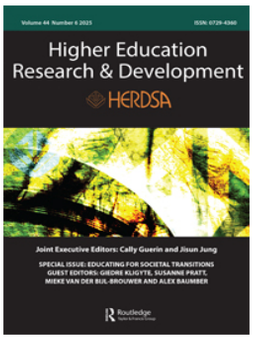

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Embodied learning for wicked problems and societal transitions: perspectives from transdisciplinary higher education practitioners

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ABSTRACT

Higher education plays a crucial role in supporting societal transitions towards more sustainable and equitable futures. As universities evolve to prepare learners to tackle wicked problems and lead long-term systems change, embodied teaching and learning approaches are gaining attention for their ability to integrate felt experiences with analytical thought, fostering boundary-spanning thinking. While the value of embodied approaches in learning is evident, limited research explores how educators understand and enact these approaches in practice in higher education. This study investigates how educators at an Australian University conceptualise and apply embodied approaches to support students in addressing complex challenges and leading societal transitions within transdisciplinary higher education. Through an autoethnographic case study inquiry, we contextualise our understanding and practice within the scholarship on transdisciplinary higher education, embodied learning and societal transition. Our findings reveal four dimensions of practice that speak to how we understand and enact these approaches: (1) Transdisciplinary sensemaking, (2) Emotion-driven creativity, (3) Empathetic enactment and, (4) Embodied boundary-spanning. Each dimension is illustrated through autoethnographic vignettes that demonstrate the diverse ways we enact these approaches to support reflexive, creative and critical engagement with wicked problems and systems change, fostering core knowledge integration and boundary-spanning capabilities.

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Transdisciplinary; embodied teaching and learning; wicked problems; creativity; emotion; societal transitions

1. Introduction

Societal transitions are 'fundamental transformation processes through which society changes over a generation or more' (Rotmans et al., 2001, p. 1). These transitions are

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society's response to complex social challenges or 'wicked problems' such as climate change or mass migrations – challenges that require systems change over sustained periods of time (Keller et al., 2022). Transition processes, therefore, involve complex interactions between technological, social, cultural, economic, and institutional changes across multiple levels (Geels & Schot, 2007).

Higher education plays a crucial role in preparing students for societal transitions through engagement with wicked problems and developing the capacities such as collaboration, reflexivity and creativity needed to support systems change (Pinheiro et al., 2015). Universities can support societal transitions by developing graduates capable of working across traditional boundaries who can navigate complex problems, ideas and dynamics (Barnett, 2004). This requires teaching and learning approaches that embrace multiple ways of knowing, connecting understanding with action and impact. This increases our collective potential to address complex challenges and support societal transitions in more holistic ways (Gibbs & Beavis, 2020).

The complex nature of societal transitions demands new approaches to teaching and learning. Transdisciplinary education has emerged to support the type of learning and capacity development required (Bernstein, 2014). Where multi-disciplinary learning brings disciplines together and inter-disciplinary learning aims for active integration of knowledge across academic disciplines, transdisciplinary approaches extend this by emphasising iterative interaction and integration of disciplinary and other knowledge systems (McGregor, 2017).

Transdisciplinary learning takes place through collaboration and co-creation with different actors, including academic scholars, industry, government, community groups and those with lived experience (Tress et al., 2005). By engaging students in problem-focused, action-oriented and holistic inquiry that transcends disciplinary boundaries (Nicolescu, 2012), students consider multiple perspectives when examining complex problems or phenomena (Bernstein, 2015) and develop critical capacities including creative problem solving, systems thinking, collaboration and knowledge integration.

Within transdisciplinary learning environments, embodied learning can support transdisciplinary engagement and develop critical capacities by integrating felt and emotional experiences with analytical understanding. Embodied learning is based on the ontological assumption that cognition – in lay terms, the 'state and processes involved in knowing' (Brittanica, 2024) – is fundamentally grounded in the body. It is argued that knowledge is generated through the activity, experience and perception of our body within its environment (Lindgren & Johnson-Glenberg, 2013), opening up epistemological possibilities and generating new forms of understanding (Lipson Lawrence, 2012).

