frontiers in Education

HYPOTHESIS AND THEORY
published: 09 March 2022
doi: 10.3389/feduc.2022.787490

Facing Crises of Unsustainability: Creating and Holding Safe Enough Spaces for Transformative Learning in Higher Education for Sustainable Development

Mandy Singer-Brodowski[1], Ruth Förster[2], Saskia Eschenbacher[3], Petra Biberhofer[2] and Sofia Getzin[2]*

[1] Department of Education and Psychology, Institut Futur, Freie Universität Berlin, Berlin, Germany, [2] Swiss Academic Society for Environmental Research and Ecology, Basel, Switzerland, [3] Department of Education and Social Work, Akkon University of Applied Human Sciences, Berlin, Germany

OPEN ACCESS

Edited by:
Lili-Ann Wolff, University of Helsinki, Finland

Reviewed by:
Antje Disterheft, New University of Lisbon, Portugal
Marianna Vivitsou, University of Helsinki, Finland

***Correspondence:**
Mandy Singer-Brodowski
s-brodowski@institutfutur.de

Specialty section:
This article was submitted to Higher Education, a section of the journal Frontiers in Education

Received: *30 September 2021*
Accepted: *02 February 2022*
Published: *09 March 2022*

Citation:
Singer-Brodowski M, Förster R, Eschenbacher S, Biberhofer P and Getzin S (2022) Facing Crises of Unsustainability: Creating and Holding Safe Enough Spaces for Transformative Learning in Higher Education for Sustainable Development. Front. Educ. 7:787490. doi: 10.3389/feduc.2022.787490

The multiple crises of unsustainability are provoking increasing stress and unpleasant emotions among students. If higher education is to fulfill its mission to support transformation processes toward sustainable development, it must adapt its pedagogical approaches to help students deepen their critical thinking and empower them to engage in these transformation processes. For this reason, emotions – which can also prevent critical thinking – should be carefully addressed within transformative learning journeys. However, these journeys are themselves challenging for learners and educators. They push them to abandon stable meaning perspectives, causing feelings of incoherence and tension. Learners need safe enough spaces to navigate these situations of uncertainty. The central questions of this manuscript are: What is meant by safe enough spaces? How can learners, educators, and higher education institutions create and hold such spaces? These questions are explored on three different levels: (1) the intrapersonal level, (2) the interpersonal level, and (3) the organizational and systemic level of discourses in higher education. For the intrapersonal level, perspectives inspired by neurobiology are used to discuss reaction patterns of our autonomous nervous system and present insights into stress development. Learners should feel bodily safe when engaging in transformative learning processes. This is supported by balancing the challenges learners face with the resources they have. For the interpersonal level, the manuscript argues that focusing solely on rational discourse is insufficient to support safe enough spaces for transformative learning. We call for a culture of edifying conversations supported by respectful relationships among learners, as they are more adequate for regaining self-direction. For the organizational and intertwined systemic level, the ambition is followed to make higher education institutions offer learning environments that feel safe enough for all involved. However, as these institutions are strongly influenced by dynamics of economization and competition, they do not necessarily empower learners to challenge and disrupt unsustainable and neoliberal

discourses. The manuscript explores how learners and educators can cultivate engaged critique by acknowledging their own embeddedness in neoliberal dynamics and opening up so-called transformative spaces for institutional change. Finally, recommendations for educational practices in higher education for sustainable development are offered.

Keywords: transformative learning, safe space, emotions, higher education, sustainable development, critical thinking, climate crisis, stress

INTRODUCTION: FACING CRISES OF UNSUSTAINABILITY

Unsustainability crises are increasingly serious. Critical tipping points in global ecosystems have already or nearly been reached (Lenton et al., 2019), causing unpredictable dynamics. Against this alarming background, education for sustainable development (ESD) is facing enormous challenges, particularly in education systems in the Global North, which are hardly capable of taking into account the emotional condition of learners. Individuals are increasingly affected by the consequences of unsustainability crises, leading to emotional reactions that are difficult to deal with. Some authors argue that there is a need for education that prepares people of all ages for the potential of an interconnected planetary and social systems' collapse (Andreotti, 2021) and education for the end of the world as we know it (Stein et al., 2020). This form of education must account for learners' stress and emotional challenges.

