Presentations   Learning,Teaching & Technology Centre

2023-03-06

Technological University Dublin's Pathway to Embedding Sustainability in Food Degrees, NEMOS and Beyond

Julie Dunne
Technological University Dublin, julie.dunne@tudublin.ie

Catherine Barry-Ryan
Technological University Dublin, Catherine.Barryryan@tudublin.ie

Cormac McMahon
Technological University Dublin, cormac.mcmahon@tudublin.ie

Follow this and additional works at: https://arrow.tudublin.ie/ltcpres

Part of the Education Commons

Recommended Citation

TECHNOLOGICAL UNIVERSITY DUBLIN'S PATHWAY TO EMBEDDING SUSTAINABILITY IN FOOD DEGREES, NEMOS AND BEYOND

J. Dunne, C. Barry-Ryan, C. McMahon

Technological University Dublin (IRELAND)

Abstract

The School of Food Science and Environmental Health, Technological University Dublin, commenced a journey to embed Sustainability in its modules and programmes in 2020 with a nationally funded project 'Sustainable Food Curriculum Co-Create'. The project's goal was to build capacity for integrating sustainability learning outcomes across Food programmes through educator professional development and co-creation with students. The CPD curriculum design involved several stakeholders in Education for Sustainable Development from across the Food System including enterprise and state organisations who advised on sector-specific sustainability issues, food experts from across several Schools, and sustainability experts from across the University and beyond. It also was informed by industry publications and policy frameworks.

In 2021, the School commenced the European Erasmus partnership NEMOS – A new educational model for acquisition of sustainability competences through service-learning. Using a TU Dublin designed sustainability mapping tool, our BSc Food Innovation degree was analysed for current levels of sustainability, based on the AASHE Stars categorisation. Through research involving internal and external stakeholders, barriers to sustainability were identified, and categorised as economical, supply chain issues, labour, knowledge, awareness, investment, government, human nature, climate change, environmental, social sustainability, capitalism, low adoption of Innovation, and food safety. Meanwhile, key food related Sustainability concepts that will be useful to inform the review of food degrees were identified and categorised as Farming Practices, Climate change direct impacts, Environmental, Agrifood Circular Bioeconomy, Waste reduction, Measuring and benchmarking, Food Safety and Regulatory Affairs, Food product development, Sustainable and Ethical Food Business. In all, 70 competencies were identified.

In this special session, TU Dublin will outline the CPD module for enhancing lecturer capacity for embedding sustainability in the curriculum, the TU Dublin curriculum mapping tool for measuring sustainability, and provide an Irish and European context for sustainability competencies.

Keywords: AASHE-STARS, Curriculum, Food Sustainability Competencies, Professional Development, SDGs, Service Learning

1 INTRODUCTION

Technological University Dublin (TU Dublin) is the first Technological University in Ireland and was established in 2019. Its vision is to create a better world together, through fostering a solution-oriented capability amongst its people and encouraging them to find rapid resolutions to the global challenges. Its first strategic plan focuses on the three pillars of People, Planet and Partnership, which resonates with the 5Ps of the UN 2030 Agenda for Sustainable Development: People, Planet, Prosperity, Peace and Partnership [1]. Of particular relevance here is the ambition of TU Dublin to be 'A Powerhouse for Living & Breathing Sustainability'[2]. To achieve this, TU Dublin commits to working with stakeholders to champion these issues at local, national and global level. Specific objectives include being known for the creation of new knowledge and the development of timely & practical solutions that address the SDGs; and producing a new generation of TU Dublin graduates who will be leading the sustainability agenda with passion and purpose. To realise these objectives, TU Dublin has committed that all programmes will have sustainability as a learning outcome and every learner will engage in practice-based research [3].