The potential of embodied learning is increasingly recognised by education scholars, informing new practices and policies that meet the needs of a complex and ever-changing world (Barnett, 2004; Nathan, 2021; OECD, 2018). Within transdisciplinary settings, embodied learning supports thinking across boundaries (Henriksen et al., 2015; Midgelow, 2017), with the potential to evoke integrated insights about how equitable, just and sustainable transformations can take place (Bentz et al., 2022a, 2022b). Embodied learning expands epistemological possibilities, creating new pathways for understanding and taking action. Through the body, students can confront wicked problems and make sense of them in personal and multi-faceted ways (Allen et al., 2023; Lipson Lawrence, 2012). Despite growing interest and evidence, the body continues to be regularly overlooked as a foundational aspect of cognition within higher education (Leitan & Chaffey, 2014).

Embodied approaches are commonly used in niche areas like outdoor education, the performing arts and early childhood learning. Beyond these, they are often met with resistance from university educators, students and institutions where they are viewed as alternative, unintellectual and uncomfortable (Nguyen & Larson, 2015). Educators play a crucial role in how the body is invited into the classroom. Developing awareness and understanding of embodied approaches is essential to effectively engage students and enhance learning (Fugate et al., 2019; Lipson Lawrence, 2012).

As Hegna and Ørbæk (2024) argue, there is a need to 'open up the field of embodied teaching and learning' (p. 16) and increase its visibility. Further empirical and conceptual research is needed to embed these approaches into mainstream higher education, which includes investigating where these approaches are already utilised. In this study, we examine how seven higher education practitioners understand and enact embodied approaches within a transdisciplinary undergraduate degree.

Driven by the question, 'how do educators understand and enact embodied approaches in transdisciplinary teaching and learning?', we examine educator experiences and sensemaking to identify four dimensions of practice that shed light on how educators conceptualise and enact these approaches in practice. This case study aims to contribute to the collective appreciation for the conditions necessary to support embodied learning (Forgasz & McDonough, 2017), laying foundations for further investigation of the role embodied approaches play in supporting transdisciplinary teaching and learning and societal transitions more broadly.

First, we turn to the literature on transdisciplinary higher education and embodied learning in the context of societal transitions, and the limited scholarship connecting these domains to establish the theoretical foundations for this work. We then present the autoethnographic case study used in this study. Next, we identify how we as educators understand and enact practice, discussing how our theorising builds upon existing literature through the articulation of four dimensions of practice. These dimensions are brought to life in autoethnographic vignettes offering illustrative examples of how we as educators enact embodied approaches to support the focus on addressing wicked problems and leading societal transitions within transdisciplinary higher education.

2. Theoretical rationale

To understand the significance of embodied approaches in transdisciplinary higher education, we must first examine the broader context of societal transitions and the theoretical foundations that inform our research. Societal transitions are open-ended and complex (Loorbach et al., 2017). Transition theory recognises that systems change emerges through complex interactions between multiple levels – from innovative niches to established regimes and broader landscapes (Geels & Schot, 2007). Enabling societal transitions requires teaching and learning approaches that support students to navigate 'a journey that has no defined destination' (Bentz et al., 2022b, p. 503) where they must make sense of disparate knowledges, perspectives and experiences as they come to understand the systems within which they reside (Knight, 2001).

Transdisciplinary higher education environments cultivate conditions for students to engage directly with complex challenges and societal transitions, developing their capacity to support action through their capacity for collaboration, knowledge

integration and creativity (Baumber, 2022). Within these environments, embodied approaches are critical for connecting students with 'equitable and sustainable transformations in a deeper and embodied way […] closing the gap between knowledge and action' (Bentz et al., 2022b, p. 504). In particular, by supporting students to link their personal experiences and understanding with action (Bentz et al., 2022a, 2022b).

Transdisciplinary education scholars recognise that embodied approaches offer a compelling way to rethink the nature of teaching and learning as we see what is at stake and encounter ourselves and our relationships with others and otherness (Macintyre Latta & Buck, 2008). As Midgelow (2017) suggests, embodiment is a crucial mode of and for transdisciplinary education, through which 'knowledge can be undone, (re)generated and made particular, beyond the usual dictates of prescribed curricula … [to] inform the transdisciplinary' (p. 124). Mishra et al. (2011) propose 'embodied thinking' – the ability to think with the body and be empathetic – as one of seven transdisciplinary skills that support individuals in facing and acting in challenging situations where there is no one truth or answer. Within transdisciplinary teaching and learning, embodiment is seen as both an approach to learning as well as a capability we should strive to develop in students.

