






COMMENT



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# Breaching boundaries: reflections on the journey towards a transdisciplinary arts and sciences undergraduate degree programme to address global challenges

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This commentary reflects upon the progress, limitations, and some of the pitfalls of one UK London-based HE institution's development of a trans-disciplinary arts and sciences undergraduate degree programme specifically designed to build knowledge and confidence in students to both reflect upon and effectively respond in constructive and just ways to some of the 'global challenges' facing society. It does not challenge the importance and necessity of specialist expertise but sees the potential of a trans-disciplinary approach to education as not just complementary but increasingly valuable to a wider range of graduates. Graduates needed to lead systems change and facilitate wider appreciation and practical understanding of multidimensional problem-solving, the importance of stakeholder engagement and more holistic systems thinking, something that should not be limited to those who have the opportunity and means to study Masters or PhD degrees. As one of a few UK universities that offer inter-disciplinary or trans-disciplinary undergraduate degrees and with some added insights from a former colleague who now works on University College London's (UCL) interdisciplinary BAsC, we offer the following suggestions and advice for those interested in working towards developing trans-disciplinary provision. This includes the development of a financial model that allows students and staff to work between departments or faculties; an administrative structure that promotes communication and information sharing between different departments without compromising the requirements of data protection; the buy-in and support of senior leaders who both understand and can advocate for the benefits of a trans-disciplinary approach and explicit university-wide recognition of the staff who work on such programmes in terms of career progression and support for the trans-disciplinary research they undertake.

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### Rationale for programme design

The benefits of a trans-disciplinary approach for effective problem-solving have long been recognised (Ahmad et al., 2012; Bernstein, 2015; Orozco-Messana et al., 2020). Among these benefits is an acknowledgement of and a focus on the complexity of reality and the use of multiple paradigms and methodologies to discover and profit from hidden connections between disciplines. Whilst essential, specialist expertise alone is insufficient to effectively cooperate on intimately interconnected challenges, from the climate crisis to entrenched forms of inequity and injustice. A trans-disciplinary approach recognises that responding effectively to existential threats like the climate crisis needs to inspire and speak to the heart as much as the mind (Mulkey, 2017). This requires graduates who are, to some extent, conversant in the language of both.

In contrast to world-leading education provision (OECD, 2015; Strauss, 2015), which has moved towards a phenomenon-based (PB) approach for learning across disciplines, with an emphasis on learner-centred and enquiry-based approaches (Niemi, 2021), most UK school pupils study a relatively narrow range of discretely organised disciplinary subjects, before specialisation at university. Against this grain, one of the rationales for our programme was to create a learning environment that would support the re/construction and appreciation of disciplinary interconnectedness built on a disciplinary foundation. Our design starting point has some parallels with a liberal arts and sciences tradition (Cook, 2014) but is underpinned by the organising principle of responding to global challenges. Arranged thematically to work towards dissolving disciplinary boundaries, students are encouraged to view issues holistically and to examine intersectional mechanisms that contribute. With this understanding, students may be better able to determine what choices might be available in response.

So why is it so difficult to de-silo from discrete disciplines when developing degree programmes? Academics are often motivated by the excitement of carrying out research. Much research (and research council funding) encourages researchers to work in inter or trans-disciplinary teams because the value of this approach is recognised. However, such value and the adjacent insights of cross-disciplinary working are not usually extended to creating undergraduate, degree-integrated, credit-bearing learning opportunities. We argue that investing in an approach that builds disciplinary knowledge as well as strategies for adopting principles of trans-disciplinary offers considerable personal and societal benefit.

The emphasis placed on motivation (heart) and cognitive (mind) adaptability is not inevitably in service to the neo-liberal machine or concerned with addressing the UK's 'low productivity' (Pessoa and Van Reenen, 2014; Spencer and Slater, 2020), but is rather about confidence and expanding choice for students, primarily from backgrounds 'under-represented' in HE who we serve; those who have not gained access to a more elite institution which more easily bestows upon its graduates the cultural capital needed to gain leadership roles in global contexts (Friedman, 2018). This is done through design features, which include compulsory core classes to increase student exposure to natural and social scientific knowledge, techniques and experiences that underpin the ability to grasp and practice a trans-disciplinary approach. An approach that we argue improves graduates' chances of gaining work (in its broadest sense), that is meaningful, financially and environmentally sound, and that enhances confidence, prioritising well-being. We place equal emphasis on the value of statistical thinking as we do creative community practices. As a result, we embed opportunities to expand or 'back-fill' where students recognise gaps in their earlier education and desire and are motivated to gain strength in disciplinary areas where previously they were not considered strong.