To meaningfully develop graduate sustainability competencies, it is essential to integrate sustainability as a programme learning outcome, and to reflect this throughout module learning outcomes in all Stages and disciplines. In the case of Food Degrees, the embedding of sustainability to produce graduates who have sustainability literacy and knowledge of food-specific sustainability competencies is essential for Ireland to achieve its ambition of being an international leader in Sustainable Food Systems over the next decade [4]. So, whilst emerging competency frameworks informed by the literature [5], such as GreenComp, are useful in addressing the interdisciplinary aspects to sustainability problem-solving, they are inadequate for detailing the food-specific competencies required to design, develop and implement a sustainable food system. Such a system is profitable throughout (economic sustainability), has broad-based benefits for society (social sustainability) and has a positive or neutral impact on the natural environment (environmental sustainability). The School hosts several staff with specific expertise in food sustainability, some of whom are members of the TU Dublin Environmental Health and Sustainability Institute for research, and others who focus on teaching for sustainability, and all who have a wider national and international network related to food sustainability. Nonetheless, the School identified that staff development would be required to successfully review curricula to meaningfully embed sustainability.

This paper will outline the pathway that the School has taken to date to embedding Sustainability in Food Degrees, with a particular focus on staff development, through a nationally funded project 'Sustainable Food Curriculum Co-Create'; and through participation in the European Erasmus partnership NEMOS–A new educational model for acquisition of sustainability competences through service-learning.

PHASE 1 EDUCATING FOR FOOD SUSTAINABILITY MODULE DEVELOPMENT

2   METHODOLOGY

Given the centrality of SDG 4 (Quality Education) to enabling the achievement of the other 16 SDGs, Continuing Professional Development (CPD) has been recognised globally by higher education as an essential element to facilitating its necessary transformation [6],[7],[8]. The project Sustainable-Food-Curriculum Co-Create was funded through the Irish National Forum for the Enhancement of Teaching and Learning call 'Strategic Alignment of Teaching and Learning Enhancement (SATLE)' 2020. The project objective was to enhance the practice of lecturers in multidisciplinary Food Science education with respect to integrating sustainability through the development, validation and piloting of a formal CPD 5 ECTS short course in 'Educating for Food Sustainability'. It sought to address the reality that most Climate Change education initiatives offer resources for students, but too few for educators [9]. Hence, the first step in building capacity for Education for Sustainable Development (ESD) is for educator professional development, since many lecturers do not have significant and broad sustainable development experience, nor dedicated qualifications in embedding sustainability in Higher Education. The CPD aimed to provide a foundation in sustainability in the immediate term, and allow a step change in delivery of TU Dublin programmes in the medium term. It intended to have an immediate effect, through assessments that involved reviewing of TU Dublin module descriptors to include sustainability learning outcomes and assessments. However, as sustainability knowledge is transformative and evolving faster than adaptation facilitated by typical University Quality Assurance review processes, it also aspired to encourage ongoing review and enhancement for a long-term positive impact. The module targeted three main knowledge domains, namely [i] sustainability literacy, [ii] food sustainability and [ii] education for sustainability.

Included within the project design was a co-creation process that included students. The concept was that current students would enroll in a new Food Sustainability elective module that would be co-delivered with the CPD. This would provide current students the opportunity to develop sustainability competences while also allowing them to contribute to the reviewing of the TU

Dublin module curricula in their discipline. Future students would subsequently benefit through studying the cocreated reviewed modules and programmes. The module was underpinned by curated open education resources (OERs) and three workshops. The first workshop facilitated a deep dive into the SDGs, exploring goals, targets, indicators and metadata. Figure 1 summarises the second workshop, which provided participants an experiential learning of the design thinking process for problem-solving super-wicked sustainability challenges [10].