Both embodied approaches and transdisciplinary teaching and learning have emerged in response to postmodern understanding of the nature of knowledge, recognising it as not static or rational but complex, indeterminate, inter-personal and contested. There is a natural affinity between these approaches in supporting holistic and integrative education through which assumptions about the nature of knowledge are challenged (Forgasz & McDonough, 2017). Both are also tied closely to the arts and strive for an 'equilibrium between analytic intelligence, feelings, and the body' (Nicolescu, 2012, p. 15). Chappell et al. (2023) suggest that 'creative, aesthetic and embodied teaching practices might amplify the powerful learning experienced through mediums such as visual art and spoken poetry, which linger with audiences/learners beyond the encounter' (p. 18).

Despite growing interest, there are many limitations and challenges associated with enacting embodied approaches in transdisciplinary higher education settings. Due to the deeply engrained Cartesian paradigm emphasising mind-based education, and neoliberal frameworks privileging outcome-driven and commodified teaching and learning (Wagner & Shahjahan, 2015), embodiment is sometimes viewed as a 'circus sideshow, a vulgar distraction' (Gregory, 2006, p. 316) within the academy. Moreover, there are ongoing debates about what constitutes embodied learning and its relevance in the classroom. For example, one might assume we're always partaking in embodied learning given we have bodies, or that embodied learning involves physical movement. Scholars dispel these assumptions by recognising that embodied approaches enhance learning when the body – its felt, sensory, emotive and physical aspects – are involved in meaning-making processes (Nathan, 2021) which can, but doesn't necessarily, involve physical movement.

Education scholars are quick to point out the practical considerations of enacting embodied approaches in the classroom and the importance of accounting for the broader education cultures and structures that need to change. This includes acknowledging the labour-intensive nature of embodied pedagogical approaches (Wagner & Shahjahan, 2015). Educators and students must be supported to adjust to new learning

environments and methods and develop an understanding of the value of embodied learning, while working through the resistance (Nguyen & Larson, 2015). Careful consideration of body politics within the classroom and the role of gender, power, culture, trauma, and emotion within embodied learning must also be grappled with and addressed.

For embodied approaches to be effectively enacted educators must become aware, willing and equipped with the understanding and confidence needed to effectively facilitate embodied teaching and learning (Lipson Lawrence, 2012). Macintyre Latta and Buck (2008) call for the 'falling into trust with the body's role in teaching and learning', critically citing that 'educators must have intimate experience with embodied practices to foster like experience in their students' (p. 324). Gaining an understanding of how embodied approaches feel, are understood and enacted can help improve learning in the classroom (Fugate et al., 2019).

Cognitive science and education research have contributed to our understanding of embodied approaches in past decades (Coetzee, 2018). Yet, this research is predominantly focused within the primary and secondary education contexts, and in mono-disciplinary subjects such as English (Gregory, 2006), science (Lindgren & Johnson-Glenberg, 2013) and mathematics (Lakoff, 2000). Moreover, few studies examine the educator experience and how practitioners are supported to enact embodied approaches (Hegna & Ørbæk, 2024). This study builds upon the contributions of key scholars examining the contribution of embodied approaches, specifically, within transdisciplinary higher education (Henriksen et al., 2015; McGregor, 2017; Midgelow, 2017). With this theoretical founding established, we now detail our methodological approach.

3. Methodology

This study examines how educators understand and enact embodied approaches in transdisciplinary learning environments to engage students in wicked problems and prepare them to lead long-term systemic change. In this study, we examine teaching and learning practices, specifically focusing on the experience of seven transdisciplinary higher education practitioners involved in the undergraduate transdisciplinary degree the Bachelor of Creative Intelligence and Innovation (BCII) within Transdisciplinary School at the University of Technology Sydney (UTS). This focus on the educator perspective aligns with the call for educators to better navigate the implementation of embodied approaches (Fugate et al., 2019; Lipson Lawrence, 2012).

The research arose out of a desire to support each other and other educators in understanding and enacting embodied approaches to realise broader aims of addressing wicked problems and supporting just social transitions through higher education. In doing so, we contribute to emerging scholarship on embodied and transdisciplinary practices. We employ a case study approach to generate an in-depth, multi-faceted understanding of situated practice within a specific institutional environment (Yin, 2017). Taking an autoethnographically approach, we leverage our educator experiences, contextualising them with theory, cultures and life experiences to develop new understanding and rich insight (Chang, 2016; Reed-Danahay, 2021). In the remainder of this methodology section, we describe the setting of the case study and outline the data generation and analysis approach.