There is a growing research strand about learners' emotions in the context of the climate crisis: anxiety (Ojala, 2016), worry (Ojala et al., 2021), guilt about being "implicated subjects" in high-emission societies where individuals cannot easily follow a more sustainable lifestyle (Bryan, 2020, based on Rothberg, 2019), grief about the loss of species (Verlie, 2019), powerlessness and helplessness. Climate knowledge is seen as "difficult knowledge" (Bryan, 2020, p.15, based on Britzman, 1998) that can increasingly be compared to knowledge about war or genocide. Its content is "traumatic or hard to bear" and leads to "learning encounters that are cognitively, psychologically and emotionally destabilizing for the learner" (Bryan, 2020, p.15).

In a way these unpleasant emotions are a healthy response to the global crisis of unsustainability: they show that individuals increasingly acknowledge and feel the dangers that are lying ahead of us (Cunsolo et al., 2020; Ojala et al., 2021). But at the same time the dynamics of unsustainable development and related emotions are causing many symptoms of stress and people are starting to think and feel about the global crisis of unsustainability in a way that prevents them from taking action. Emotions can be viewed as necessary for profound learning; but they can also cause learning blockages. Additionally, they have the potential of causing resistance to or even denial of the existence of problems.

Transformative learning is a theory that allows for looking at the conditions that learners need in order not to disconnect from unpleasant, even stressful emotions or remain in automated stress reactions (Mälkki, 2019). Instead, learners can use these emotions to deepen critical thinking and develop the competencies that will enable them to deal with the multifaceted dilemmas and tensions within sustainability. Generally, "[e]motion readies us for action, for evoking motion (e-motion) of the internal or external sort" (Siegel, 2020, p. 148). Kaisu Mälkki has coined the term "edge-emotions" for "those unpleasant emotions that arise when our assumptions are being challenged" (Mälkki, 2019, p. 60) and "prime us for action to restore our sense of comfort and security" (ibid.).

Embedding (edge-) emotions in the learning process is important: neurobiology and psychology have shown that individuals usually want to maintain their frames of reference in order to stabilize the level of arousal they experience (ibid.). This prevents critical thinking and transformative learning, because individuals avoid entering processes of critical reflection triggered by edge-emotions. This manuscript argues that ESD should enable learners to embrace difficult emotions that come along with the knowledge and experience of unsustainability crises, and with the way educational organizations tackle them. It is necessary for learners to deal constructively with their inner tensions, with tensions within their relationships, as well as with tensions within their learning environments arising from the multifaceted crisis. This can empower them to be part of deep organizational and societal transformation processes. The manuscript argues that learners need *safe enough spaces* to articulate their emotions and deal with stressful experiences.

The following sections explore what safe enough spaces can look like and how learners and educators in higher education can create and hold them, ending with recommendations based on these insights at three different levels: the intrapersonal, interpersonal, and organizational and systemic levels. Section "Creating Safe Enough Spaces for Transformative Learning" presents how transformative learning is discussed and why it includes navigating a liminal space of not-knowing. Section "Balancing Challenges and Resources – the Intrapersonal Level of Safe Enough Spaces" elaborates on why transformative learning can be deeply linked to stress and coping with stressors. This section focuses on the regulation of emotions on an intrapersonal level and on how educators can support learners dealing with this process by making them feel bodily safe enough. Section "From Rational Discourse to Transformative Conversations – the Interpersonal Level of Safe Enough Spaces" discusses how safe enough spaces can be developed on the interpersonal level of human communication. It broadens the perspective of Habermas' "ideal speech situation" (1984/1987) within transformative learning and pleads for more "edifying conversations" (Arcilla, 1995;