The third workshop represented the culmination in learning over the duration of the module in which participants were guided, using the nomenclature of the UN SDGs, in rewiring learning outcomes to better reflect sustainability components taught within the School curriculum. Participants completed a materiality mapping to the relevant SDGs and a comprehensive sustainability lexicon was provided to assist with rewriting learning outcomes. All participants were also required to take the UN Sustainability Literacy Test (Sulitest) and write a reflection based on the (Describe, Interpret, Evaluate, Plan) DIEP framework as an authentic assessment designed to foster transformative learning [11].
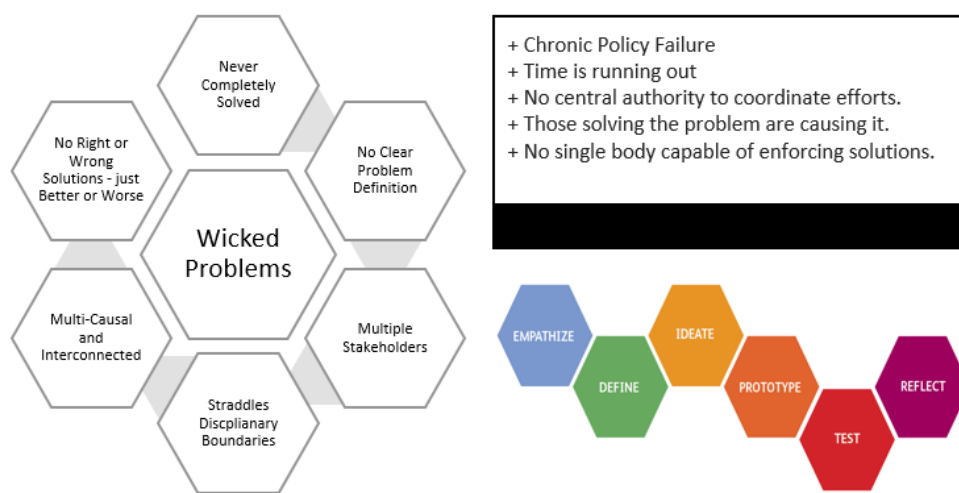

Figure 1: Design Thinking and the Super wicked Nature of Sustainability Challenges

3   RESULTS AND DISCUSSION

The Educating for Food Sustainability CPD and student Food Sustainability modules were developed and delivered as a collaboration between the TU Dublin Learning Teaching and Technology Centre, a university sustainability expert, and the School of Food Science and Environmental Health.

Education for Sustainable Development (ESD) requires several considerations. The content for sustainable development must be rooted in the knowledge disciplines and consider how technology and other advances can influence sustainable development solutions. However, sustainable development is complex, requiring transdisciplinary approaches, allowing knowledge to emerge between established fields, providing space for alternative perspectives, innovative ideas, and solutions to be created [12]. The difficulty is that sustainability requires appreciation of system complexity, far beyond that historically taught in traditional disciplinary focused programmes. Solutions will not derive from traditional problem-solving but require innovative interdisciplinary approaches that foster food-specific competencies and a wider set of future-oriented skills, as well as for students to reflect critically and question their worldviews. To be meaningful, ESD must be influenced by the viewpoints of all stakeholders, including business and enterprise, regulatory and state bodies, communities, and social partners. ESD encourages learners and educators to collaborate widely to effect change. The ethos of the project is based on

sector focused multi-disciplinary co-creation, with a strong focus on academic-enterprise co-creation of curriculum, leading to co-creation of knowledge for sustainable development, and integrating UNESCO's key competencies for sustainability. The modules were two-thirds general sustainability knowledge; and one-third food sector specific. The module learning outcomes are shown in Table 1. The mode of delivery was blended. Curriculum delivery included peer-lectures from staff participating on the module, lectures from experts from across the University, as well as non-academic experts who were invited to deliver key industry related elements. The profiles of speakers are given in Table 2.

Table 1: The learning outcomes of the Educating for Food Sustainability module.