### From inter-disciplinary to trans-disciplinary

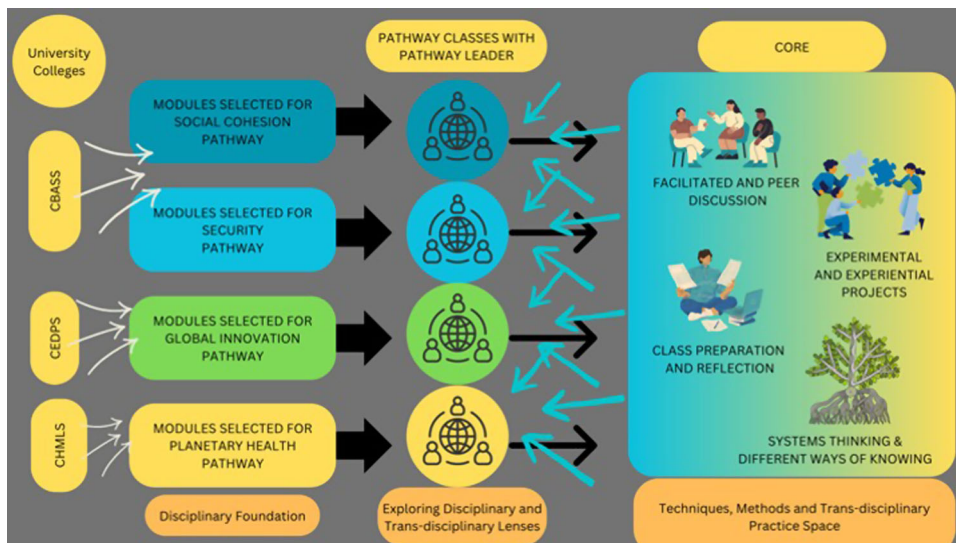
While the key principles of an inter-disciplinary approach—multiple disciplines working together with a set of goals under a thematic umbrella—have important parallels with our approach, we embrace opportunities to cross-disciplinary and sectoral boundaries to explore, gain inspiration and potential solutions from a diversity of concepts and expertise, to provide a holistic and integrated response (Mitrano et al., 2023). We use 'trans-disciplinary' as a key and contested term because of the link we wish to make with a reconsideration of knowledge-making within the university as not limited to conventional natural, social, scientific and humanities methods but one that embraces other sectors. This includes other ways of knowing: oral, embodied, spiritual, experiential, and unwritten his/her stories that lie outside of academia. We aim to reduce the underlying extractivism of neo-colonial and neo-liberalist approaches through more emphasis on centring areas of knowledge outside of the Western canon. It is an approach that is informed by more humble, relational, and reflexive problem-solving strategies. One that is attentive and responsive to students' perspectives while encouraging increased self-awareness, seeding the ground for bearing this orientation into graduates' futures.

