to lab-based capstone projects for STEM undergraduate students, an initiative between Queen's, W5 and the STEM Hub NI for students to develop, deliver, and determine the impact of outreach activities within local schools on current research undertaken within the University. It is our hope that these projects can be widened out to other Schools within the University and beyond to benefit students and pupils across the breadth of the University's research fields.

Goal 4 of the UN's SDGs, "*Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all*", highlights the importance of sharing knowledge as an equaliser in social mobility, as well as to inspire the next generation of knowledge-generators. Unfortunately, much of the knowledge generated within Universities and research institutions remains confined within the small expert community which produce, peer-review and collaborate in individual research fields. To aid dissemination, towards this SDG goal, Universities have a responsibility to provide our students, the future knowledge-generators, with the necessary motivation, skills and values to educate the wider public to increase awareness of, and inspiration in, our fields of expertise.

The Capstone research project, which undergraduates complete in their final-year, is one of the only authentic-learning opportunities that many students have within their degree programmes to engage in novel research and to take ownership of their own field-specific project. Within STEM subjects, these traditionally involve lab- or computer-based projects which culminate in the generation and/or analysis of subject-specific information, and the production of a thesis aimed at experts in the field. While an invaluable and necessary experience for students who wish to progress in their chosen fields, these projects often do not have a focus on the development of science communication skills which is a growing concern for future STEM graduates (Rayner & Papakonstantinou, 2016). Furthermore, for UK science and maths graduates, education or science communication-related occupations are consistently in the top three most commonly chosen professional occupations (AGCAS, 2022), but students often identify a lack of an opportunity to explore teaching- or communication-related activities within their academic programmes.

Within the School of Biological Sciences, we devised SEPs which are capstone-research projects coorindated between QUB, local Science & Discovery Centre **W5**, and the UK **STEM Hub Network**. These projects enable undergraduate students to work with their supervisors to develop an outreach/educational activity which can be delivered in local schools, whereby the students complete a thesis related to the activity's impact. SEPs, which have been delivered since the 2020/21 academic year, enable students to not only design and produce a short teaching activity on a research-topic of an academic, but also requires the development of an evaluation procedure which needs to be approved by the Faculty Research Ethics Committee (**FREC**). Undergraduates also register (for free) as a **STEM Ambassador** to provide Access NI checks, as well as relevant training for school-level outreach. Once the activity is delivered in participating schools (which are identified and enrolled by W5 and/or the STEM Hub NI), students complete analysis of their pupil and/or teacher evaluations which are central to their final capstone thesis. Students are supported through this processes through a series of pre-made resources, and a learning community available through MS Teams.

SEPs offer an authentic learning experience for students, as well as an opportunity for community-based learning to benefit multiple stakeholders, aiding the development of SDG 4 (Pedersen, Meyer & Hargrave, 2014). While pupils and teachers identify the benefit to broadening the breadth and relevance of subject-specific knowledge within the curriculum, undergraduate students demonstrate the value of these projects on their communication, management and research skills, as well as informing and/or preparing them for a potential future career (McClure et al., unpublished).

If you are interested in discussing setting up these projects in your School within QUB, please get in touch with Colin McClure (**c.mcclure@qub.ac.uk**).

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The Climate Emergency: how can pharmacy make a difference?

By Sarah Gillespie, Professor Roísin O'Hare and Dr Sharon Haughey

Worldwide, the healthcare sector produces around 4.6% of global emissions1. Healthcare in the UK produces around 5.4% of our total emissions2, with medicines alone responsible for 25% of the NHS's carbon emissions3. Healthcare professional colleagues have acted to address the concerns, with the British Medical Association and the Royal College of Nursing declaring a Climate Emergency in 2019. The Royal Pharmaceutical Society, due to effective lobbying by climate activists such as Pharmacy Declares, followed suit in 2021.

Final year student project to establish current sustainability teaching

Pharmacists who train in the UK complete a 4-year MPharm degree and a final year of Foundation training in practice before registration. The degree and Foundation year are regulated by the General Pharmaceutical Council (GPhC) and locally the Pharmaceutical Society NI. The Standards for the Initial Education and Training of pharmacists outline 55 learning outcomes however none specifically mention sustainability4. A recent final year project by an undergraduate MPharm student (Sarah Gillespie) aimed to identify any current sustainable healthcare teaching included within pharmacy degrees in the UK. Also, to establish whether respondents felt it was important for sustainability to be included within pharmacy degree programmes and, if so, then what specific content should be included.

Two online questionnaires (staff and student) were developed and data collection was conducted over a 3 week period between January and February 2022. Questionnaire 1 was distributed solely to pharmacy students currently undertaking their 4th year of the MPharm degree in the UK (28 Schools of Pharmacy), and Questionnaire 2 was sent to Heads of School/Programme directors.

Results

Questionnaire 1; A total of 56 students in their 4th year of a pharmacy degree in the UK responded.

Questionnaire 2; Eight Schools of Pharmacy (28.6%) responded to this questionnaire.