Learning Outcomes:	
On Completion of this module, the learner will be able to	
1	Demonstrate high-levels of sustainability literacy - knowledge, skills and mindsets to become deeply committed to building a sustainable future
2	Demonstrate high-levels of sustainability literacy - knowledge, skills and mindsets to become deeply committed to building a sustainable future as related to the Food sector
3	Critically appraise sustainability-related exemplars of curriculum design, pedagogical approaches and assessment strategies that inform the design and implementation of transformative learning 'interventions' to create cognitive, affective and behavioural learning opportunities.
4	Apply design-thinking to the food sector systems, premised on collaborative experimentation that integrates stakeholders as co-creators of food sustainability knowledge.
5	Co-create an evidence-based framework to support the design, implementation, impact-measure and durability of learning 'interventions' in food-related disciplines for achievement of the SDGs.
6	Explore fundamental questions about the purpose of higher education in building embedded pathways though curricular, co-curricular and informal curriculum for life-long sustainability.

Table 2: Guest Speaker Series

Topic	Speaker
Sustainability Literacy	Member of Ireland's National Regional Expert Committee for sustainability literacy.
Indicators of Sustainable Living	Senior lecturer on TU Dublin's MSc in Sustainable Development
Food Production and Climate Change	Environmental Health and Food Science Lecturer at TU Dublin
Urban Food Initiatives	Environmental Planning Lecturer at TU Dublin
Sustainable Challenges in Irish Agriculture	Enterprise Ireland expert on supporting SME agriculture and Professor of Dairy at University College Dublin
Decarbonising Ireland's Energy	Expert form Ireland's Wind Energy Association with PhD in sustainable energy planning.
Food Sustainability Accreditation – Origin Green	Expert from Bord Bia sustainability programme - the only one in the world which operates at a national level and which includes farmers and primary producers, processors and retailers working together to create a better future for all involved.
Waste Valorisation	Senior lecturer in Food Product Development at TU Dublin
Sustainable Diets	Senior Lecturer in Dietetics at TU Dublin
Corporate Sustainability	Head of Sustainability from Dawn Meats

The open education resources (OERs) used to support the module were curated from a variety of sources, including The UN Food and Agriculture Organisation (FAO), seminal sustainability reports, such as Limits to Growth [13] and Brundtland [14], the SDG Academy, national and international policy documentation, the international panel on climate change (IPCC) and emergent ESD guidelines. As much of the module delivery occurred during the COVID'19 pandemic, many of the guest-lectures were delivered online, recorded and subsequently edited into OERs for on demand consumption. These are available under creative commons (CC) license from a TU Dublin community of practice [15], known as SDG literacy. Guest-speakers were invited to deliver master-classes on different topics, including the impact of climate change on agriculture, decarbonising Ireland's energy, sustainable diets, the UN food systems dashboard, corporate

sustainability, food waste valorisation, the circular bioeconomy, the EU green deal, urban food initiatives, food industry sustainability accreditation and indicators of sustainable living.

The student voice is captured through co-creation workshops and reflective exercises. All participants in the modules were asked to complete a reflection-in-action, which was designed to document learning transformation in knowledge, values and behaviours. All co-creation workshops were facilitated online using MS TEAMS breakout rooms. The first workshop focused on evaluating the embeddedness of sustainability within individual module descriptor by applying the AASHE-STARS criteria for sustainability-focused and sustainability-related courses . The AASHE-STARS (2019) technical manual provides a detailed methodology for measuring and reporting the contributions of a university to the SDGs [16]. It classifies modules into three categories: 'Sustainability-focused' modules must contain significant content with an explicit reference to sustainability or focus on a major sustainability challenge; 'Sustainability-inclusive' modules do not have an explicit focus on sustainability, they must incorporate a sustainability component to indicate requisite learning; 'Non-sustainable' modules represent those that are neither sustainability-focused nor sustainability-inclusive.

