

Co-creation of sustainability education: 'made by students'

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Introduction

Allowing space for the students as co-creators is viewed as a novel pedagogical approach¹ with particular gain for teaching in interdisciplinary cohorts, from embracing new aspects of participatory content creation, empowering young researchers to inform educational content with state-of-the-art ideas, and rendering content relevant to the classrooms of the future. At the University of Strathclyde, a number of projects are currently underway that adopt a co-creation model: from the design of an undergraduate module in the School of Psychological Science and Health and a postgraduate interdisciplinary module on Nature-based solutions at the Centre for Sustainable Development, new space is created for staff-student collaboration through empowering students as co-creators and giving them equal role to staff, as content generators.

The paper will describe the process and lessons learnt from establishing those co-creation projects on novel educational resources development for both undergraduate and postgraduate levels, focusing on the role of tutor and students as co-creators⁽³⁾ and moving on to discussing challenges and benefits for both, aiming at supporting the effective application of this model across more higher education institutional settings. Such teaching and learning experiences form part of the university's approach to integrating Education for Sustainable Development (ESD) in learning both in terms of adoption of pedagogical innovations but also in terms of new content development. ESD aims to equip people to develop the skills and competencies to play an effective part in real-world action for sustainable development, often by employing transdisciplinary processes of learning and action^(4,5). Finally a critical review of links to ESD competencies integration through this co-

¹ Wakerley, Elodie, and Shivani Wilson-Rochford. "Co-creation for collaborative curriculum design: An exploration into a staff-student partnership in learning and teaching."

² Bovill, Catherine. "Co-creation in learning and teaching: The case for a whole-class approach in higher education." *Higher education* 79, no. 6 (2020): 1023-1037.

³ Healey, Mick, Abbi Flint, and Kathy Harrington. "Students as partners: Reflections on a conceptual model." *Teaching and Learning Inquiry* 4, no. 2 (2016): 8-20.

⁴ Sterling, Stephen, and David Orr. *Sustainable education: Re-visioning learning and change*. Vol. 6. Totnes: Green Books for the Schumacher Society, 2001.

⁵ Wiek Arnim, Lauren Withycombe, and Charles L. Redman. "Key competencies in sustainability: a reference framework for academic program development." *Sustainability science* 6, no. 2 (2011): 203-218.

creation approach is included here opening up the discourse for new ways of co-developing content that can support learning for sustainability from a bottom-up approach.

Case studies

The paper includes two core case studies from our latest co-creation module development project at Strathclyde. The first case study briefly describes the student-driven development of an undergraduate module focused on 'Introduction to human factors', covering a topic featuring on 4th year, BA degree in Psychology, led by a tutor in the department of Psychology, Faculty Of Humanities And Social Sciences (HASS). This is a 10 credit module offered for online learning and the upgrade of the module was instigated by a group of students working in this area, including two doing their PhDs and some conducting undergraduate research who identified gaps in the content that would be meaningful to cover as part of a collaborative redesign of the class. The wider learning content on Human Factors includes looking at designer and user perspectives to improve design solutions in various contexts and promote human-centred solutions.

Conceptual aspects were mainly framed by the experienced tutor, who shared pedagogical thinking and guidance on practical aspects of integration of sustainability-relevant pedagogies into the module development. Using questions like How do we insert SDGs format from the bottom up? Were considered in the development process and seek to naturally integrate SD questions and reflections where it fits within the course. The core aspects of human factors, leading to links to engineering psychology, psychology of design was in the core focus. Where can those be applied? Designing inclusively for humans, requires multiple considerations to be taken into account including aspects of impact on users to be included in design processes.

Professional links were considered crucial for topics coverage and definitions to be covered: lead students connected with HASS careers advisor for this purpose to see how to integrate careers in the module, gaining further understanding of real-world professional skills and knowledge recognition processes.