### Theoretical rationales behind programme design

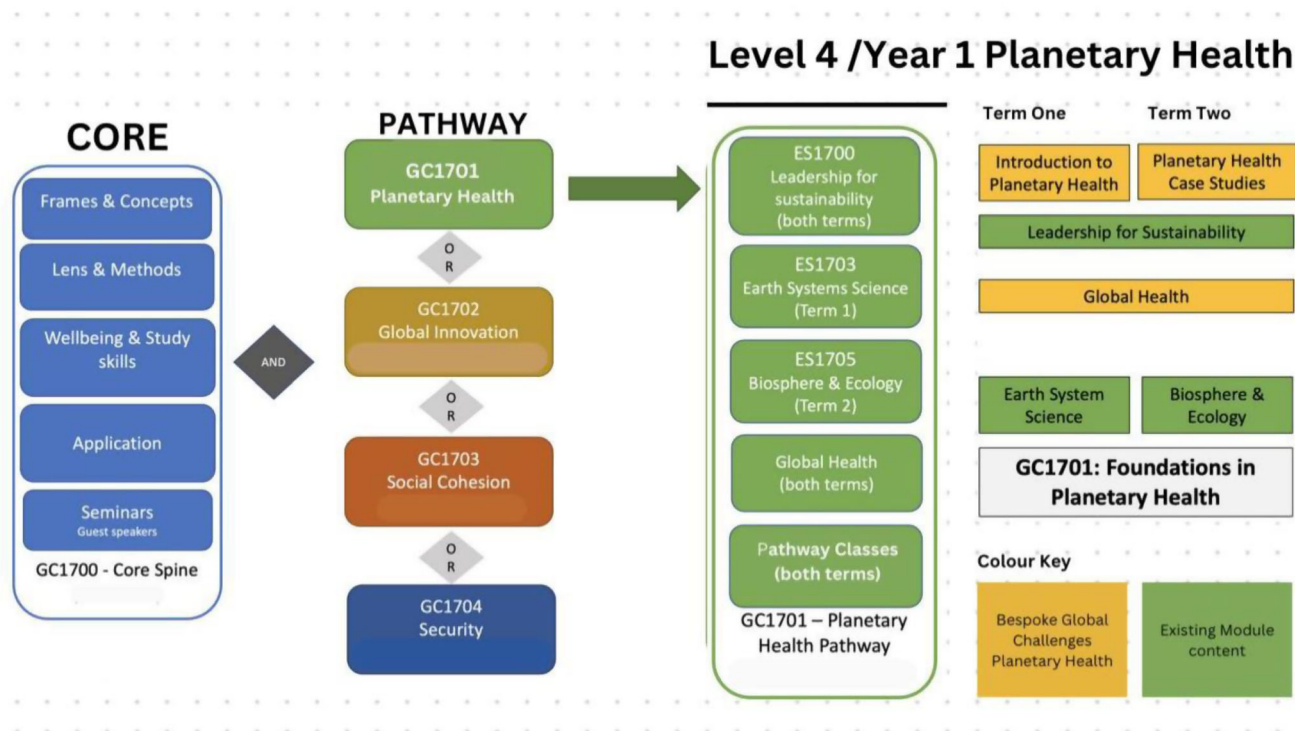
The design of the programme evolved from a projection of what a 21st-century graduate would want to know and be in the face of the climate crisis and mounting global challenges. (Mulkey, 2017), with the awareness that Gen Z enjoy hands-on and self-directed learning (Seemiller and Grace, 2018). With regulations that allowed us to work with staff across all three Colleges, the use of a study and assessment block model permitted us to effectively draw upon specialist material from across the institution (see Figs. 1 and 2). A study block is simply a term used to refer to material curated from individual modules (which can be from a wide range of different disciplinary areas) and which is assessed through a series of assessment blocks designed to draw upon that material synoptically and authentically (i.e. 'real-world' tasks), with an emphasis on social value (McArthur, 2023).

In many respects, our work and ethos have resonance with Anke Schwittay's reflections on 'creative universities' (Schwittay, 2021). Schwittay's approach embraces "critical hope", fully acknowledging the frustration and demoralisation students may experience as a result of recognising complex, systemic injustices and inequities at the heart of 'global challenges' but embraces what Sarah Amsler calls "pedagogies of possibility" (Amsler, 2014) that promote and enable learners to go beyond established pathways to embrace "whole person learning" and praxis, that combines criticality and creativity (Schwittay, 2021). This encouragement is done without fostering naive solutionism or hopeless nihilism. Our programme shares a number of features with Schwittay's approach: the need to develop more design as well as systems thinking, the recognition of the partial and subjective positionality of each of us, the importance of reflexive practice, and the embedding of wide-ranging tasks and skills development that encourages the maintenance of cognitive agility needed to investigate, analyse and respond to complex societal and global challenges in ways that exceed the framing provided by a single or prescribed set of disciplines.

The trans-disciplinary lens, a refinement of earlier reductionist scientific views and practices, is, however, not free from obstacles (Lawrence et al., 2022), even disadvantages. Although this idea of knowledge and knowledge-making may adapt well to contemporary, 'wicked' problems (Lönngren and Van Poeck, 2021), trans-disciplinary academics striving to educate under this



**Fig. 1 Representation of the programme structure as it relates to its disciplinary and trans-disciplinary learning approach.** CBASS College of Business Arts and Social Sciences, CEDPS College of Engineering, Design and Physical Sciences, CHMLS College of Health, Medicine, and Life Sciences.



