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Transdisciplinary curriculum design for sustainability transitions: A reflective dialogue

Inter- and transdisciplinary curricula can potentially develop an integrated understanding of an increasingly interconnected, complex world and develop students' agency, empathy, creativity and critical thinking skills. Within the South African qualification landscape, the Postgraduate Diploma (PGDip) is identified as a multi- or interdisciplinary qualification that allows working professionals 'to undertake advanced reflection and development by means of a systematic survey of current thinking, practice and research methods in an area of specialisation'. In this paper, four academics reflexively share their experiences of (re)developing and piloting transdisciplinary curricula for the PGDip in Sustainable Development (at Stellenbosch University) and the PGDip in Sustainability Learning (at Rhodes University). Reflections centre around the rationale, context and emergence of the two programmes, their structure and intended learning outcomes, and principles guiding the overall curriculum design. We highlight the appropriateness of transdisciplinary approaches to curricula focused on the sustainability field, and it distils three broad features of the two PGDip programmes that seem important – even necessary – for developing students' competencies as sustainability practitioners. These are ontological groundedness, epistemological openness and ethical attentiveness.

Significance:

This paper provides a rationale for pursuing transdisciplinary curricula that are oriented to sustainability. It shares reflections from two postgraduate diploma curriculum design processes and provides summative insights into broad features of transdisciplinary curriculum design that may enhance sustainability transitions. These features may help to guide other university curriculum developers wanting to design similar programmes to support sustainability transitions.

Introduction

Inter- and transdisciplinary learning can equip students with a nuanced understanding of global sustainability concerns while cultivating their creativity, agency and skills such as empathy and critical thinking. Such understandings and skills are increasingly recognised as necessary for addressing sustainability concerns effectively.¹⁻⁴ This paper offers a reflective conversation between the conveners of two transdisciplinary postgraduate diploma (PGDip) programmes focused on the sustainability field: the PGDip in Sustainability Transitions (PGDip:ST) at Stellenbosch University and the PGDip in Sustainability Learning (PGDip:SL) at Rhodes University. Our reflections centre around the broad question: 'What features of inter- and transdisciplinary postgraduate curricula might prepare students to participate generatively in societal transitions to sustainability?' This question is timely in that sustainability is an 'emerging academic field'^{5(p.1)} that is still clarifying what kinds of orientations, pedagogies and competencies are needed for its advancement. We explore similarities and divergences between the two programmes, limiting our reflections to those of relevance to inter- and transdisciplinary curriculum design in the sustainability field. We preface the reflective part of this paper with an outline of key concepts.

Sustainability and the sustainability field

'Sustainability' is the educative focus of both PGDip programmes and the basis of other core concepts within them, such as 'sustainability transitions' and 'sustainability learning'. Across both programmes, our stance is to invite deliberation around the open-endedness of the concept rather than to pin down specific definitions. The ideal of sustainability defies traditional disciplinary boundaries and challenges long-held assumptions about knowledge, methodology and the very nature of reality. We recognise sustainability as a loaded (and increasingly over-used) concept with cultural, legal, economic, technological, political and ethico-moral implications – depending on the context in which it is applied. As noted by Ramsey⁶, sustainability is a normative term that continues to elude definition because, "What appears to be an issue about clarity in language is really a set of issues about how we view and interact with the world" (p. 1076). Here, for brevity, but not denying the contested and emergent nature of the concept^{7,8}, we use the term 'sustainability' to refer to an ideal that shapes human actions and relationships in the environment–economy–society nexus in just, responsible and future-oriented ways.

We locate this paper in the 'sustainability *field*', recognising that the transdisciplinary nature of responding to the global crisis of unsustainability transcends 'sustainability sciences'. Our stance is guided by Wiek et al.⁵ who motivate for a term with broader scope than 'sustainability science':

Even if used in a broad sense including natural sciences, social sciences, and humanities, other important fields addressing sustainability issues such as engineering, business, design, and planning are not sufficiently captured and recognized under the term 'science'. With the formulation ['sustainability field'], we propose to overcome all of these demarcations as the field develops its genuine program beyond disciplinary anchoring. (p. 1)