Systems thinking was part of the wider content and analysis of human behaviours as part of learning. Student activities focuses a lot on designing the assessment, suggesting a task analysis for a professional in a specific role as core part of the assessment. Consideration of what the producers, suppliers had to consider was integrated and assessment was finally designed as a group-based activity.

This second case study described the development of a postgraduate 10 credit module on 'Nature-based solutions (NBS): benefits and applications' designed for online and hybrid learning environment, through a collaborative model of working with two postgraduate researchers (PGRs) with expertise on the topic and one teaching fellow (tutor) in coordinating role.

The researchers were part of the recently established *Sustainability Journal club* and shared readings and expertise with the rest of participants in the group linked to climate justice, aspects of nature-inspired engineering for global challenges etc, including discussions around their own readings on applications of NBS in policy and practice instigating collaboration after noting a gap in current university provision on this subject. Sharing a common background on architecture and urban design with the tutor, but with distinct professional expertise/background, the team combined their strengths to identify the prospective audience for the course: early discussions revolved around professionals with a need to upskill from planning background policy makers and practitioners alike (interested in technological innovations around NBS). The team identified a structure that could offer a cross-disciplinary view of MBS and therefore be suitable for all those types of participants, while adopting a theoretical framing that would cover the definitions and role of NBS in policy and practice. We set out to design an exciting learning experience, aiming to offer something different from existing programmes that would showcase the university's own expertise and Scottish perspectives on the topic. We agreed on a model for assessment that would combine at least two types of assessment, from quizzes for quick verification of knowledge to case study reflective exercises and essays to develop participants skills in critical thinking as well as global awareness of innovation around the topic.

In both cases, the *development approach* was rather open, bottom-up development with the tutor providing a pedagogical structure and ensuring constructive alignment⁶ through the stages of co-creation of content and structure. The use of tools like the BOLD framework⁷, developed at Strathclyde for hybrid and online/blended modules development supported a shared understanding of module development process and the role of well identified Learning outcomes linked to a sequence of learning activities for alignment and quality learning experience considering multiple ways of learning⁸. The framework drives on Blooms taxonomy⁹ and provides pre-registered examples of learning approaches, types of testing and reflecting as well as inspiration for effectively sequencing the learning experience¹⁰.

The sequencing of activities and targeted use of *learning activities* (remember, understand, apply, analyse..) and Bloom's taxonomy in practice was practically useful for the students in shaping and forming ideas around learning activities within each sub-module/unit. For the NBS module, particular challenges included identifying the suitability of activities for online delivery and the differences from in-person delivery, especially for the formation of a cohort and designing of group activities. A set of meetings allowed for exchange of expertise and review of existing short courses or online modules of similar nature with our own, that targeted various conceptual aspects of NBS.

⁶ Biggs, John. "Enhancing teaching through constructive alignment." *Higher education* 32, no. 3 (1996): 347-364.

⁷ Morrissey, Sean, Katy Savage, Veronique Lemieux, and Howard Ramsay. "Blended and online learning design: an inclusive approach." *Excellence in Teaching* (2022).

⁸ Morrissey, Sean, and Kathleen Savage. "Inclusive curriculum (re) design for blended and online learning: evaluation and toolkit/video resource production." (2022).

⁹ Clark, D.R. (1999). [Bloom's Taxonomy: The Psychomotor Domain](#).

¹⁰ Akhilesh, K. B., and K. B. Akhilesh. *Co-creation and learning*. Springer India, 2017.

For the Human factors module, students were introduced to the Bold framework as well early on and were supported by the tutor to structure the content, making decisions on relevance and focusing a lot on authentic assessment¹¹, looking at types of assignments and formative activities that can be included in the module, from their perspective.

In the NBS module, tools like mind maps helped us identify the relevance of concepts like Ecosystem services with NBS and later with sustainability through interactive meetings. This led to the development of a structure and content page for the course and assigned leading roles for each member of the team in relation to content generation. The PGRs adopted a module each to structure and develop further with a set of slideshows to fit their content in, using group agreed topics and learning questions to structure the learning objectives as they went along.