**Fig. 2 Outline of Programme Level 4/Year 1 structure.** Detail of PH pathway to illustrate the use of module content and bespoke material.

paradigm may struggle at some point to hold and present to students a cohesive and coherent view of those problems due to the number of disciplines and evidence sources. The cognitive capacity available to us to integrate these different perspectives and distil workable approaches is finite, the real test is not just learning many facts emanating from many disciplines about a given topic but aligning those building blocks to clearly demarcate boundaries of uncertainty and gaps, as well as confidently (if and as much as possible) mapping synergies and strengths.

Additionally, academics may struggle to shed their ‘pre-trans-disciplinary personas’, identities shaped by years of training, education, and tradition within given disciplines. These identities may act as an intellectual straitjacket, simultaneously rigid in terms of

boundaries yet comfortable about expectations in thinking and methods (Mula et al., 2022). This understanding and proficiency of the disciplinary culture (i.e. ‘this is how we do things in this discipline’) might not be transferable at all when engaging with scholars from other areas to co-develop trans-disciplinary understanding. This understanding, additionally, may also trigger a desire or need to adopt traits and conventions from other disciplines, with benefits but also challenges noted (Castelló et al., 2021).

**Pathways in global challenges programme**

The programme’s pathways emerged from multiple cross-College events. It includes one in the emergent field of planetary health



and three other pathways in the thematic areas of social cohesion, security, and global innovation. As mentioned earlier, we use study and assessment blocks rather than modules because modules have a tendency to be ‘owned’ by a single academic. With this ownership, a potential disconnect can arise between the programme objectives and the individual academic’s interest in keeping and delivering ‘my module’. This is something Tansy Jessop suggests gives students the impression that each part of their programme and its assessments are discrete rather than interconnected components driving towards an overarching programme-level objective (Jessop, 2023).

Pathway leaders curate content from extant modules for each level of their pathway and do the work of liaising and collaborating with different module leaders and departments to ensure a comprehensive experience that meets pathway or programme rather than module learning outcomes. Pathway leaders work closely with students to assist in the process of sensemaking the content students are exposed to (Fig. 1). They also provide a mechanism for learning reflection and integration (Roebuck, 2007). Our contrasting design evolved from attempting to anticipate the key attributes and knowledge needed to equip graduates with specialisation in their particular thematic area of challenge while still ensuring a foundational understanding of the broader context within which particular ‘global challenges’ are located. Given the rapidly changing landscape of the evidence, paradigms and interventions re/shaping ‘global challenges’ and their impacts, this programme’s pathways consider the key systemic socio-economic, cultural, technological, and political factors that underpin these challenges.

Simultaneously, there is a robust wish to foster the capacity and appetite of students to see their education as an unfolding; an ongoing, iterative process grounded in finding alternatives, but with an expanding awareness of extant contradictions, gaps in knowledge and understanding, and ambiguities to be negotiated. In this way, the aim is to develop students’ resilience whilst also deterring them from any complacency with proposed ‘solutions’ they might encounter or put forward as ‘answers’ to any identified problem.

### **Exemplifying trans-disciplinary approaches to teaching and learning, the planetary health pathway**

The following section outlines the design of the Planetary Health (PH) pathway to provide the further context of how the degree aims to use a trans-disciplinary approach to de-silo learning. PH is an emerging discipline interested in exploring and mitigating the causes and impact of human disruption on the planet’s natural systems (Guzmán et al., 2021). This trans-disciplinary field is focused on movement building bolstered by equity and social justice (Rouf and Wainwright, 2020). As a recent emergent discipline, there is still much ongoing debate about which areas of knowledge should be reflected by PH teaching and practice (Simon et al., 2023), with tensions between the medical and environmental disciplines and traditions struggling to prevail in the PH narrative.

However, there seems to be a consensus about the five pillars of education which ought to be common to PH programmes (Cadeddu et al., 2022). These pillars are foundational to the learning and assessment in the pathway; ‘*interconnectedness with nature*’ is explored by examining the evolving place of the environment throughout the history of Western as well as indigenous traditional medicine, the use of reflexive diaries and short eco-biographical exercises; ‘*Anthropocene and health*’ is the organising principle of the building blocks of the pathway. Students are introduced to ‘*systems thinking*’ and project management tools (stakeholder analysis, causal loop diagrams, theory of

change/logical frameworks), which will then be used to analyse PH case studies.