Inter- and transdisciplinary curricula

Part of our aim is to interrogate the interdisciplinary and transdisciplinary characteristics of the two PGDip curricula and reflect on the learning possibilities that they offer. A necessary starting point is to clarify the concept of 'curriculum'. A curriculum is more than a course outline or even the sum of a programme's modules, teaching activities and assessment



practices. Rather, curriculum includes all aspects of the learning journey – explicit, tacit and hidden. Boughey and McKenna^{9(p.83-84)} explain that curriculum encompasses “the what, the who, the how, and the where of teaching and learning”, which are all imbued with norms and values emergent in the rich cultural history of their settings. Such a view of curriculum is important in any higher education setting but is especially significant for inter- and transdisciplinary programmes because of their emphasis on reflexivity, collaboration and engaging difference to solve real-world problems.^{9,10}

Inter- and transdisciplinary curricula are now widely recognised as important and necessary, responses that equip people to respond to ‘wicked problems’¹¹ and the global polycrisis^{12,13}. Examples of sustainability challenges include climate change, poverty, drought, desertification, military conflict, biodiversity loss, social injustice, e-waste disposal and ocean acidification. What these and other sustainability challenges have in common is that they are complex, contested and contingent – features that transgress disciplinary boundaries. As such, inter- and transdisciplinary approaches require curriculum developers to make profound epistemological shifts from disciplinary and hierarchical views of knowledge towards pluralistic and dynamic views and knowledge co-production processes.^{1,14} Below, we describe briefly the features of interdisciplinary and transdisciplinary curricula.

Drake and Reid¹⁵ explain that interdisciplinarity involves making connections across established disciplines to address societal problems. Commonly, interdisciplinarity is associated with collaboration, integration and ‘epistemological openness’ that can help to renew, advance or exchange disciplinary knowledge.^{16(p.205)}

Transdisciplinarity entails the *transcendence* of disciplinary boundaries and the integration of methodologies (academic and non-academic) for a common cause. It is associated with participation, emergence, relationality, generativity and critical and open engagement with complexity in the joint search for a new and better understanding of a problem space.^{4,10,16,17} We are drawn to the openness of Vogel and O’Brien’s¹⁸ stance that transdisciplinarity is “...an approach, a process, a practice, and a capacity that draws attention to the quality of relationships. It involves being respectful of various ways of knowing and perceiving what is real. It can be considered a way of being” (p. 655). In a similar vein, Drake and Reid¹⁵ propose transdisciplinary thinking as a critical *disposition* for building the necessary competencies for the complexities of the 21st century. They describe transdisciplinary work as being holistic, creative and relevant to real-world issues.

Although leading thinkers in transdisciplinarity, such as Nicolescu¹³, Bhaskar and Hartwig¹⁹ and Max-Neef²⁰, have argued for an educational revolution to enable a genuinely flourishing society and planet via transdisciplinary ways of being and doing, the literature on transdisciplinarity reflects a stronger focus on ‘transdisciplinary *research*’²¹⁻²³ than on ‘transdisciplinary *education*’. This is an important distinction because, although closely linked, the ways in which inter- or transdisciplinary research projects are designed and implemented in society differ from how inter- or transdisciplinary curricula are designed and implemented in higher education settings. The latter have unique features such as student learning needs, curriculum accreditation, timetables, assessment of learning outcomes and so on. Broad insights from transdisciplinary ‘real-world’ projects and research programmes therefore need to be *translated* into curriculum design processes with an educators’ gaze.

The postgraduate diploma qualifications

Within the South African qualification landscape, the PGDip is identified as:

generally multi- or interdisciplinary in nature but may serve to strengthen and deepen the student’s knowledge in a particular discipline or profession. The primary purpose of the qualification is to enable working professionals to undertake advanced reflection and development by means of a systematic survey of current thinking, practice and research methods in an area of specialisation.^{24(p.35)}

Located at level 8 on the National Qualifications Framework alongside the honours degree, the PGDip is a 120-credit qualification that offers

progression into master’s-level studies. Access is via a bachelor’s degree or advanced diploma at National Qualifications Framework level 7.

In both PGDip programmes discussed in this paper, the developers recognised the qualification’s suitability and potential to strengthen engagement with the sustainability field due to its relative flexibility in terms of disciplinary access and content. The primary rationale was to respond to the need for relational and transformational competencies in the sustainability field in South Africa.²⁵

Both programmes are now briefly described before moving to the reflective section of this paper in which we consider aspects of our curriculum design experiences.