Student co-creators were asked to remind themselves each time of what is that your student going to learn after following this session or watching this video. They were exemplary in bringing in innovative ideas, new knowledge/identifying state of the art literature to support critical learning and developed a set of reading resources to accompany core learning material, while moved on to be creative in shaping their own narrated videos and graphs to illustrate the structure of their modules. The PGRs explored also novel ways of creating digital content, recording and narrating in combination with imagery that brings the content into life and engages the audience in captivating ways.

Roles and collaboration/co-creation as a process

Key role of the tutor was structuring *the co-creator's own learning experience* while ensuring alignment and quality of designed material ensured by end of design phase. Establishing a more definite structure and moving on to content from identification of learning objectives onwards.

Key tasks of the tutor in both classes included the development of a timeframe, milestones and coordination of the project, offering learning time and collaboration time to the team to exchange knowledge while acting as a critical friend. Ensuring each member had clarity and undertook responsibility in shaping a part of the course, while combining their pieces with others in iterations was also part of the tutor's role in the process¹².

ESD integration approaches

Both case studies here identified the challenge of co-creation while integrating aspects of ESD pedagogies: at one hand we strove *for bottom-up inclusion of concepts relevant to SD* (as opposed to explicit links to SDGs for example), incorporating student co-creators perspectives on social, economic and environmental impacts where possible and concepts of human progress and prosperity. On the other hand, there was an *intentional and direct need to include activities and approaches that shape multiple ESD competencies* for course participants.

1. Critical introduction of concepts relevant to SD involved:

¹¹ Gulikers, Judith TM, Theo J. Bastiaens, and Paul A. Kirschner. "A five-dimensional framework for authentic assessment." *Educational technology research and development* 52, no. 3 (2004): 67-86.

¹² Taylor, Carol A., and Catherine Bovill. "Towards an ecology of participation: Process philosophy and co-creation of higher education curricula." *European Educational Research Journal* 17, no. 1 (2018): 112-128.

- Identify the relevance of disciplinary content to SD aspects first.
- Identify needs and limitations coming from accreditation bodies and relevant requirements for content first. (Which dictated levels of flexibility to adapt and include SD concepts within core content)

In NBS class for example, through a series of meetings between the team and use of brainstorming tools, a series of debate questions were used to structure core content and tackle key concepts, which would then give floor to development of mini-lecture material for each, in the form of presentations and narrated videos. Those critical questions aligned with session learning outcomes¹³ and enabled a break-down of the wider module to the session-aligned outcomes¹⁴.

- Approach SD not as new content (but link to SD considerations, responsibility, impacts to society, real life case studies and global challenges) to keep courses meaningful while retaining key topic (eg. human factors).

In NBS class for example aspects of globalisation and citizenship became relevant through questions: what does NBS look like in different contexts? What is the role of local context in defining best practice in NBS and what are the solutions that may be most urgently needed for sustainability challenges across the globe? Collaborators had work experience from Middle East, as well as bringing in perspectives from studying in other Northern European universities and their scholarship on the topic. There was also a practical aspect in offering this, seeking to equip future course participants with tools and approaches they may need for using or applying NBS in their career worldwide.

The tutor introduced PGRs to trans-disciplinarity and its role for developing Sustainable Solutions¹⁵ and such concepts were integrated in the content, in areas where the role of policy and practice were coming together as aspects of systemic solutions for example.

In Human factors class, the concept of sustainability, following a similar approach, was not therefore introduced as part of the key content coverage. Instead, students were encouraged to consider global contexts, cross-disciplinary needs for using human factors theories and concepts to improve design of systems, products and designed services, which would improve sustainability in the context and lives of users. Such elements were included in reflective elements of learning experience.

1. Keeping ESD competencies¹⁶ in mind during the whole design was the approach that both case undertook, focusing on skills that best suited the content and types of learning activities designed could improve. The co-creation being a de-facto group work experience brought in great ideas on group-based work and assignments that could be part of the actual learning experience.