To assist with AASHE-STARS categorisation, TU Dublin developed a computational technique [17], which applied a natural language processing method (NLP), known as Term Frequency-Inverse Document Frequency (TF-IDF), to a lexicon of keywords extracted from the 169 targets and 247 indicators describing the SDGs, as a means of scoring their relative sustainability importance to each SDG. The relative sustainability importance of each keyword to each SDGs was scored, as shown in Equation 1 below.

$$\text{Score} = \frac{Number\ of\ Times\ the\ Keyword\ appears\ in\ the\ t\arg ets\ and\ indicators}{Number\ of\ SDGs\ in\ which\ the\ keyword\ appears}$$

Equation 1: SDG Scoring

Searching for these keywords within module descriptors then provided a basis for scoring the relative importance of modules to the SDGs. A statistical parsing of these importance scores then provided the basis for categorising modules to AASHE-STARS criteria. A detailed analysis of the modules in the Food degree programmes was shared with programme teams for consideration. Guided by the SDSN's SDG keywords, students and staff mapped selected module learning outcomes, indicative syllabi, assessments and learning resources to the SDGs, manually simulating the NLP technique, and opportunities for enhancing the relative sustainability importance score of each module were identified [17]. Each breakout room contained a mix of staff and students who were familiar with the respective modules for evaluation. An additional workshop was run to evaluate the circularity of module delivery using SusTEACH [18]. Finally, the third workshop, focused on design thinking, required students to adopt different personas in understanding user needs for a sustainability travel app, thereby replicating the problem-solving process typically required in addressing complex sustainability challenges.

The assessment strategy of the Food Sector sustainability modules involved (1) reflection of personal development throughout the module, as well as on improving performance in the UN supported online multiple-choice question sustainability literacy test (SULITEST); (2) artifacts generated during the workshops and (3) for academic staff, reviewing one of their module descriptors to embed sustainability learning outcomes. An example of a module descriptor review is shown in Figure 2, with sustainability elements shown in **bold**, and is available as an OER [19].

Module Overview:
The module aims to enable students to employ analytical techniques to food analysis to generate high quality analytical data.
This subject deals with principles of chemical analysis and the application of analytical methods to food, including the use of advanced instrumentation. An emphasis will be placed on extraction and analysis of nutraceutical components, including structure identification, **and the role in circular bioeconomy. An emphasis will also be placed on the role of green chemistry in food analysis.** Laboratory work involves the application of analytical methods to food, including the use of advanced instrumentation.

Learning Outcomes (LO):	
On Completion of this module, the learner will be able to	
1	Describe the basic terminology of chemical analysis and explain the decision process for choice of methods, and use of validated methods.
2	Describe the principles of sampling
3	Explain the uses of traditional sample preparation techniques **as well as potential for greener solvents for extraction of bioactives.**
4	Describe aspects of laboratory Quality documentation for analytical methods
5	Describe applications of chemical techniques in food analysis, **and the role of green chemistry in analytical methods.**
6	Describe applications of instrumental techniques including rapid methods in food analysis
7	Discuss **global challenges** in the context of food chemistry and analysis: **food fraud and the impact of climate change on food chemical contaminants.**
8	Develop enhanced numeracy through in-class and in-practical calculations, including identification and reduction of variance.
9	Develop enhanced laboratory skills to perform high quality food analyses for a range of food constituents
10	Develop enhanced research and scientific writing skills to report on food analysis experiments

Figure 2: A module descriptor reviewed to embed sustainability competencies.

Whilst staff and students were each enrolled on different versions of the programme, the underlying ethos was on co-learning. As partners equally vested in a transformative learning process for a rapidly evolving field of study.

The foundation provided by the Educating for Food Sustainability CPD module allowed the team in School of Food Science and Environmental Health to engage with the EU Erasmus+ NEMOS project [20] and contribute in a more informed manner to the direction of the project.

PHASE 2 DEFINING COMPETENCES AND A FOOD SUSTAINABILITY PROFILE

4   METHODOLOGY

TU Dublin commenced the EU Erasmus project 'NEMOS A new educational model for acquisition of sustainability competences through service-learning' [20] in 2022, and to date has completed work towards the first objective: Defining a food sustainability profile (FSP) through a community building methodology.