PGDip: Sustainability learning

The PGDip:SL is offered at Rhodes University by the Department of Secondary and Post-School Education in collaboration with the Department of Environmental Science. The programme was designed in 2020 to support early and mid-career professionals to understand, critique, plan and implement socially engaged learning processes that are needed for society to transition to social-ecological sustainability. The internal and national approvals and accreditation processes took place between 2020 and 2022.

As indicated by the programme’s name, its core focus is on learning, which has been widely recognised as a key response to sustainability challenges. The pilot programme is currently part-time, with the first cohort of 12 students registering in 2023/2024. The students entered from diverse disciplinary undergraduate backgrounds (including Environmental Science, Economics, Politics, Sociology, Occupational Therapy and Education) and work settings (including the environmental NGO sector, higher education sector, local government and nature conservation). The unifying element across these diverse backgrounds is the programme’s focus on learning (mostly outside the formal education sector), which is oriented to sustainability.

PGDip: Sustainability transitions

The PGDip:ST is offered by the Centre for Sustainability Transitions in the Faculty of Economic and Management Sciences at Stellenbosch University. The PGDip:ST aims to deepen students’ understanding and knowledge of sustainable development ambitions and challenges during this time of global transition. It facilitates advanced reflection and offers both personal and professional development opportunities in the emerging fields of sustainability transitions and transformations. The PGDip:ST attracts students from diverse disciplinary backgrounds (including Public Administration, Environmental Management, Economic and Management Sciences, Political Science, Engineering, and Development Studies) and professional experience (including local government, corporate governance, construction management and the NGO sector).

The PGDip:ST curriculum was restructured in 2023 as part of an academic renewal of the existing PGDip: Sustainable Development at Stellenbosch University. This renewal retained the accredited focus and intent of the programme but included a renaming of the qualification to align with the strategic orientation around sustainability transitions. Institutional and national approvals for the proposed name change from PGDip: Sustainable Development (PGDip:SD) to PGDip:ST were initiated and progressed in 2023 and, at the time of writing, final approval is pending. For the rest of this paper, we refer to the PGDip:ST with the proviso that approval of the name change is pending.

Methodology

This paper is the outcome of an experimental exchange among academic colleagues from two South African universities who had followed separate processes to design and (re)structure transdisciplinary curricula for the PGDip:SL and PGDip:ST, respectively. In structuring this paper, we took inspiration from Kulundu-Bolus et al.²⁶ in their exploration of what it means to learn, live and lead in transgressive ways in a neoliberal world. Like them, we identified broad themes (in our case, themes of relevance to our interest in transdisciplinary curriculum design in the sustainability field from the context of higher education institutions in the Global South). We framed a series of reflective dialogues (online



and in-person) in late 2023 and early 2024. We had not collaborated up to this point, although two of the authors knew each other through an international research programme on transdisciplinary research that is not directly related to either PGDip programme. Our exchanges emphasised reciprocity and curiosity, and an attentiveness to what was shared and unique across the two PGDip programmes. Insights gained from the dialogues were advanced through asynchronous stretches of writing which culminated in an online sensemaking workshop to harvest insights and points of connection that form the backbone of this paper.

The sections below are the outcome of this reflective dialoguing and writing process. Sub-headings '*Megan & A'ishah*' and '*Lausanne & Jessica*' indicate the perspectives of the PGDip:ST and PGDip:SL developers, respectively. The reflections are bounded by the curriculum design processes and do not include experiences of programme implementation or students' learning. Reflections are arranged according to the themes that guided our initial reflections:

- Topic 1~ Rationale, context and emergence of the programmes
- Topic 2~ Programme structure and intended learning outcomes
- Topic 3~ Principles guiding the curriculum design

Through the reflective dialogue process, we noted the emergence of cross-cutting themes that reflected the contextual, theoretical and ethical dimensions of the two PGDip programmes. In the concluding section of this paper, we reflect on these in more philosophical terms as the onto-epistemological and ethical dimensions of the transdisciplinary curriculum design processes. 'Onto-epistemology' refers to the intersection of our views of reality (ontology) and how knowledge is produced and shared (epistemology). 'Ethical' refers to principles or guidelines about what is morally right and acceptable, which is an important aspect of curricula so explicitly oriented to sustainability. Although we do not use these philosophical terms when reflecting on Topics 1–3, readers may be able to identify and trace these aspects before we return to them in the conclusion.