¹³ Biggs, John, and Catherine Tang. "Applying constructive alignment to outcomes-based teaching and learning." In *Training material for "quality teaching for learning in higher education" workshop for master trainers, Ministry of Higher Education, Kuala Lumpur*, vol. 53, no. 9, pp. 23-25. 2010.

¹⁴ Gulikers, Judith TM, Theo J. Bastiaens, Paul A. Kirschner, and Liesbeth Kester. "Relations between student perceptions of assessment authenticity, study approaches and learning outcome." *Studies in educational evaluation* 32, no. 4 (2006): 381-400.

¹⁵ Bennett, Max. "Transition to a new paradigm in Education-Universities and Knowledge for Sustainable Urban Futures: as if inter and trans disciplinarity." (2017).

¹⁶ Rosén, Anders, Kristina Edström, Audun Grøm, Lena Gumaelius, Peter Munkebo Hussmann, Anna-Karin Högfeldt, Meeri Karvinen et al. "Mapping the CDIO Syllabus to the UNESCO key competencies for sustainability." In *15th International CDIO Conference*. 2019.

In the case of Human Factors class development, systems thinking, collaborative and problem-based learning approaches were part of core competencies developed as part of the process and learners' journey. Critical thinking and critical appraisal were employed across the co-development process and necessary for completing most of assignments designed. Students had the opportunity to delve into what systemic thinking means for design practitioners and those using human factors theoretical elements to shape services and other products, thus considering a wide range of applications that cross disciplinary limitations in thinking and applying solutions.

In the case of NBS class development, systems thinking and problem -based learning were core *cognitive competencies* of relevance identified early on in the phase of shaping learning outcomes. Similarly normative competence and examining one's own values (eg. in relation to using natural resources, nature's own ways etc) were naturally tested through reflective exercises and stakeholder perspective activities that enabled a greater understanding of the concept of NBS for policy makers, planners and practitioners alike.

Normative competence was relevant in areas where asking key questions could enhance learners' positionality and support learning (eg. who decides on applying NBS? What does it mean for different stakeholders? Policy makers, designers, financiers supporting sustainability projects?)

Critical thinking, systems thinking was exerted through activities asking: how can we critically assess the success of an NBS in a context? Which frameworks can be used to design NBS? Which are the most pressuring challenges that NBS can contribute to solving today?

Problem solving: the case studies and assignment offered the basis for testing and improving those skills, as they were challenge-based¹⁷. Due to the nature of the NBS course for example, shorter assignments were chosen and individual basis ones were referred to group activities. We did opt for group discussions that revolved around case studies or specific challenging cases, do that participants would have the space to share perspectives, exchange knowledge and engage in group problem solving via brainstorming.

Systems thinking: such skills were considered most relevant while studying NBS, especially through activities like mapping of co-benefits and trade-offs of some solutions. As mentioned earlier, for Human factors class, the systemic thinking was key part of applying human factors thinking and considering needs of multiple sub-users and communities. The aspect of mapping relevance of stakeholders was contributing to systemic thinking in both classes: ensuring we visualise for the participants how different stakeholders may contribute to solutions and the links between policy interventions and impacts on natural resources management for example in the NBs module.

Impacts: benefits for students through their role as co-creators and path to empowerment

What is in this for students? Multiple aspects of empowerment appear as key benefit for student participants in co-creating teaching content. The ability to proudly declare you developed the material that other students will benefit from, combined with mere representation of students' own generational and 'literary community' considerations lead to

¹⁷ Bertel, Lykke Brogaard, Maiken Winther, Henrik Worm Routhe, and Anette Kolmos. "Framing and facilitating complex problem-solving competences in interdisciplinary megaprojects: An institutional strategy to educate for sustainable development." *International Journal of Sustainability in Higher Education* 23, no. 5 (2022): 1173-1191.