The methodology for defining the FSP was developed through the NEMOS project team. Research Ethics approval was granted for NEMOS to conduct Surveys, Focus Groups and Interviews. All participants were provided with information on the project. All participants consented to participate in the research. The question schedule developed by the NEMOS project was used for all qualitative interviews. Focus groups were conducted online by TU Dublin NEMOS leads. They were recorded, and key points summarised, followed by overall analysis of themes arising from staff and students. An interview with TU Dublin Students Learning with Communities (service learning) Unit lead was conducted by TU Dublin NEMOS lead. It was recorded, transcribed, summarised, and 8 key themes identified. Five interviews with external stakeholders were carried out by NEMOS lead and NEMOS Fellows. Key points were summarised to various extents depending in the interviewer and are reported. All the data from these interviews were drawn into a single summarised report by a NEMOS lead. Surveys were completed by TU Dublin students (N=39), staff (N=21) and the data was analysed.

A computational approach to evaluating curricular alignment to the United Nations sustainable development goals which was developed in TU Dublin by Lemarchand was used for the curriculum analysis on the TU Dublin BSc Food Innovation as part of the NEMOS objective of defining a sustainability profile for food degrees [17].

The analysis of the four stages of the TU Dublin BSc Food Innovation shows no incidence where the category of sustainability-focused modules is highest (Table 3). When sustainability focused and in-mind modules are combined, Stage 4 has the highest level of sustainability, with Stage 2 the lowest.

Table 3: BSc Food Innovation with year and the % of modules in each AASHE category.

Year	AASHE Category *	Number of Modules	%
1	1	4	33
	2	5	42
	3	3	25
2	1	8	66
	2	2	17
	3	2	17
3	1	3	25
	2	7	58
	3	1	8
4	1	2	17
	2	7	54
	3	3	25

* 1 = Non-Sustainable, 2 = Sustainability-Inclusive, 3 = Sustainability Focused

However, these results compare favourably with other TU Dublin programmes. Across the wider TU Dublin curriculum portfolio the incidences of sustainability-focused and sustainability-inclusive modules average 5%, and 13% respectively, indicating that the School's curricular portfolio is rooted in a strong sustainability orientation

Through interviews, surveys and focus groups with stakeholders as outlined in the methodology barriers to sustainability were identified, and categorised as economical, supply chain issues, labour, knowledge, awareness, investment, government, human nature, climate change, environmental, social sustainability, capitalism, low adoption of Innovation, and food safety.

Key food related Sustainability concepts that will be useful to inform the development of a sustainability profile and for the review of food degrees to embed sustainability learning outcomes were identified and are shown in Table 4.

Table 4: AgriFood Sustainability Themes and Competencies.

AgriFood Sustainability Theme	AgriFood Sustainability Competency/Learning outcome
Farming Practices	1. GMO foods – require less water, less nutrients 2. Sustainable methods ie free range, Hydroponics 3. Upkeep of land, improving organic matter and quality 4. Biodiversity 5. Availability of stock seeds 6. Improving farm activity, pollinating insects, use of pesticides 7. Reduce reliance on chemical fertilizer and pesticides 8. Soil analysis, and include worm activity, organic matter, soil structure 9. Carbon and carbon sink 10. Reduce antibiotics. Relationship between food sustainability and health.
Climate change	11. Climate change aspects 12. Erratic/destructive weather