Topic 1: Rationale, context and emergence of the programmes

Common to both programmes was the motivation to make further study opportunities in the sustainability field available at our respective universities, and to do so with an emphasis on the Global South. The global polycrisis¹² necessitates a substantial reorientation of (higher) education^{27,28}, and global, national and institutional drivers created a shared impetus for curriculum development that made an inter- or transdisciplinary approach compelling. Critiques of the global higher education system from a Global South perspective emphasise the importance of paying attention to issues related to decolonization²⁹, knowledge democracy and epistemic justice^{30,31} and paying attention to issues of intersectionality, diversity and difference⁹.

Although technical competencies are most commonly associated with the sustainability field, Rosenberg et al.²⁵ report the need for greater focus on relational and transformational competencies in South Africa's transition to a green economy. The curriculum designers at both universities recognised that the form and function of the PGDip qualification in the national qualifications landscape offered potentially connective, interstitial and bridging curriculum opportunities to innovate in that area.

Lausanne and Jessica

The primary rationale for creating the PGDip:SL was to respond to the need for relational and transformational competencies in the sustainability field in South Africa²⁵, in particular, competencies linked to enabling informal and non-formal education and training. Many professionals working in the sustainability field are mandated to plan and provide learning programmes, but they are not (and do not seek to be) qualified as schoolteachers or university lecturers. However, there was no coherent study pathway for such graduates and practitioners to strengthen the educational dimension of their work. A similar and significant gap exists for entry-level practitioners at National Qualifications Framework level 4 (equivalent to a secondary school certificate or a vocational certificate) and National Qualifications Framework level 5 (equivalent to a higher certificate, diploma). As a small,

research-intensive university, we recognised that we could not respond to both gaps and that pursuing the PGDip:SL would be appropriate and achievable within a research-intensive university.

We conducted an online feasibility survey in 2020 which confirmed there was interest and support for the diploma, both within Rhodes University and in the sustainability field. From the survey, we identified several broad knowledge and skills areas which the diploma should address for it to be responsive to the needs of the field:

1. systems thinking and ability to take a complex systems approach to planning and implementing sustainability learning processes;
2. inter- and transdisciplinary thinking skills;
3. critical thinking (embedded in critical reading and writing skills);
4. social learning and related theories and methodologies to support learning;
5. theoretical and conceptual underpinnings of sustainability;
6. research skills, especially community-based, engaged, action-oriented research in local settings;
7. facilitation, communication and leadership skills; and
8. ethics, equity, embodiment and empathy in engagement.

In naming the programme, we recognised that 'learning' rather than 'education' would better reflect its aim to support practitioners working (in most cases) outside the formal education sector. We chose 'sustainability learning' as a compendium term to encompass the more established nomenclature (Environmental Education [EE], Education for Sustainable Development [ESD], Sustainability Education [SE], Environment and Sustainability Education [ESE]) while explicitly acknowledging that learning processes oriented to sustainability transitions are not confined to formal education settings. Most practitioners in the sustainability field need to engage with complex social change processes that are entangled with dynamics of knowledge, power and agency, yet they do not identify as being 'educators' per se. Our intention was for the subtle shift in language (from education to learning) to be more resonant and inviting for practitioners in the sustainability field.

Megan and A'ishah

The PGDip:ST's emergence over nearly two decades is an example of the adaptability of transdisciplinary programme development in relation to institutional structures. The programme has been in existence at Stellenbosch University since 2006, known initially as the PGDip in Sustainable Development, Planning and Management, and later as the PGDip in Sustainable Development, located within the School of Public Leadership. In 2015, the Centre for Sustainability Transitions was established as a flagship research centre in the School of Public Leadership, with an explicit commitment to transdisciplinary research, complexity theory and sustainability science. In 2021, the Centre became a type-2 research centre, the equivalent of a department, within the Faculty of Economic and Management Sciences. The following year, all three postgraduate programmes in sustainable development (PGDip, MPhil and PhD) were migrated to the Centre, and an academic renewal process was initiated to reflect on their curricula. This was an opportunity to update the content and structure of the PGDip to ensure a cutting edge, globally relevant offering in sustainability transitions, as well as to align and integrate the Centre's transdisciplinary sustainability science research programmes with the PGDip curriculum. The programme renewal process affirmed the importance of an introductory course in sustainability transitions and sustainable development. The PGDip's carefully curated and facilitated learning experiences provide unique opportunities for students wanting to pursue postgraduate studies but not yet ready to commit to the more extensive and self-directed research of a master's programme.