3.1. Setting

The BCII was launched in 2014 as a combined degree enabling students from 26 different courses from across UTS to undertake transdisciplinary learning alongside their 'core' degree (e.g., design, business, and engineering). Transdisciplinary School is a centralised School at the University of Technology Sydney (UTS), Australia, a public technical university. Transdisciplinary School leads transdisciplinary learning and research at UTS, delivering undergraduate and postgraduate degrees that 'facilitate transformative learning through a focus on real-world challenges, complex systems thinking, the integration of diverse knowledges and reflexivity' (Baumber, 2022, p. 1). Educators support learners in addressing wicked problems where there is no one solution while working in dynamic fast-paced and collaborative environments (Madni, 2007).

3.2. Data generation and analysis

Four data collection and analysis methods were brought together – reflexive autoethnography, focus groups, thematic and embodied analysis – through a three-phase process. The first phase drew on reflexive autoethnography to position personal experience as primary data (Chang, 2016). Each educator wrote a reflection on a learning experience facilitated in the BCII where they had enacted embodied approaches to engage students in wicked challenges and develop capacities for leading systems change. The narratives identified the learning activity, its design rationale and included critical reflections on practice. These reflections were shared within the group.

The second phase involved collaborative analysis of these reflections and our experience through three two-hour focus groups with all seven educators. Each focus group commenced with embodiment attunement exercises, such as deep breathing and sensing activity, to ground our analytical practice in the body (Ellingson, 2017). Drawing on MacLure's (2010) concept of data that *glows,* we collectively identified words, phrases, fragments, interactions, relationships, questions and themes that sparked our interest across our narratives (MacLure, 2010). This process generated initial thematic codes, documented through collective notetaking and visual mapping.

The third phase involved iteratively grouping, mapping and interrogating the thematic codes to articulate the four dimensions of practice. These dimensions were refined through a return to the reflexive narratives and *glowing* data discussed in the focus groups, which helped us identify specific examples from the original narratives that best illustrated each dimension. These vignettes allowed us to maintain the authenticity of our experiences as educators while supporting the key insights presented.

Throughout these phases we paid attention to 'sensations resonating in the body as well as the brain' (MacLure, 2010, p. 282) to notice not only what the data said but how the process of insight generation and analysis felt (Srivastava & Hopwood, 2009). This allowed us to 'test' whether the insights and dimensions resonated with our lived experience as educators, leading to further refinement of the dimensions and vignettes.

This iterative data generation and analysis process allowed us to move from individual reflections to collective insights while remaining true to the embodied nature of our subject matter and research approach. By integrating traditional qualitative analysis with embodied methods we moved beyond the view that data, in its traditional sense,