PH students, drawing upon a central element of the core spine of the programme, in which “Frames and Concepts” classes (see Fig. 3) interrogate questions of ‘*equity and social justice*’, and use their exposure to these framing concepts to inform their intervention task. Moreover, during the end-of-term project weeks, where all students work in mixed pathway groupings to look at ‘*movement building and systems change*’ in practical application, there is scope for PH students to share with peers their understanding and perspective of the challenge through a PH lens, whilst simultaneously learning from students on the other three pathways.

PH is about and embraces complex fields and issues, and the authors, when teaching PH to undergraduates, use a trans-disciplinary pedagogical approach which combines some of the elements identified by Dambre et al.; didactic sessions with experts from different disciplines, supplemented by peer learning and support activities, as well as opportunities and expectations for students to create and deliver sessions based on their backgrounds, interests, and strengths. Such an approach is reported as beneficial to the learning experience of students (Dambre et al., 2022). Students not only expressed an appreciation for this multimodal, co-produced approach but also favourably evaluated its effect on their experience and advocated for its wide dissemination to prepare future leaders able and willing to confront the planetary challenges ahead.

Despite the positive reception echoed by students of our BASc PH pathway, there is room for further improvement. The calls to address the lack of direct stakeholder involvement in PH beyond academics and scientists (Pham et al., 2023) is resolved in our pathway by encouraging students to learn and consider how efforts and solutions from industry, governments and political decision-makers and civil society, in addition to academics, can be best integrated, mirroring the “quadruple-quintuple helix” (Carayannis, Campbell (2010)), hoping these efforts are sufficient to achieve planetary welfare.

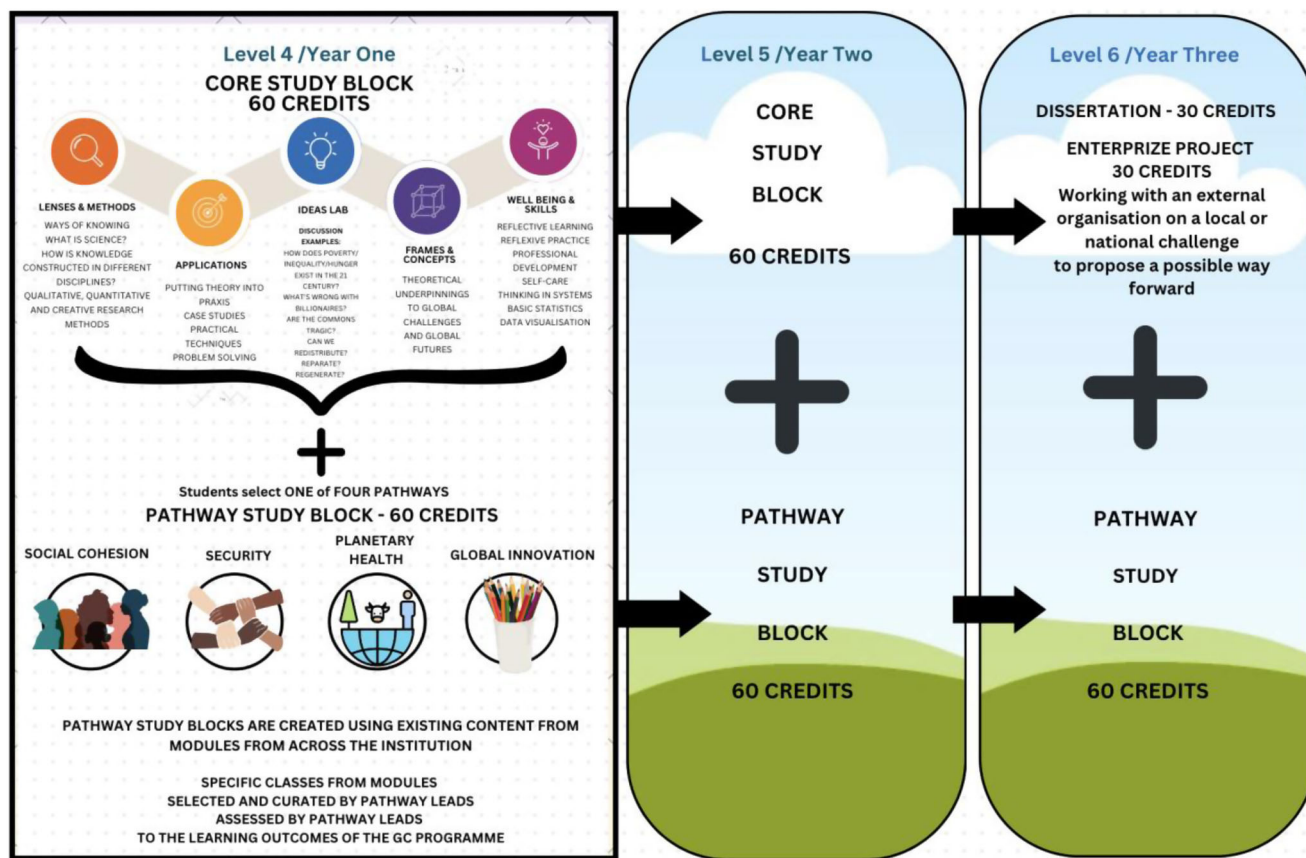
### **The bigger picture trans-disciplinary approaches for phenomenon-based teaching**