Eschenbacher, 2020)[1]. Section "Challenging and Transforming the Embedded Dysfunctional Tendencies in Higher Education From Within – the Systemic Level of Safe Enough Spaces" explores how the learning environments of higher education institutions (at the organizational and systemic level) are influenced by the dynamics of economization strategies that privilege market and competition principles and therefore do not offer students safe enough spaces for transformative learning. It suggests how to critically reflect on these tendencies from the perspective of an engaged critique and thus offer the potential to change these learning environments. Section "Recommendations for Creating and Maintaining Safe Enough Spaces" wraps up the argumentation of what a safe enough space can look like on the three different levels in the form of recommendations for practice that can be used both by learners and by educators. These recommendations include the recognition of ambiguity and ambivalence in educational settings, encouraging learners as well as educators to face the situation in the liminal spaces; the manuscript also makes a plea for educators to seek strategies that make them feel safe enough as well. Section "Conclusion" summarizes these recommendations and discusses what this approach means for higher education institutions on the intrapersonal, interpersonal, and organizational and systemic levels.

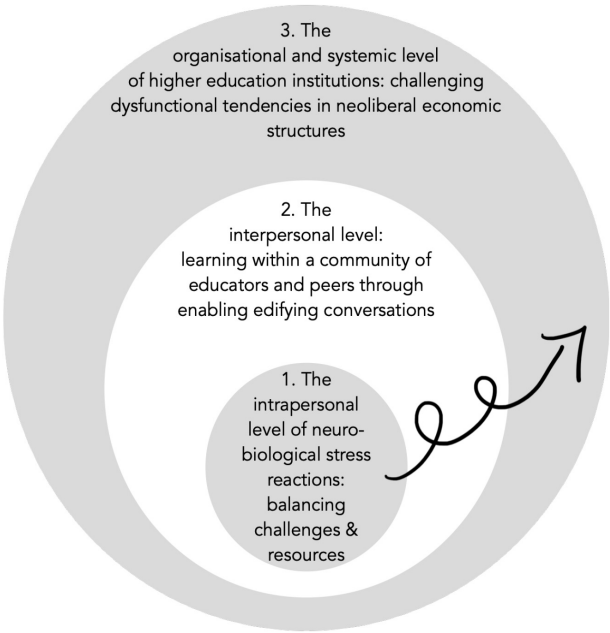

FIGURE 1 | Three levels of safe enough spaces for navigating the transformative learning journey.

CREATING SAFE ENOUGH SPACES FOR TRANSFORMATIVE LEARNING

Transformative learning is "an approach to teaching based on promoting change, where educators challenge learners to critically question and assess the integrity of their deeply held assumptions about how they relate to the world around them" (Mezirow and Taylor, 2009, p. xi). This notion of change and liberation is key to transformative learning. The transformative dimension of adult learning becomes a necessity when "the coherence-producing mechanism of our minds is interrupted" (Mälkki, 2019, p. 64). This experience of interruption, incoherence, or disorientation paves the way for reflecting on and transforming one's most guarded beliefs and guiding assumptions. For this reason, transformative learning is mostly initiated through and accompanied by diverse experiences of tension, ambivalence, ambiguity, and friction, such as facing crises of unsustainability with feelings of deep uncertainty and insecurity. These tensions and frictions do not only have intra- and interpersonal causes: they can also have organizational and systemic causes. All three levels influence the way learners experience a safe enough space for transformative learning and require specific strategies for providing safe enough spaces, as shown in **Figure 1**.