Most student respondents believed that their curriculum contained no content on sustainability, despite staff from England, Scotland and NI reporting at least 1-5 hours in the curriculum (Figure 1). The majority of
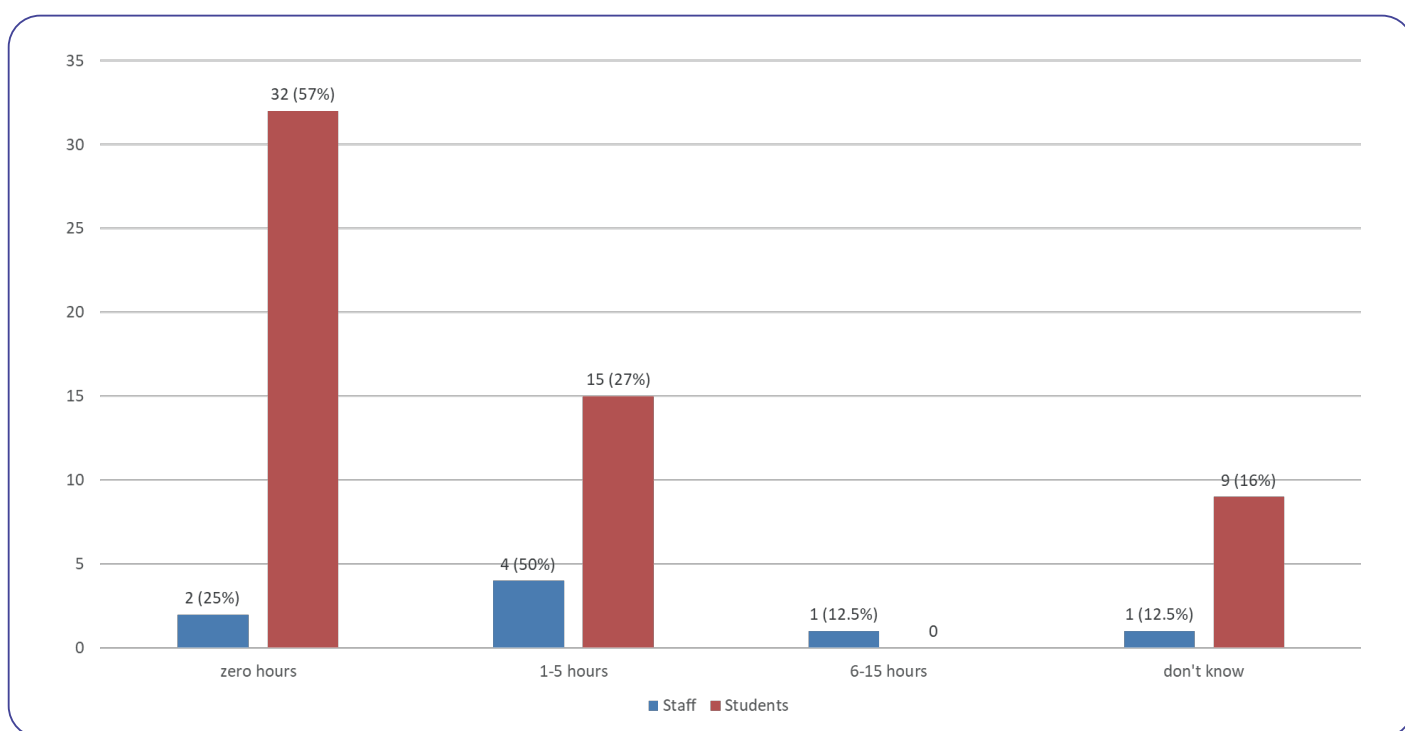

Figure 1: Number of reported hours of teaching relating to sustainable healthcare in the MPharm curriculum.

respondents (students: 98.2%; staff: 87.5%) thought sustainability teaching was important.

The three main content areas relating to sustainability in the MPharm curriculum were

1. Antimicrobial stewardship (to measure and improve how antibiotics are prescribed and used)

2. The environmental impact of medicines

3. Sustainability in laboratories

Most staff responded that they did not know enough about sustainability in healthcare to be able to teach it. One hundred percent of student respondents believed that their MPharm programme had not prepared them to apply sustainability in their future pharmacy practice, and 48% (n=27) agreed that the sustainability efforts of their potential employers would influence their decisions in applying or accepting jobs.

Despite the lower than expected response rate to these questionnaires, our results show that sustainable healthcare teaching within UK pharmacy degree programmes is limited. There is a disconnect between student respondents "lived experience" of sustainable topics in the MPharm and staff knowledge of the intended curriculum, which may suggest that there is a need to "signpost" existing sustainable topics.

What next?

The study does highlight that there is an awareness of a need for this content to be included in future MPharm curriculum by both student and staff respondents. Since this study began, a UK-wide group of academic pharmacy teaching staff (including the authors) has been established and are lobbying the GPhC to include learning outcomes of sustainable practice in all UK MPharm degrees. This group has established a community of practice with the first '**Sustainability in Education**' Conference running on the 15th October this year, bringing together educators from across the UK, Australia and the USA. Within this community of practice we have a project to establish Planetary Health Report Cards for Pharmacy Schools. The Planetary Health Report Card is a metric-based tool for evaluating and improving planetary health content in health professional schools. At each participating institution, student-led, faculty-mentored teams fill out the report card, identifying opportunities for improvement4. In Queen's we have also been actively identifying the content in our Canvas modules which helps to address the 17 Sustainable Development Goals (SDGs) as described previously. Much work must be done but the enthusiasm and drive within this group has led to invaluable collaborations within a short space of time. If you would like to be involved please feel free to contact the authors for more information.

We would like to thank the undergraduate MPharm students and academic staff across the UK who took the time to participate in this research study as well as the support from colleagues in Pharmacy Declares and the UK Initial Education and Training group looking into sustainability in the MPharm.

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