Within the BASc GC programme, phenomenon-based teaching (PBT) has emerged as a natural, powerful pedagogical strategy that not only interrogates and questions sustainable development principles but cultivates the conditions in which students become active learners and are prepared for experiences outside of the institution.

Phenomenon-based teaching (PBT) is characterised by its departure from traditional subject-oriented instruction (Silander, 2015). Instead of compartmentalising knowledge into separate subjects, PBT takes an interdisciplinary approach, emphasising the interconnected nature of various disciplines. We expand the PBT approach to take into account the trans-disciplinary features detailed previously, which articulates the importance of diverse forms of expertise for sustainable solutions. This approach reflects both the values of the degree and the reality of the world.

### **Setting up the foundations for phenomenon-based teaching (PBT)**

As seen in Fig. 3, in both their first and second year, students engage in core classes (“Frames & Concepts” and “Applications”) focused on weekly topical issues framed by current debates, events and engagement with literature from across the world. The purposeful segmentation of the Applications lessons (“The Challenge”, “A Challenge”, and “Your Challenge”) fosters the conditions whereby students engage in active enquiry, research,



**Fig. 3 Structure of the programme.** The left panel illustrates some topics covered in the core programme at Level 4/Year 1. The second panel illustrates the distribution of credits at Level 5/Year 2. The third panel illustrates the distribution of credits between dissertation, pathway and the Enterprise project at Level 3/Year 3.

critical thinking, and problem-solving. For example, in the latter part of their second year, students are introduced to the economics and politics driving today’s educational policies and systems during “The Challenge”. In “A Challenge”, students are presented with a case study drawing on practitioner insight, such as the role of low-cost private education in Liberia. The lesson concludes with a challenge posed to students through an activity intended to enable them to utilise a series of professional and technical skills. For this lesson, students respond to the prompt ‘Can social enterprises and or charities with established mechanisms for education delivery be the key to achieving SDG4?’ in a talking circle model (Running Wolf and Rickard, 2003). This approach challenges students to draw on previous lessons, their own research and relevant set readings, express their opinions, seek clarification from peers and engage meaningfully in exploring contemporary issues.

By immersing students in ‘real-world’ phenomena and mechanisms for them to gain relevant knowledge, we hope to nurture a sense of responsibility and agency. Qualitative and quantitative research has highlighted the positive effect PBT approaches have on the student’s metacognitive awareness (Akkaş and Eker, 2021; Symeonidis and Schwarz, 2016). By centring the learning experience upon curiosity, motivation, and reflection, PBT enables the cultivation of sought-after learner attributes—dynamic application of knowledge and fluidity when facing complex challenges. As institutions aim to embed ‘employability’ into the curriculum, the considered application and adaptation of PBT throughout programmes, particularly the continuous bridging of industry and academia, and furthering of key taxonomy of skills (cognitive, methodological, subject-specific

and social (Ornellas et al., 2019), offers a measurable approach to predicting graduate outcomes (Oraison et al., 2019; Habash, 2022) Such experiential learning opportunities, including annual project weeks in first and second year allow students to rehearse the trans-disciplinary approach which culminates in the final year Enterprise Project.

**The enterprise project**

The integration of theory and practice of the degree is amplified within the final year module: Enterprise Project. A 6-month endeavour, this is a brokered opportunity for student teams to collaborate with industry partners from across sectors and nations, who have shared with students an exploratory brief outlining a complex challenge they are facing.