All individuals are vulnerable in one way or another; thus, no situation or space can be considered completely safe. Since no "absolutely" safe spaces exist, we suggest speaking of "safe *enough* spaces." These support learners and educators by making them "feel safe enough" to enter liminal spaces of uncertainty and to navigate through them, as this is crucial for transformative learning. In these liminal spaces old ways of being, feeling, thinking, and acting as well as underlying meaning perspectives are invalidated or stop being functional and new ones are not yet established (e.g., Land et al., 2014; Förster et al., 2019). Orientation is destabilized in "that 'in-between' zone where *all that was once stable [.] become[s] fluid*" (Mälkki and Green, 2014, p. 8). This uncertainty is challenging and stressful in itself. Learners also enter this liminal zone already destabilized by experiencing a crisis or disorientation. All these conditions cause unpleasant (edge)-emotions and stress reactions (Förster et al., 2019).

The following paragraphs elaborate on what navigating through liminality within safe enough spaces can look like on all three levels, arguing that navigating through the liminal space is necessary for empowering people to contribute to societal change processes.

Balancing Challenges and Resources – The Intrapersonal Level of Safe Enough Spaces

Transformative learning is triggered by interruption, incoherence, or disorientation, leading to liminal experiences. To get out of these unpleasant situations on the intrapersonal level, automated defense patterns may be triggered and these may inhibit critical thinking and social behavior. Therefore, understanding the role of unpleasant emotions, stress development, and coping is key to providing safe enough spaces

[1]Edifying conversations support learners in their quest for self-understanding (see section "From Rational Discourse to Transformative Conversations – the Interpersonal Level of Safe Enough Spaces").

for transformative learning. Based on the neurobiologically rooted polyvagal theory (Porges, 2017, 2021), a safe enough space on an intrapersonal level can be argued to be the space where both learners and educators feel bodily safe and are not in defense mode. An individual's overall resources have to be in a balance with the challenges to be met; this helps avoid defense reactions from emerging and supports the regulation of emotions and stress. Section "Theoretical Perspectives on Stress and Emotions in Transformative Learning" introduces the theoretical foundations of stress development and section "Practical Implications of the Stress-Development Perspective" derives recommendations for enabling feeling safe enough while facing unpleasant emotions.

Theoretical Perspectives on Stress and Emotions in Transformative Learning

Polyvagal theory describes how physiological states of the autonomic nervous system (ANS) and human behavior interface in situations of safety, threat, and life-threat, i.e., under stress (Porges, 2021). It emphasizes that the ANS has three distinct subsystems, two in the parasympathetic nervous system (PNS)[2] – the dorsal and ventral vagal circuits – and the sympathetic nervous system (SNS) (ibid., p. 258ff.). The ANS regulates three main states and corresponding responses to stimuli: (1) feeling bodily safe: allowing social engagement, (2) feeling threatened: mobilizing for fight-or-flight, and (3) feeling life-threatened: immobilizing for freeze, in the sense of a shutdown (see **Figure 2**).

From a neurobiological perspective our body is constantly evaluating inner and outer sensory inputs (stimuli) to keep us in homeostasis and support our growth and survival. Emotions reflect these complex appraisal processes and prepare us for action (Siegel, 2020, p. 148). According to polyvagal theory, appraisal *via* unconscious, rapid "neuroception" is dominant and enables the ANS's immediate adaptation of the physiological state to cope with a situation. The ANS-triggered responses to stimuli can stay within or exceed our so-called "windows of tolerance," in which humans operate in homeostasis (**Figure 2**).

When do we feel bodily safe and when not? We feel safe when our ANS is controlled by its ventral vagus circuit, the associated "social engagement system" is activated, and we are not in defense mode (Porges, 2017, p. 23ff.). This supports our primary human need to feel connected with other humans and our ability for social behavior, including regulation of emotions. A situation, in particular human interaction, is assessed as safe by neuroception *via* "cues of safety": facial expression, prosody, gestures, or contextual stimuli that we receive *via* our sensory channels (visual and auditory). Moreover, we convey our states through these cues, e.g., joy or anger *via* facial expression and corresponding intonation.