Topic 2: Programme structure and intended learning outcomes

Table 1 presents the intended learning outcomes of each PGDip programme and, in the second column, an overview of the course/module names with their credit weighting.



Table 1: Learning outcomes and structure of the two qualifications (PGDip:SL and PGDip:ST)

Learning outcomes	Course structure and content*
PGDip: Sustainability Learning	
By the end of the two-year part-time PGDip:SL programme, learners should be able to:	<i>Course 1: Foundations of Sustainability Learning [50 credits]**</i>
1. engage critically with a range of perspectives on sustainability, sustainable development and sustainability learning;	• Module 1.1: Sustainability Concepts and Critique [10]
2. compare, contrast and apply diverse approaches to systems thinking;	• Module 1.2: Systems Thinking: History, Context and Future [10]
3. make connections between the political history of knowledge production and contemporary challenges in sustainability learning;	• Module 1.3: Interdisciplinarity, Knowledge and Power [10]
4. reflect critically on, and apply, social learning praxis to social-ecological sustainability;	• Module 1.4: Participation, Solidarity and Sustainability Ethics [10]
5. understand and apply interdisciplinary social science research methods;	• Module 1.5: Introduction to Social Learning Processes [10]
6. plan, implement and report on a sustainability learning action research change project;	<i>Course 2: Introduction to Interdisciplinary Social Science Research*** [10 credits]</i>
7. reflexively apply context-appropriate evaluation methods and processes; and	<i>Course 3: Action Research Change Project [30 credits]</i>
8. develop reflexivity through relational and critical thinking in their own sustainability learning practice and context.	• Module 3.1: Describing Sustainability Learning Contexts [10]
	• Module 3.2: Envisioning Change for Sustainability [10]
	• Module 3.3: Enacting Change for Sustainability [10]
	<i>Course 4: Evaluation as Learning [10 credits]</i>
	Elective Courses (students select ONE course from Elective A options, and ONE from Elective B)
	<i>Elective A [10 credits]</i>
	• Option 1: Creative Practice for Sustainability Learning
	• Option 2: Citizen Science for Sustainability
	<i>Elective B [10 credits]</i>
	• Option 1: Climate Change Education and Governance
	• Option 2: Building and Sustaining Multi-stakeholder Learning Networks
	(Elective options may vary from year to year based on student profiles and availability of collaborators).
PGDip: Sustainability Transitions	
By the end of the one-year full-time or two-year part-time PGDip: ST programme, learners should be able to:	<i>Module 1: Sustainability Transitions and Transformations [15 credits]</i>
1. identify, describe and analyse key historical and current global economic, political and ecological trends driving global change at multiple scales that culminate in a sustainability polycrisis;	<i>Module 2: Complexity Literacy and Systems Worldviews [15 credits]</i>
2. distinguish and apply different perspectives and frameworks on multi-level dynamics of change and how these coalesce into relational and dynamics perspectives on sustainability transitions and transformations;	<i>Module 3: Biodiversity and Climate Change [15 credits]</i>
3. critically evaluate and cultivate divergent South African, African and global interpretations of theoretical and practical approaches to sustainable development, considering how these approaches address issues of justice, equity and human-nature connectedness within social-ecological systems to develop more inclusive and effective strategies for sustainable development;	<i>Module 4: Financing Just Energy Transitions [15 credits]</i>
4. develop effective strategies for initiating social processes that bring diverse stakeholders together for transformative action on social, political and environmental causes, applying systems thinking;	<i>Module 5: Water and Food Nexus [15 credits]</i>
5. cultivate skills of reflection, reflexivity, empathy, curiosity, negotiation and experimentation with diverse groups of actors in collaborative learning processes, navigating the intricate ethical and social dimensions of sustainability issues.	<i>Module 6: Just and Sustainable Urbanisms [15 credits]</i>
	<i>Module 7: Governance and Institutional Change [15 credits]</i>
	<i>Module 8: Leadership for Sustainability Transitions and Transformations [15 credits]</i>

* There is international and institutional variability in naming the parts of a learning programme. The PGDip:SL arranges the curriculum by 'courses' composed of smaller 'modules'. The PGDip:ST uses smaller 'modules' throughout.

** One credit is roughly equivalent to 10 notional hours.

*** Social science research methodology is considered appropriate for the educational focus of the PGDip:SL, laying a foundation for the subsequent Action Research Change Project course.