Early on, the student teams develop a common understanding of the challenge amongst themselves and the partner organisation; propose, negotiate and validate project objectives; and establish an actionable approach reflective of discussions had with all stakeholders. In this respect, the approach has similarities with student opportunities for consultancy style work with “university and societal stakeholders” to research and provide possible responses to sustainability challenges that are “relational, responsible and responsive” (Tassone et al., 2022). However, within the framework of the Enterprise project, stakeholders and students work together as active participants to co-create and then *implement in practice* a response.

Collaborative working, particularly in newly formed relationships (as a student team and with stakeholders), has the potential to give rise to a series of friction points due to conflicting perspectives, expectations or ways of working (Dorst, 2015; Paavola

and Hakkarainen, 2014). Amongst other values, the Enterprize Project is underpinned by a concerted effort to challenge presumed institutional and relational power and privilege so that knowledge is exchanged, created, and integrated inclusively and equitably (Godemann, 2008). As such, this is intentionally not a student consultancy (co-production) but rather one of trans-disciplinary co-creation.

While having had various opportunities throughout the degree to apply relevant competencies, the public-facing and self-directed nature of the Enterprize Project adds a layer of complexity and raises personal and relational challenges. For example, when students are unfamiliar with effective self-directed learning techniques, dysfunctional teamwork and transactional relationships with stakeholders may arise – qualities ineffective for co-creation. Consequently, this leads to an overreliance on the Module Lead's input for appropriate tools, general direction, and mediation, a trend noted in other similar student-led projects (Lycko and Galanakis, 2021).

To overcome this obstacle, mindful and responsive curation of class-based workshops focused on knowledge transfer and explicit instructions related to milestones, such as establishing the scope of the project with the partner organisation, has proven vital. It is observed that when students have used related techniques in previous years or have participated in work-based learning opportunities, the transition to self-directed practice is not as challenging. For the module lead, navigating the role of support and the shift in relationship similarly requires attention and discipline. The expectation and transparency concerning Academic-Student expectations and responsibilities are reinforced in the materials provided and through practice, in turn, signalling the importance of students' responsibility to develop robust habits of self-directed learning (Tekkol and Demirel, 2018).

Through these interactions, the Enterprize Project's goal is to outwardly reaffirm the student's ownership and responsibility for the knowledge journey so that, in turn, they are seen as active investigators in partnership with professional experts (Bleakley and Bligh, 2006). By design, the Enterprize Project challenges the notions of the Module Lead as a static 'educator', with students as 'learners' and partner organisations in supporting roles, to one where students and partner organisations act as co-educators/experts and the Module Lead is instead in a supportive 'Broker' role ensuring that there are clear anchor points and supportive scaffolding tools to pursue lines of enquiry (Habash, 2022).

### Challenges of breaching boundaries and building bridges

While consultation and development of the degree took several years, not all senior leaders were convinced of the value of the programme's approach. Even after some notable successes' some scepticism remains. This is where a champion at a senior level of the university is essential. As noted earlier, while it is commonplace for researchers to work in cross-disciplinary teams, the organisational structures of institutions can hinder the development of a learning environment that allows for the sharing of teaching and the associated online module resources between Colleges, which all have their own discrete budgets. Typically, having students from one College access the resources of another College can be interpreted as diverting resources to someone or something 'not paid for' within the College. This issue has, in some parts of the university, proved to be a considerable stumbling block. This has led to tensions that have not helped staff working between Colleges nor the students who are not conversant with how funding structures work.

Rather, students would like to be able to access and engage in areas that do not formally 'belong' to their home department, and

it should be possible to create mechanisms where this can be achieved without compromising staff or resources. This barrier could be addressed with a more transparent discussion between senior leaders, academic staff, technicians, and administrators, where the reality of actual costs could be more transparently weighed against the potential and actual benefits of cross-institutional working. This itself might facilitate the development of a mutually agreed internal transfer system with in-kind contributions between Colleges, enhancing opportunities for students whilst simultaneously putting academic and other staff in contact with each other; something that has resulted in serendipitous discoveries and enhanced teaching and research collaborations. These reciprocal benefits should be emphasised and recognised by the institution and enhance rather than limit career progression.