	13. Changes in pathogen/toxin biology
	14. Human population movements
	15. Pollution
	16. Biodiversity loss/change
	17. Curbing methane and other GHG emissions from livestock and other sources
	18. Food security
Environmental	19. Carbon footprinting of the lifecycles of common food production
	20. Use of new power sources, e.g. hydrogen, wind, wave
	21. Emissions reduction
	22. Life cycle assessment
	23. Laboratory design, solvent reduction in food chemical/ analytical analysis
	24. Reusable laboratory materials
	25. Reuse tools and materials for less wastage
	26. Energy management in food processing and distribution.
	27. Capacity for measuring sustainability and environmental quality
	28. Biodiversity
Food product development	29. Sustainability in NPD
	30. Sustainability of food packaging
	31. Changing public opinions, diets, perspectives, fears.
	32. Healthy and nutritious food (reformulation, reduced sugar, salt, etc)
	33. Reduce focus on animal-based food – less energy and feed, water, shelter
	34. Utilise crops that are in season
	35. Alternative products ie flexitarian
	36. Food processing sustainable innovation
	37. Food ingredients sustainability
	38. Supply chain reliability
Agrifood Circular Bioeconomy	39. Use of food and other waste (manure, cardboard) to generate biogas and biodiesel and offer back as renewable energy (Green Generation).
	40. Reduction in waste & removal costs
	41. Offsetting fossil fuel usage
	42. Side streams circulated back eg as fertiliser
	43. Organic fertiliser reducing other fertilisers
	44. Use of enzymes for bioremediation and valorisation
	45. Bioeconomy principles as a means to achieve sustainability
Waste reduction	46. Reducing water waste
	47. Food waste for animal feed
	48. Eliminating / reducing food waste
	49. Packaging recycling
Measuring and benchmarking	50. BRC Food safety standard V9 will include sustainability
	51. Auditing skills
	52. Capacity for measuring sustainability and environmental quality on farms
Food Safety and Regulatory Affairs	53. Traceability, food safety, regulation and compliance
	54. Sustainable packaging and food safety
	55. Food Safety and Climate change adaptation
	56. Benchmarking systems for sustainability targets
Sustainable and Ethical Food Business	57. Measurement of sustainability in the food industry
	58. Marketing – responsible marketing, consumer, transparency
	59. Sustainable Certification eg Bord Bia Origin Green
	60. Adulteration and sustainability. Labelling.
	61. Gender equality and food. Not well known or understood.
	62. Social issues, equality, climate justice, unfair wages, fair trade.
	63. Balance sustainability and business viability

64. Negotiating with suppliers and customers
65. Innovation brokerage for sustainability
66. Ethical ingredients, supply chain, labour
67. Innovations in procedures, equipment
68. Plans for surplus food grown
69. Commercial requirement for sustainability plans, ethical credentials, sustainable provenance
70. Bioeconomy as a driver of sustainability and new markets

In terms of sustainability and University education, the findings are within two categories. The curriculum, including technical knowledge and transferable skills; and the operation of the University as a sustainable organisation.

Staff are interested in food sustainability, and most have aspects included within their modules. Nonetheless a need for professional development within their food related discipline area, in general sustainability, and in pedagogies to embed sustainability were identified.

Meanwhile, almost all students identify the need for specific knowledge and training in sustainability issues as a necessary part of their professional education. Most would be interested in sustainable development projects or activities. The interest in participating in service learning was high across all those surveyed and interviewed. Specific guidance on integrating sustainability through service learning was provided by the University service-learning lead.

5 CONCLUSIONS

A pre-requisite to realising the intent of embedding sustainability in a deep and meaningful way is a provision of staff professional development. Capacity for TU Dublin curriculum review and enhancement through the lens of the sustainable development goals, particularly with respect to embedding sustainability learning outcomes in food programmes, has been enhanced through the provision of modules in Educating for Food Sustainability. These provided a foundation in the immediate term, and will allow a step change in delivery of modules in the medium term and facilitate the development of sustainability focused programmes in the longer term. A key dimension has been the development of capacity to engage with enterprise in a more responsive fashion. The emergence of sustainability knowledge that is transformative mandates a CPD provision that encourages ongoing review and positive impact of the education for the food sector. In tandem, the Food Sustainability student module provided learning opportunities for TU Dublin students to develop sustainability leadership capabilities until curricular integration of sustainability is achieved through curriculum review processes.

In tandem with the development of staff sustainability literacy, knowledge of educating for sustainable development (ESD), including generic sustainability competencies, pedagogies for ESD, and curriculum review tools and frameworks, the NEMOS project has identified specific sustainability themes and learning outcomes, as well as a curriculum analysis of the BSC Food Innovation for levels of sustainability embeddedness. Taken together, the TU Dublin programme team are now well positioned to review the BSc Food innovation curriculum to embed specific food related sustainability learning outcomes, and to design aligned learning activities and assessments to significantly enhance the capacity of graduates of the programme to contribute to the Irish national agrifood strategy Food Vision 2030 and its ambition that Ireland should become an international leader in Sustainable Food Systems [4].