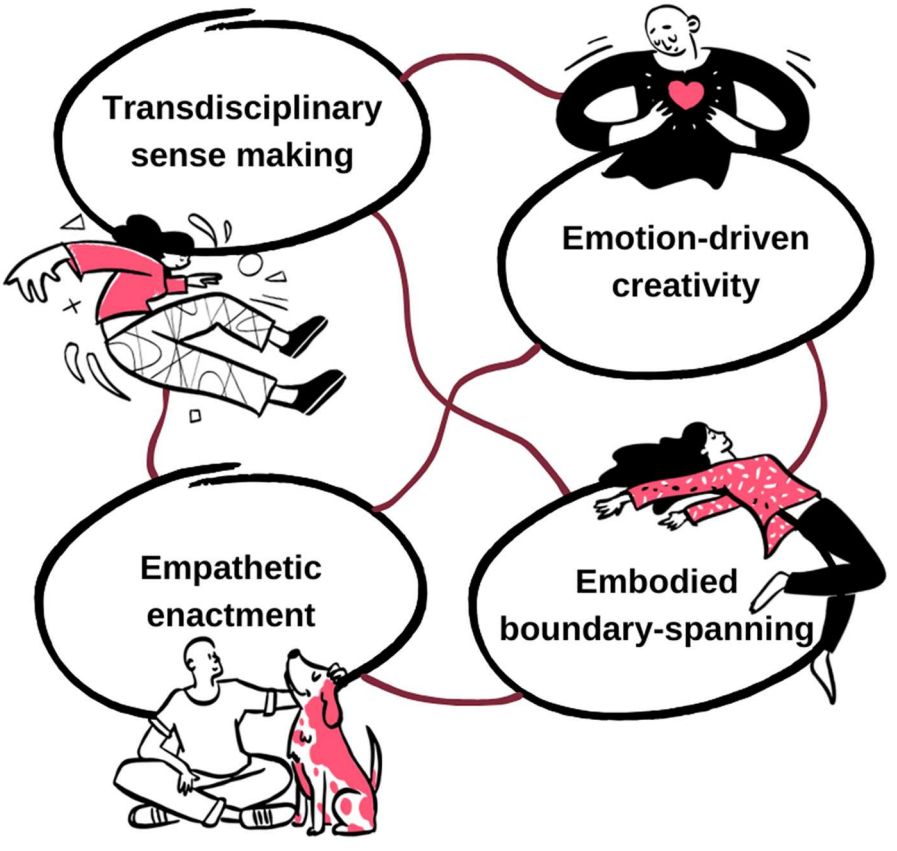

Figure 1. Four dimensions of practice.

is harvested to produce 'a particular rational insight' (Chappell et al., 2023, p. 8) to instead leverage our lived experience to ground the theoretical proposal outlined in this paper, supporting continued reflexive engagement with practice.

4. Findings: four dimensions of practice

Our findings are organised under four dimensions of practice that illustrate how educators understand and enact embodied approaches in transdisciplinary learning environments to engage students in complex challenges and prepare them to lead long-term systemic change.

These dimensions emerged through autoethnographic analysis of practice and collaborative, embodied sense-making of how we understand and enact these approaches in our transdisciplinary context. The in-depth qualitative data demonstrates how we make sense of and enact these approaches, by building on the contribution of key scholars in this space. These dimensions are (see Figure 1):

(1) Transdisciplinary sensemaking – paying attention to the body for reflexive transdisciplinary sense-making

(2) Emotion-driven creativity – engaging emotions in transdisciplinary learning to enhance creativity
(3) Empathetic enactment – enactment to cultivate situated knowledge and empathy for tackling complex challenges
(4) Embodied boundary-spanning – developing an aptitude for boundary spanning through the body.

In the following section, we present each dimension and offer vignettes – examples from our practice – to illustrate how we use embodied approaches to foster engagement with wicked problems and develop capacities for systems change. Specifically, we focus on supporting students from different disciplinary backgrounds to develop understanding of wicked problems, developing the ability to take action and lead societal transitions. The following dimensions and accompanying vignettes demonstrate how specific approaches such as role-play, tableau exercises, and improvisation are enacted to support students in developing capabilities integral to transdisciplinary practice and societal transition work.

4.1. Transdisciplinary sense-making

The first dimension involves paying attention to the body for reflexive transdisciplinary sense-making. Understanding system dynamics and our relationship to them requires attention to both analytical and felt understanding (Bentz et al., 2022a, 2022b). We use embodied approaches to support students from different disciplines to notice and make sense of the world through their bodies in reflexive ways. Noticing sensations, such as signals from the gut, can help learners become aware of how their personal values and emotions might be influencing their understanding and perceptions of situations (Holzer, 2017).

The following vignette offers an example of how we invite learners to pay explicit attention to sensory systems and reflect on their emotions, to attune to their bodies to reveal insights through the 'stuck exercise'. Developed by The Presencing Institute as part of their Social Presencing Theatre methodology, the exercise invites learners to 'let the body be the guide' and 'feel deeply into the situation, suspending our problem-solving habit' (Hayashi, 2015, n.p.).

When grappling with wicked problems and exploring systems change, students often feel 'stuck' as they try make sense of complex ideas and dynamics. An adapted version of the stuck exercise is introduced in the first BCII subject to support students in attuning to the body and tapping into unconscious emotions and conscious feelings related to feeling stuck. In groups, students each tune into a place they feel stuck in relation to their learning, such as a tension or breakdown. They are invited to create a pose with their body to capture this 'stuckness'. What they choose to focus on is up to them; for example, they might focus on the aspects of the wicked problem they are tackling, or team dynamics. Students are then invited to transition into a new body position reflecting the process of becoming unstuck.

Insights are achieved through group reflection and discussion on individual and collective stuck poses, and the movements that were then performed to move out of the stuck state. The discussion further explores how the insights that emerged from

paying attention to the body support a new understanding of the problem or situation at hand. This activity helps us 'disrupt assumptions, passive learning, and mind/body division' (Nguyen & Larson, 2015, p. 341). Encouraging an 'embodied reflexivity', we support students to generate insight from their own and peer perspectives that only become accessible through critical engagement with embodied action (Midgelow, 2017, p. 130).