Megan and A'ishah

The renewed PGDip:ST curriculum reflects the core thematic research areas of the Centre for Sustainability Transitions at Stellenbosch University: (1) knowledge co-production, (2) social-ecological resilience, (3) transformative future thinking, (4) finance and resource flows and (5) political economy and development. These articulate across a wide range of empirical research fields and areas of activities, including education and training, research, and engagements across the science-policy-practice interface. The diploma's eight integrated modules are enriched by these transdisciplinary research areas and case studies that speak to the heart of the global polycrisis. The aim is for students to develop their understanding of the Anthropocene polycrisis as the culmination of multiple, historical and intersecting crises across diverse domains. As shown in the selection of learning outcomes in Table 1, students should, by the end of the programme, be able to discern, co-design, lead or facilitate appropriate interventions to mobilise social change across diverse personal and professional settings.

Collaborative learning processes across the eight modules cultivate deep skills of reflection, reflexivity, empathy, curiosity, negotiation and experimentation. The assessment framework entails a variety of individual, reflective, analytical and collaborative elements that meet a variety of assessment purposes. Importantly, the final module in the programme, 'Leadership for Sustainability Transitions and Transformations', is positioned as a capstone module that supports programme-level assessment. Here, students develop a range of group and individual assignments that culminate in a portfolio of evidence, linking their overarching learning experience in the programme.

Lausanne and Jessica

Since the start of our curriculum design journey, we have grappled with the question of whether the PGDip:SL is an inter- or transdisciplinary programme. This is evident, for example, in the naming of some modules (see Table 1): 'Interdisciplinarity, Knowledge and Power' and 'Introduction to Interdisciplinary Social Science Research', yet we consider the overall programme to be transdisciplinary. Our view is that the PGDip:SL curriculum has many features of interdisciplinary curricula that are in service of the overall learning outcomes which are for students to do educative work in transdisciplinary settings. The programme is conceptually and administratively anchored in the discipline of education, yet it draws on other disciplines (a feature of interdisciplinarity) so that students can investigate, critique, dream and innovate in the authentic problem spaces of their own work or community contexts (a feature of transdisciplinarity).

We are also cautious to avoid dismissing interdisciplinary curricula as inferior to transdisciplinary curricula without more detailed and careful consideration of the ways in which pedagogy, assessment and the institutional framings of postgraduate-level studies interface with knowledge production and real-world application. This requires further research with our students and critical friends, but our preliminary insight is that some interdisciplinary elements within a transdisciplinary curriculum can usefully scaffold learning and guide students towards transdisciplinary applications – bearing in mind the point made earlier that the considerations when designing and implementing transdisciplinary *research* programmes and transdisciplinary *teaching* programmes are not necessarily interchangeable. For example, the sequencing of the courses 'Foundations of Sustainability Learning' and 'Introduction to Interdisciplinary Social Science Research' before the 'Action Research Change Project' reflects our intention to scaffold students' progression from bite-size encounters with a range of concept-laden modules (an interdisciplinary moment) into the design and implementation of an action research project in their own work or community setting (a transdisciplinary moment).

Integrated reflections

Through our reflective dialogues, and evidenced in the course and module names, we identified numerous concepts and curriculum features common to both programmes. These include:

- relational thinking
- complexity

- a justice orientation
- working out of/into an authentic context
- reflexivity
- social change
- collaboration / participation
- past–present–future connections

There is general agreement among scholars that transdisciplinary curricula must include opportunities to learn about and solve real-world problems^{1,10} by “thinking from the life world, beyond disciplinary boundaries”³². In both PGDip programmes, we have structured the course of learning around transdisciplinary questions. For the PGDip:ST, we ask: How do we engage with the dynamics of change for sustainability transitions at multiple scales? And for the PGDip:SL, we ask: What kinds of learning processes are needed for society to transition to social-ecological sustainability? Case study methodology (including field trips, excursions and guest presenters) is central to exploring these questions. This design decision echoes Scholz and Steiner's³³ insight that case studies have educative value in transdisciplinary learning processes because, “they embody the complexity, multi-layeredness of tradeoffs and conflicts, uncertainty, and incompleteness, which relate to any form of scientific knowledge for which real-world contexts and -structures are the underlying basis” (p. 528).