[2](1) The dorsal vagal circuit is responsible for calming down and regenerating. Its state under life-threat is immobilization. (2) The ventral vagal circuit and its associated social engagement system are activated when we feel safe. They support social behavior by conveying and assessing physiological (emotional) states mainly *via* facial expression, prosody (voice intonation) and optimized listening capabilities to human communication. They inhibit defense reactions and promote health, growth, and restoration.

In this safe mode, the sympathetic subsystem (SNS) and parasympathetic subsystem (PNS) work in a homeostatic range, and humans operate within their "window of tolerance" (Ogden et al., 2006; Porges, 2021, p. 263). This is the optimal zone for (transformative) learning: it is still possible to experience unpleasant emotions and connected arousals of the SNS but these emotions can be regulated, leading to recovery. Within the window of tolerance, the arousal of the SNS does not lead to automated defense but supports individuals in coping with the situation. They learn something new and can be creative while staying connected with others. If they are successful in coping, they can then experience pleasant emotions, like reaching their goals or fulfilling their needs. They are rewarded (e.g., Hanson, 2013). Furthermore, if they are aroused by pleasant emotions like curiosity while facing a challenge, this will support them in approaching and exploring an unknown situation, instead of avoiding it. From this perspective "[s]afe states are a prerequisite not only for social behavior but also for accessing the higher brain structures that enable humans to be creative and generative" (Porges, 2017, p. 47). Learners can access their resources, they can engage socially, and enter and navigate through transformative learning processes.

By contrast, when a given situation is appraised as threatening or even life-threatening, it is not safe, corresponding unpleasant emotions are generated, such as fear or even anxiety, and our avoiding system is aroused (e.g., Hanson, 2013). Automated and therefore rapid defense patterns are activated by the ANS, hard-wired in the human brain to adapt to the situation fast and to survive (Porges, 2017). In defense mode, the ventral vagus circuit is first overruled by the SNS mobilizing for fight-or-flight, e.g., through increased heartbeat, while impeding the social engagement system. When this is insufficient the dorsal vagus circuit of the PNS takes over, bringing individuals into a freeze state, involving lowered heartbeat and breathing, e.g., feigning death or responding with panic, dissociation with numbness, or collapse. In defense mode, human beings can neither reflect cognitively and critically, nor be open for creative experimenting and engaging in positive social contact in order to change their way of being, thinking, feeling, and acting, as demanded in transformative learning. These processes are impeded because they would be too time- and energy-consuming in an emergency. Defense reactions endanger the ability to return into a safe mode – within the window of tolerance – when they are very intense (short period, high impact) or become chronic (last long) and individuals have no chance of regenerating themselves (Semmer and Zapf, 2018).

Complementing the polyvagal theory with other conceptualizations of stress development and coping (Semmer and Zapf, 2018) brings further insights into how safe enough spaces can be created and maintained. When individuals appraise their resources subjectively as insufficient to cope with a challenge, this causes stress (e.g., ibid., p. 24ff.). Inner or outer stimuli, events, challenges, or circumstances that have the potential to cause stress in the majority of humans are called "stressors" (ibid.). In this sense, someone "feels safe" when his/her resources are in balance with the challenges or stressors. From the perspective of polyvagal theory, staying in a safe mode