4.2. Emotion-driven creativity

The second dimension relates to how we engage emotions in transdisciplinary learning to enhance creativity. Understanding and responding to wicked problems and societal transitions requires both creative capacity and emotional intelligence (Nicolescu, 2012). Indeed, the emotional and energetic states impact individuals' cognition, perception, and creativity. We use embodied approaches to support the deliberate integration of students' embodied emotional states, feelings and moods that play a significant role in learning and development (Li et al., 2020). In the following vignette, we demonstrate how we encourage engagement with emotions in the classroom to support different learning experiences.

Energisers and grounding exercises are used across all subjects at various scales in the BCII; from collaborative theatres with up to 350 students to smaller tutorial classes with 30 students, and even in online teaching. Exercises take the form of icebreakers, or check-ins and check-outs at the start and end of class or can be embedded within different activities. Energisers aim to activate students and stimulate a pleasant and energetic mood, which can be beneficial for the non-linear creative process of collaborative idea generation (Perry-Smith & Coff, 2011). In contrast, grounders are typically more meditative, encouraging a calm mood and a more contemplative, reflexive and analytical stance.

When bringing together students from different disciplines, embodied energisers and grounders enhance group coherence. The following vignette is an example of an energiser activity used to support creative ideation for a complex challenge brief set by an industry partner. At the start of class, an adapted version of *Rock, Paper, Scissors* (Extreme Rock, Paper, Scissors Game, 2022) was facilitated to build energy and excitement in the classroom and encourage social connection. In this game, the person who loses joins the 'cheer squad' for the winner, who goes on to find another opponent. The activity continues until only two players are left, supported by their mass cheer squads who clap and cheer them on (see Figure 1). We use the social and emotion-based learning supported by these activities to prime students for different types of engagement, such as collaboration, ideation or reflection.

4.3. Empathetic enactment

In the third dimension, embodied approaches can be used to encourage empathic sense-making and understanding through the articulation of different possible perspectives, relationships, assumptions, and values. We create space for students to engage personally and empathetically with wicked problems and systems change in a way that connects to their lived experience while helping them negotiate different perspectives. The following

vignette offers an example of how we use embodied activities to support students in empathising with human and non-human actors to deepen their understanding of system states and potential transitions.

In the third year of the BCII program, students participate in a complexity-focused subject and assessment task where they engage in transdisciplinary knowledge construction to explore a specific wicked problem. The assessment requires students to use embodied approaches to present their exploration of a system and proposed interventions to support societal transitions. Over the years, students have designed various embodied performances and collaborative enactments of complex systems, from games in which the rest of the cohort takes part, to poetic imaginings of the system from more-than-human perspectives. The assessment prompts students to move away from the analytical 'in your head' understanding to a more embodied and collective format that could be experienced and understood together with other students from diverse disciplines. Students must demonstrate a deeper situated understanding of complexity concepts by having to translate them, rather than repurposing the definitions through exposition (e.g., through written text or presentation).

One activity we facilitate early in the subject to support students in this assessment is 'Complex Systems Tableau', which draws on systems thinking and theatre-based practices, inviting students to embody and explore different roles, perspectives and relationships within a system. Drawing on the drama convention of tableau, students make a frozen scene using their bodies, striking different poses and facial gestures (Crumpler et al., 2006) as seen in Figure 2. Students are invited to build a living picture of a system (e.g., a National Park) and then respond to systems interventions (e.g., a

Figure 2. Students cheering each other on during Extreme Rock, Paper, Scissors.

bushfire, poaching etc.). They can embody any element, relationship or aspect of this system, using their bodies to inhabit and respond as different perspectives (e.g., a native animal, tree, piece of bark etc.). The facilitator then questions participants holding different positions, inviting reflections from their embodied perspective. Insights around actor's values and perspectives are later explored through primary and secondary research.

This activity helps students develop empathy towards other actors in the system and understand their own complicity in propagating problems and conceptualise their role in leading systems change – something much harder for students to grasp when only analytical approaches to systems thinking and complexity are used. The co-creative process fosters collective agency and empowerment among students (Bentz et al., 2022a, 2022b). As students empathise with others and engage their senses in generating new knowledge, they come to question and collectively transform their own perspectives, mental models and ideas about the world, which is vital for transdisciplinary collaboration and societal transition work more broadly (Ross & Mitchell, 2018).