ACKNOWLEDGEMENTS

REFERENCES

[1] UN (2015) Transforming Our World: The 2030 Agenda for Sustainable Development. Seventieth Session of the United Nations General Assembly Resolution A/RES/70/1. UN, New York.

[2] TU Dublin (2020) TU Dublin Strategic Intent. https://www.tudublin.ie/media/TU-Dublin-2030.pdf

[3] Government of Ireland (2023). ESD to 2030: Second National Strategy on Education for Sustainable Development.

[4] DAFM (2021) Food Vision 2030 – A World Leader in Sustainable Food Systems. Available at: https://www.gov.ie/en/policy/b2a3c-food-vision-2030-a-world-leader-in-sustainable-food-systems/

[5] Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: a reference framework for academic program development. Sustainability science, 6(2), 203-218.

[6] Holdsworth, S., Wyborn, C., Bekessy, S., & Thomas, I. (2008). Professional development for education for sustainability: How advanced are Australian universities?. International Journal of Sustainability in Higher Education.

[7] Collazo Expósito, L. M., & Granados Sánchez, J. (2020). Implementation of SDGs in university teaching: a course for professional development of teachers in education for sustainability for a transformative action. Sustainability, 12(19), 8267.

[8] Schudel, I., Down, L., McKeown, R., Baumann, S., Petersen, A., & Urenje, S. (2023). Supporting Education for Sustainable Development through an Online Global Forum for Teacher Educators. At school in the world: Developing globally engaged teachers, 287.

[9] ALLEA (2020). A snapshot of Climate Change Education Initiatives in Europe: Some initial findings and implications for future Climate Change Education research. Lead authors: Cliona Murphy, Gabriela Martínez Sainz, Maija Aksela, Gerd Bergman, Michael Jones, Pierre Léna, David Wilgenbus. Berlin. DOI: 10.26356/climateeducation

[10] Yearworth, M. (2016). Sustainability as a 'Super-Wicked' Problem: Opportunities and Limits for Engineering Methodology. Intelligent Buildings International, 8(10, pp. 37–47, 2016.

[11] Freeman, O., Duffy, D., McAlpine, A., Nolan Dr, C., McMahon, C., & Walsh, L. (2021). Exploring the impact of authentic assessment on sustainability literacy through reflective and action-oriented tasks: A roundtable podcast. Irish Journal of Academic Practice, 9(2), 7.

[12] QAA (2014) Education for sustainable Development: Guidelines for UK Higher Education Providers. Higher Education Academy and UK QAA.

[13] Meadows, D. and Randers, J. (2012). The limits to growth: the 30-year update. Routledge.

[14] Brundtland, G. H. (1987). Our common future—Call for action. Environmental Conservation, 14(4), 291-294.

[15] Behan P, Ferns S, Foley S, Freeman O, Gabaudan O, McAlpine A, McMahon C, Walsh L. (2022). Using the Community of Practice model to shape approaches to Education for Sustainable Development across disciplines in a Technological University context: A Roundtable Podcast.

[16] AASHE (2019) Technical Manual V2 - The Sustainability Tracking, Assessment & Rating System (aashe.org)

[17] Lemarchand P, McKeever M,MacMahon C and Owende P (2022) A computational approach to evaluating curricular alignment to the united nations sustainable development goals. Front. Sustain.3:909676.doi: 10.3389/frsus.2022.909676

[18] SUSTEACH Available at http://www9.open.ac.uk/SusTeach/index.htm

[19] Dunne, Julie, "Food Analysis Module Descriptor with SDGs Embedded" (2021). Reusable Resources. 1. https://arrow.tudublin.ie/totalarcresreu/1

[20] NEMOS A new educational model for acquisition of sustainability competences through service-learning. Available at https://www.nemosproject.com/