By contrast, the widely used modular system used in UCL's own interdisciplinary BSc degree operates in a context where students select modules with the support of a personal tutor. This gives freedom for students to tailor their degrees in an institution with a wide selection of modules. However, this is not without administrative issues, including the lack of recognition by hosting departments of the difference between students choosing an elective module as an option within the design of a disciplinary degree from students enrolled in inter-disciplinary degrees who have to select the majority of their modules within departments other than their home departments. There can be administrative pressures to simplify programme 'diets' that may be seen by senior managers as cost-effective in the short term. However, we warn against management systems guiding programme design instead of management systems being adapted to and supporting trans-disciplinarity. While designs like UCL's offer more choice than that of a single discipline degree, it can also result in a more fragmented experience, with some students perceiving that the various options available from different disciplinary departments are, in effect, competing against each other for their time and attention (Jessop, 2023).

### Final thoughts on trans-disciplinary teaching in a context of crisis

It is well known that the enormity of the 'global challenges' to be addressed can lead to despair, frustration and "eco-anxiety" among these change-making students (Coffey et al., 2021). It is, therefore, critical to be mindful of how the topics under consideration are navigated so that students recognise potential alternatives rather than fixate on limits. As noted earlier, most students studying in the BSc GC programme are considered 'under-represented in HE'. Such students can find the approach and content of the programme intense. Even when the intention is to support students to gain the knowledge and cultural capital to recognise that they have a 'place at the table' to work at the highest levels. When underrepresented students have as much, if not more, to contribute as anyone attending a more elite institution, the engagement of some of these students can be hampered by underlying barriers. Barriers arise from some of the very systemic injustices and inequalities explored in the curriculum.

For example, the recent COVID-19 pandemic has exacerbated these struggles, compounding access challenges, impacting confidence and catalysing mental health issues. The cost-of-living crisis has added to the burden of already limited financial and material resources. This has contributed to students from "backgrounds left behind" questioning their aspirations. (Gómez-García et al., 2022). Supporting these students to persevere is a priority for the BSc GC team but takes its toll in terms of emotional labour and time. Increased institutional support and recognition of this work is needed to shift the narrative from one where such students need additional support to 'fit in', to one that



recognises that the unique experience and insights of these students enrich the learning experiences of all students.

Aside from socio-economic obstacles, the sort of organisational boundaries outlined above may reflect the ‘new managerialism’ embedded in the current architecture of HE institutions (Al Mahameed et al., 2023), which for the BAsC GC degree demonstrates the potential frictions and tensions which may arise as a result, or because of, transdisciplinary working (Lawrence et al., 2022). As seen in knowledge mobilisation, for example, it may not be enough for faculty experts to lead their specialisms without establishing a common understanding of each other’s disciplinary traditions and expectations.

Finally, the core programme and pathway leads come from backgrounds as disparate as health, engineering, political science, theatre, military history, development, and environmental sciences. All are passionate about the potential of PBT and the transdisciplinary approach of our programme for learning, leadership and delivering systems change. The focus needs to remain on building and cultivating mutually respectful relationships between academic departments that include opportunities for learning from each other en route to facilitating students’ learning. As a teaching team, we strive to complement and extend each other’s understanding through cross-talk, debate and team meals, coupled with the practicalities of shared spreadsheets and responsibilities. With students, we can and do achieve moments of personal revelation. More often, we struggle alongside and with students to navigate content and deal with the discomfort of ambiguity and uncertainty in a world where every day seems to bring a fresh new hell.

We acknowledge that our approach to programme content is not one of neutrality. Instead, we actively highlight our own subjectivity, recognising that bias is inherent in all perspectives. We emphasise the importance of acknowledging and examining this bias to bring clarity to our discussions. This acknowledgement extends to conversations about effective and competent activism, which are complemented by an introduction to opportunities to get involved in the local and global communities, volunteering, engaging in political and policy processes, and even protesting. In this respect, faculty are not only supporters but practitioners of the advocated approach, raising their voices to amplify those of students and alumni. Without this, there can be no hope to break down knowledge silos and foster system thinking, nor real scope to support the revolution needed for systemic change.

### Data availability

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

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### Note

1 National Green Gown Award Winner: Next Generation Learning and Skills (2022), and International Green Gown Award Highly Commended (2023).

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The authors declare no competing interests.

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This article does not require ethical approval as it does not contain any studies with human participants performed by any of the authors.

### Informed consent

This article does not contain any studies with human participants performed by any of the authors

### Additional information

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