Topic 3: Principles guiding curriculum design

Principles that guide the design of any curriculum, research programme or sustainability project are traceable to an underlying philosophy and set of assumptions on whether the people involved are aware of it. McGregor³² notes that transdisciplinary curricula require a distinctive educational philosophy characterised, for example, by:

- recognising education as an active, generative process that exists in a synergistic relationship with society;
- understanding that learning is a complex, dynamic and unscriptable process that involves mind, body and soul;
- seeking unity of knowledge over disciplinary fragmentation;
- paying attention to relational and cognitive processes such as critical thinking, integrated thinking, change management and respect for diversity and tolerance.

These characteristics resonate strongly with the values and intentions guiding our emerging curricula. Below, we outline six guiding principles that, through our reflective dialogues, we found were common to both programmes.

Teaching and learning as transformation

The design of both programmes was anchored in an explicit intention to catalyse positive change at a personal and local level, and/or a broader social-ecological level. We were guided by the principle of exploring teaching and learning processes that hold genuine transformative potential. In this, we were influenced by an expanding and diverse body of scholarship that points towards socially engaged, ethics-oriented, dialogical and emancipatory learning processes underpinned by critical thinking skills, empathy, relationality, creativity, reflexivity and individual-collective agency. Elaborations of work in this area include Orr²⁷, Jickling et al.³⁴, Kulundu-Bolus et al.²⁶, Eames et al.³⁵ and Lotz-Sisitka²⁸.

Relational thinking

Transformative and transgressive learning processes can only exist within a relational philosophy. Lejano³⁶ defines relationality as “the degree to which individuals understand their being, thought, and action as integrated with that of others and, so, make decisions and take action in ways responding to these relationships” (p.109). Relational thinking is a crucial principle of transdisciplinary curriculum design because it invites “informed critical reflection”^{10(p.12)} strengthens lifeworld knowing³² and develops ethical sensibilities³⁴. Relationality is also fundamental to the sustainability field because it makes explicit our rootedness in, and complete dependence on, the natural world and planetary systems. In

both PGDip programmes, relational thinking is evident in the multi-modal pedagogies and in the construction and naming of courses and modules (see Table 1).

Contextual relevance

A contextually relevant curriculum is one that resonates with students' lifeworlds and supports them to make meaningful connections across micro, meso and macro contexts. This commitment challenges us to create learning spaces that can engage simultaneously with: (1) the scale and urgency of the planetary crisis, (2) students' lived experiences, identities and disciplinary backgrounds and (3) the complex and contested socio-political-economic and ecological settings in which they are developing their professional competence.

Developing applied competence or praxis

Both programmes were strongly oriented around learning processes that enable students to respond reflexively to real-life problems in the context of the national and global polycrisis. In the PGDip:ST, this is referred to as praxis, engaging students as co-creators of knowledge, actively engaging them in integrating theory and practice. In the PGDip:SL, this was articulated as applied competence, "the union of practical, foundational and reflexive competence"^{37(p.20)} This requires a curriculum to achieve a balance between supporting students to (1) *understand* concepts, theories and terminologies underpinning their studies, (2) *apply* that understanding to their context in practical and authentic ways, and (3) *reflect* on their practice with a view to sustaining or improving it. Developing praxis or applied competence is a prerequisite to two other important principles introduced below: activating human agency, and a curriculum rooted in the context of the Global South.

Activating individual and collective agency

Many students apply to join the PGDip programmes because they seek to resolve sustainability concerns in their communities or workplaces. Mobilising such change processes requires the activation of individual and collective agency, that is, the capacity of individuals and groups to collaborate, co-imagine and partner in support of shared goals. Equally, acting on one's agency also requires navigating tension and disruption. To this end, we aim for a curriculum that nurtures students' resourcefulness, self-awareness and creativity, and cultivates an enlivened sense of how positionality, power, justice and equity inform how, where and with whom they act. This requires a curriculum orientated to inner growth and transformation as much as broader social-ecological change. We draw inspiration from frameworks like the Inner Development Goals³⁸ that explore various skills across dimensions of being, thinking, relating, collaborating and acting in support of sustainability.