great sense of ownership of learning content¹⁸ and confidence in developing further content in the future for prospective fellow-students. At the same time the approach clearly, disrupt hierarchical models of 'tutor-student relationship' and traditional power balances that promote equality in learning¹⁹. This may be particularly relevant for research-based students who already have navigated various schools of thought and literature on certain topics. Other authors have identified co-creation can be deeply transformative: it can change students and what they want to achieve at university and beyond^{20 21}. Secondly, the direct sharing in the form of mentorship of pedagogical knowledge (around module and curriculum design and approaches towards it) is invaluable. Both students and tutor, with an emphasis on the tutor's experience, support conceptual coherence and strive for constructive alignment (especially through role of assessment, exercises, applied tests of knowledge and assignments for learning).

Students brought in novel approaches and perspectives (eg. use of podcasts, new forms of recording and shaping video content) linked to skills that are of interest to them in the first place. The ultimate benefits are shared between staff and student co-creators: integration of ideas and innovation, transferring of knowledge and experiences as learners (of what works in other modules for example) into new content development to drive improvement towards excellence, avoiding pitfalls.

Student researchers also gained professional expertise and confidence by becoming members of relevant professional associations/ chapter, seeking to understand professional relevance further and understanding the process of accreditation for the short course as a stand-alone CPD unit. In the case of Human factors, led by a more experienced PhD student, they identified a path to pursue this recognition and link to accreditation, adding further value to the module and opening up opportunities of the wider professional community to benefit from their module.

Tutors become more aware of own biases and pitfalls from repeating module structuring approaches, use of media etc that may not always work from the student perspective, much quicker and more directly than in a post-module evaluation format.

Tutors gain strong collaborative course development skills. Through collation of expert resources under commonly agreed topics and prioritisation of concepts to share with the course participants, those skills are honed and negotiation processes are introduced to quality check the material gathered and its relevance to LOs.

While this paper doesn't cover longer-term benefits and observational outcomes for students, research supports longer-term behavioural changes and action by students that support longer-term sustained benefits of co-creation processes²².

¹⁸ Curtin, Amy L., and Julia P. Sarju. "Students as partners: Co-creation of online learning to deliver high quality, personalized content." In *Advances in Online Chemistry Education*, pp. 135-163. American Chemical Society, 2021.

¹⁹ Mercer-Mapstone, Lucy, and Catherine Bovill. "Equity and diversity in institutional approaches to student-staff partnership schemes in higher education." *Studies in Higher Education* 45, no. 12 (2020): 2541-2557.

²⁰ Johansson, Charity, and Peter Felten. *Transforming students: Fulfilling the promise of higher education*. JHU Press, 2014. p.929

²¹ Lubicz-Nawrocka, Tanya, and Catherine Bovill. "Do students experience transformation through co-creating curriculum in higher education?." *Teaching in Higher Education* (2021): 1-17.

²² Doyle, Elaine, Patrick Buckley, and Brendan McCarthy. "The impact of content co-creation on academic achievement." *Assessment & Evaluation in Higher Education* 46, no. 3 (2021): 494-507.

Challenges

Bias forms a key challenge in the co-development with smaller group of tutors or students: what is relevant to us may not be to many others regarding content selection and wider triangulation with different learners and their needs is always helpful to avoid tutor's bias. This may have ramifications for inclusion of co-creators in the process as well²³. However, co-development processes actually restrict bias present in traditional module development models where the tutor develops single-handedly a class.

One of the experienced issues in our work, was the approach towards *achieving consensus* on both content and learning approaches choices: how we apply and reflect upon variant (research) interests in the co-development process? Devoting time to online and in-person brainstorming on concept coverage was one effective way to agree on key content to include and content desirable but not necessary to cover. Given that such decisions may have greater impacts on audience development and tackling expectations of future students, the consensus needs to be guided by a shared vision, awareness of prior learning were possible and ideally audience expectations' framing at the starting phase of the collaboration.