4.4. Embodied boundary spanning

Addressing wicked problems and leading societal transitions require working across multiple boundaries between disciplines, sectors and scales of change. The capacity to span these boundaries effectively is crucial for transition work (Wittmayer & Schäpke, 2014). The three dimensions discussed above all describe our understanding of and approaches to developing boundary spanning as a core transdisciplinary practice. Boundary spanning involves crossing disciplinary boundaries within the academy and with actors outside the academy (Klein, 2001). In each of the descriptions above, we highlighted a different emphasis on reflexivity, creativity and tackling complexity as transdisciplinary capabilities, but we note these are variously inter-twined. The final example uses role-play and improvisation, highlighting the entangled boundary-spanning dimensions of learning transdisciplinary capabilities. The following vignette offers just one example of how we support embodied boundary spanning in the classroom.

In the fourth and final year of the BCII, students participate in a futures-focused subject and assessments that involves developing an 'experiential future' – a participatory experience of a possible future (Candy & Dunagan, 2017), (see Figure 3). To develop and play-test their experiential vision, which is set at least 15 years in the future and in response to a real-world challenge posed by an external partner, students are invited to undertake a 'prehearsal' exercise in teams. 'A prehearsal is an improvised situation of short duration, a quick-and-dirty test of an instance of a scenario that focuses on the player's behaviours and interactions using minimal props and setup' (Kuzmanovic & Gaffney, 2017, p. 112).

Students are encouraged to use a familiar scenario to help ground and structure the role-play – such as a doctor's visit, a breaking news announcement, a court trial, or a conversation in a coffee shop – and imagine what might have changed 15–20 years in the future. They synthesise all the research they've done, gathering different trends and speculative images of the future and enact this in a short 2–3-minute role-play, improvising elements on the spot to build on their body-knowledge.

Figure 3. Students presenting their experiential future 'Plot Swap Co-op'.

The experiential futures assessment, and role-play exercises explicitly invite students to exercise their creative capacity and experiment with multiple modalities, including sound, movement, texture and even smell – not simply through the usual presentation/pitch formats that students were already very familiar with from the first three years of the BCII. Through embodied multi-modal engagement, educators strive to support students to develop the capacity to span boundaries while remaining attuned to the embodied experiences of integrating different ways of knowing and being. As Wartofsky (1979) argues ' … our own perceptual and cognitive understanding of the world is in large part shaped and changed by the representational artefacts we ourselves create. We are, in effect, the products of our own activity … ' (p. xxii).

5. Discussion

This study reveals four dimensions of practice that illustrate how educators understand and enact embodied approaches in transdisciplinary teaching, supporting the learning needed to grapple with wicked problems and support societal transitions. Each dimension represents a distinct way that educators conceptualise and enact embodied

approaches in the classroom, suggesting that the use of embodied approaches in transdisciplinary environments serves multiple functions in developing students understanding of and capacity to lead societal transitions. This includes developing embodied systemic awareness, building emotional capacity for innovation and transition processes, developing empathy for different actors and groups, and enabling effective boundary-spanning practices.

In our practice, we draw on a broad range of embodied approaches to support students moving back and forth between the background, histories, beliefs, choices, experiences and expressions that influence their own and others' actions (Satina & Hultgren, 2001). We do so to support reflexive transdisciplinary ways of being and knowing. From paying attention to and acknowledging the discomfort of having a worldview challenged to pre-hearsing possible futures, to embodied boundary-spanning practices that expand the scope of meaning-making and transformative possibilities.

Whilst the value of embodied approaches in enhancing learning cannot be assumed (Nathan, 2021), our experience as educators is that considered integration of these approaches enhances students' capacity to understand and take action for societal transitions. Wicked problems, complex systems and the action needed to support ethical and equitable transitions can be more easily understood if connected appropriately with intuitive, felt and embodied knowledge (Araya, 2017; Bentz et al., 2022a, 2022b). In our experience, the success of the examples discussed lay in how well the embodied approaches were integrated into the overall learning experience. This is aligns with scholarship that highlights that simply 'adding on' an embodied activity does not necessarily enhance learning (Mavilidi et al., 2015). Instead, there must be deep and critical consideration of where, when, how and if at all, embodied approaches are necessary.