Curriculum rooted in the Global South

This principle refers to the aspiration to infuse the curriculum with resources, case studies and theories that reinforce an African and Global South perspective. Rootedness in the Global South means working towards cognitive and epistemic justice. This requires paying critical attention to the kinds of knowledge that are treated as valid^{39,40}, for example, by working with indigenous knowledge and knowers, Global South theorists and philosophers, and confronting the hegemony of academic and scientific knowledge in higher education. Our curricula therefore aim to contribute to creating an environment where students

from a diversity of contexts and backgrounds feel welcome and valued. We aim to enable knowledge production that is change-oriented and empowers students and other participants as changemakers to enable them to address deep-seated sustainability and social justice issues. This principle is therefore relevant not only in the context of Global South higher education institutions but can add value to curricula around the world, especially in the context of rapid globalisation and the growing emphasis on internationalisation in higher education, where it is becoming necessary to "recognise the epistemic plurality of the world"^{41(p.33)}

Concluding insights

At the start of this paper, we discussed the significance of transdisciplinarity for the sustainability field, noting that transdisciplinarity is more like an approach and way of being than a knowledge production strategy. Transdisciplinarity's defining feature, the transcendence of disciplinary boundaries orientated to real-world problem-solving, offers new and promising approaches to the sustainability crisis. Within that, transdisciplinary curricula offer distinct educative responses that differ in some ways from transdisciplinary *research* programmes due to the primacy of student learning when thinking about curriculum design.

We conclude by offering a summative reflection across three broad features of our PGDip programmes: ontological groundedness, epistemological openness and ethical attentiveness. The sustainability field exists due to tensions and misalignments at the interface of ontology, epistemology and applied ethics. Ontologically, the planet is in a state of escalating polycrisis. Our conceptual repertoire and the patterns of knowledge production and dissemination (our epistemologies) influence how we investigate, understand and represent these realities with students. The sustainability field is also strongly normative in that it makes distinctions between just/unjust scenarios, desirable/undesirable futures and so on. This raises ethical questions that need to be built into curricula from the design stage, such as: Who is responsible for enacting the needed change? And does nature have moral rights?

We set out to answer the question: What features of inter- and transdisciplinary postgraduate curricula might prepare students to participate generatively in societal transitions to sustainability? Our reflections across Topics 1–3 suggest that ontological grounding, epistemological openness and ethical attentiveness are important features of inter- or transdisciplinary curriculum focused on sustainability. These features and some associated teaching methodologies are offered in Table 2.

These curriculum features are necessarily broad, leaving room for contextual adaptation and nimbleness in uncertain times. They are also interrelated and mutually supportive, meaning that the coherence of curriculum design would be undermined if the ontological, epistemological and ethical features are not pursued in unison. The illustrative examples of related teaching methodologies and pedagogies provided in column 2 of Table 2 are also consistent with the guiding curriculum principles previously discussed, namely, teaching and learning as transformation, relational thinking, contextual relevance, developing applied competence/praxis, activating agency and curriculum rooted in the Global South.

Transdisciplinary learning in service of sustainability transitions can be realised in higher education through intentional curriculum design. Based on our initial curriculum design experiences (but not yet the

Table 2: Broad features of transdisciplinary curriculum design for PGDip programmes focused on sustainability

Broad curriculum feature	Examples of supporting teaching methodologies and pedagogies
Ontological grounding	Contextually situated learning via case studies and local field trips and excursions; work-integrated assignments; action research projects; orientating to complexity and systems thinking; engaging Global South scholarship; robust knowledge inputs via experts and quality literature.
Epistemological openness	Dialogicality; knowledge co-construction and critique (group tasks); participatory methods; diversity in teaching and assessment methods; engagement with diverse knowledge systems and representations of knowledge.
Ethical attentiveness	Relational and empathetic encounters; reflexive practices; inner development and values clarification; embodied practices; deliberation and critique.



implementation experiences), we have shared thematic reflections and offered three complementary features that may be of value to colleagues in higher education who are curious, inspired or compelled to explore the possibilities of transdisciplinary curricula in a world at risk.

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Data availability

Data pertaining to the PGDip programmes' curricula are available at the relevant institutions upon request.

Declarations

We have no competing interests to declare. We have no AI or LLM use to declare.

Authors' contributions

L.O.: Conceptualisation, methodology, data collection, data analysis, validation, writing initial draft, writing revisions, project leadership, project management. M.D.: Conceptualisation, methodology, data collection, data analysis, validation, writing initial draft, project leadership. A.E.: Conceptualisation, methodology, data collection, data analysis, writing initial draft. J.C.: Conceptualisation, methodology, data collection, data analysis, writing initial draft. All authors read and approved the final version.

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