Restricting the 'immense freedom' that appears when you offer a blank page to a group of co-creators can lead to loss of motivation. Following benchmark statement restrictions in the development of UG module content for example lead to a more strictly framed process and content structure, reflecting on the process and each member's contribution to the co-creation process. The need to *cover disciplinary requirements* while not ignoring wider agendas for teaching excellence and quality of learning experience was at the heart of the challenge for the UG class (those may be spanning from an anti-racist and inclusive curriculum to integration of Sustainable Development principles within new module development processes). The tutor strove to integrate those meaningfully, while ensuring compliance with standards of accreditation and professional bodies requested learning content (eg. British Psychological Society), ensuring the class can offer key tools and competencies needed in the professional lives of students.

Adopting a reductionist approach was helpful and necessary as part of the process for the PG class to identify the most suitable content combined with a continuous assessment of relevance, practical experience of the tutor of what is possible to include to ensure coherence and constructive alignment. Acknowledging what we are not covering is also part of this process and links to the core audience of the course and its expectations. Offering supplementary readings or other resources forms part of this approach (for example provide an evaluation example that may not be directly linked to the core assignment, as an optional reading for participants).

Conclusion

Co-creation bears itself as ideal model for a student-led curriculum design (and re-design), allowing for dialectic and reflective approaches in quality curricula that are representative of student community's interest, disciplinary perspectives and state-of the art scientific knowledge integration. In relation to ESD, the process of co-creation aligns perfectly with the ethos and principles of enabling a shared understanding of SD²⁴ and links of various disciplinary topics to sustainability and a student-tutor partnerships to identify and deal with gaps around critical inquiry. The amount of ESD competencies that can be integrated can

²³ Bovill, Catherine, Alison Cook-Sather, Peter Felten, Luke Millard, and Niamh Moore-Cherry. "Addressing potential challenges in co-creating learning and teaching: Overcoming resistance, navigating institutional norms and ensuring inclusivity in student-staff partnerships." *Higher Education* 71 (2016): 195-208

²⁴ Perello-Marín, Maria Rosario, Gabriela Ribes-Giner, and Odette Pantoja Díaz. "Enhancing education for sustainable development in environmental university programmes: A co-creation approach." *Sustainability* 10, no. 1 (2018): 158.

vary per topic but the learning benefits of discussing learning outcomes in relation to ESD competencies in the design phase of new modules²⁵ can be really valuable and increase quality of learning experiences. In that sense the approach enables for a more democratic, inclusive and bottom-up integration of sustainability ramifications of multiple disciplinary contents through reflective and collaborative learning practices. Apart from the immense empowerment benefits for students and ECRs involved, the case studies here show that the process allows for constant testing on tutors' own biases and acts as a subtle quality assurance mechanism while allowing innovation and excellence to occur, through strengthening staff's collaborative content development skills. Student training into new pedagogical approaches and core concepts forms a big part of the benefits of this process, shaping skills for some of the pedagogical leaders of the future.

While the scale of this application of collaboration is rather small, approaches to scaling up student-staff partnerships for co-creation²⁶ and integration of ESD principles in learning require a reflection on educational rewards, recognition and paid roles for student co-creators as part of institution-wide responses²⁷ of recognition and further harnessing of those benefits across the wider student community.

²⁵ Rieckmann, Marco, and Matthias Barth. "Educators' competence frameworks in education for sustainable development." In *Competences in education for sustainable development: Critical perspectives*, pp. 19-26. Cham: Springer International Publishing, 2022.

²⁶ Mercer-Mapstone, L., and S. Abbot. "The Power of Partnership: Students, Staff, and Faculty Revolutionizing Higher Education. Elon NC: Eon University." *Center for Engaged Learning Open Access Book Series*. <https://doi.org/10.36284/celelon. oa2> (2020).

²⁷ Cook-Sather, Alison, Catherine Bovill, and Peter Felten. *Engaging students as partners in learning and teaching: A guide for faculty*. John Wiley & Sons, 2014.