Through this inquiry, we have been surprised by the diverse and subtle ways in which we ourselves enacted embodied approaches from the use of gesture to physical movement, role-play, improvisation, multisensory engagement, meditation and multisensory activities. This broad application can be both a challenge and an opportunity for educators. On the one hand, it expands possibilities for how embodied learning can be enacted and challenges the common assumption that it must involve physical movement of body (Nathan, 2021). This opens space for more subtle, interoceptive forms of embodied engagement, including meditation, conscious drawing and writing and considering questions such as 'how do you feel about that?' alongside 'what do you think about that?'

On the other hand, the endless ways embodied approaches can be enacted are often overwhelming, particularly for those unfamiliar with embodied practices, as they require time, resources and training, which can be hard to come by (Fugate et al., 2019; Lipson Lawrence, 2012). These challenges are further exacerbated with growing class sizes where we can find ourselves suddenly facilitating an embodied learning experience for 300 students rather than 30. The challenges also extend to the discomfort we, as transdisciplinary educators ourselves, experience. Many of us come from disciplinary domains where embodied approaches are not central to the disciplinary practices of inquiry and learning. In the same way that students require additional support to engage in embodied approaches, so do educators.

Universities must ensure educators have the support to adjust and integrate new learning approaches (Nguyen & Larson, 2015). There are several support mechanisms

Table 1. Questions for enacting embodied approaches.

Guiding questions for educators	Guiding questions for learners
What experiences might support learners to pay attention to emotions, sensations, and feelings in the classroom as a way of knowing?	What emotions, sensations and feelings are you experiencing? What is your body telling you?
When and where could embodied reflexivity be introduced to make sense of transdisciplinary learning?	What new learning or insight have you gained through the experience and how does it support your understanding?
How can learners connect their inner-world and personal experience to the outer-world?	How does your experience help you empathise with the experience of others (both human and non-human)?
How might I support learners to integrate different perspectives and ways of knowing?	How do you feel when enacting the perspective of others? What insights emerged and how does this shape understanding?

within our context that made it possible for us to enact embodied approaches. This includes the culture of collaborative curriculum development and peer learning through which educators share their experiences, workshop challenges and collectively develop embodied teaching strategies. We have access to flexible learning spaces and teaching resources such as prototyping and art materials that support embodied engagement. Additionally, there is leadership support for experimenting with and enacting embodied approaches as part of transdisciplinary teaching and learning. These supports allow us to better navigate challenges for practice such as student resistance and creating safe learning environments. Sustained institutional support including professional learning and recognition of additional time and resources required, remain crucial for the wider implementation of these approaches. Acknowledging the value of these practices as well as challenges for practice, we offer the following guiding questions (Table 1) for educators.

This research emerged from our individual and collective practice within UTS's Transdisciplinary School. Our findings drawn from our practice as educators with a specific interest in experimenting with embodied learning, were enabled by the in-depth case study approach. This iterative process provided rich insights into how embodied approaches are used to support students in addressing complex challenges and leading societal transitions. The identified dimensions of practice illustrate the valuable contributions of embodied approaches in transdisciplinary environments. Future research could build on this work by examining the relevance and applicability of these dimensions in other transdisciplinary or disciplinary contexts where students are invited to engage with complex challenges and societal transitions.

While the educator perspectives and practice were the focus of this research, we acknowledge the importance of understanding learners' experience of these embodied approaches as areas for future research, particularly for students from disciplines where these approaches are less familiar. Questions of how psychologically safe environments and student support for managing discomfort are provided are crucial areas for future research. Further, given the challenges educators face when enacting embodied approaches, further examination of how broader institutional structures make these practices possible is necessary.

6. Conclusion

This paper makes three contributions to higher education scholarship and practice in the context of societal transitions. First, we provide insight into how educators understand

and enact embodied approaches to develop capacities for navigating and leading systems change. Second, we show how educators enact this in practice to support reflexive, creative and critical engagement with complex challenges, fostering core knowledge integration and boundary-spanning capabilities required for societal transitions. Third, we argue that supporting educators to effectively implement these approaches is essential if higher education is to fulfil its role in fostering just, ethical and sustainable societal transitions. For the contribution of embodied approaches to be fully realised, greater recognition and support for the challenges educators face is required. This includes conducting case studies in other transdisciplinary higher education contexts and developing actionable frameworks to support professional learning and practice.

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