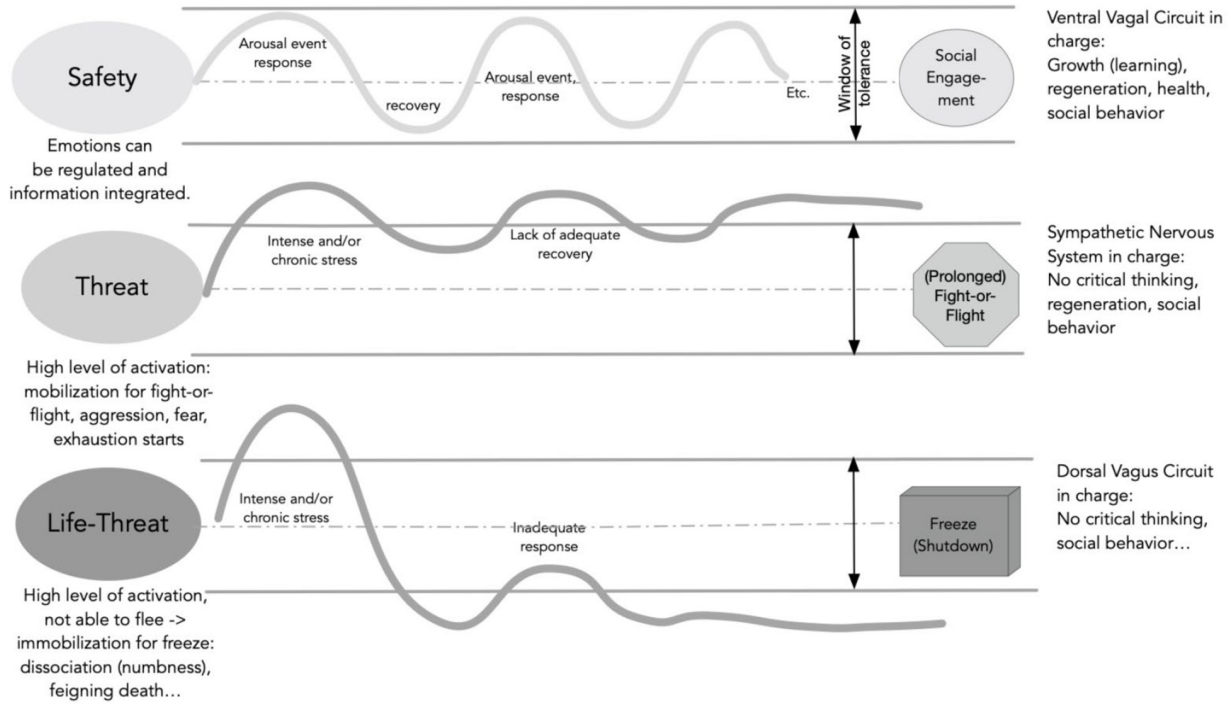

FIGURE 2 | Polyvagal theory: ANS states and corresponding responses to stimuli related to the "window of tolerance" (based on Ogden et al., 2006; Siegel, 2020; Porges, 2021).

with an activated social engagement system is therefore the most crucial resource for regulating emotions. At the same time feeling bodily safe is supported by balancing challenges with resources.

What a person experiences as stressful and particularly as (life-) threatening also depends on the intensity and/or the duration of stressors, on personal predisposition, and on the accessibility of resources. This also means that the width of the "window of tolerance" differs individually and can change depending on the context (e.g., Siegel, 2020, p. 345ff.). The more spacious it is the less reactive humans are to stressors and the less likely they are to respond with defense-activation. Nevertheless, situations like wars, car accidents, deep injustices, or environmental hazards such as flooding and wild-fire are (life-) threatening for all humans. People may have severe acute defense reactions, lose the status of feeling safe, and leave their window of tolerance. Furthermore the window of tolerance narrows, meaning the defense-reactivity to potential stressors increases after an overwhelming, traumatizing experience. This requires therapeutic intervention that will help the individual come back to a state of feeling safe and experiencing regeneration.

But humans can also cope with extreme situations through less severe stress reactions – still staying in or returning to their window of tolerance – and education can support them here. Stress is experienced when enduring the loss of orientation related to questioning our deepest sustainability values and understanding of the world as a "safe operating space for humanity" (Rockström et al., 2009), or when facing great uncertainty and not-knowing related to the accelerating climate crisis. These are experiences of disorientation, interruption, or incoherence that can become an entry point for transformative learning journeys.

Examining the initial starting point of transformative learning processes more closely helps understand why safe enough spaces are crucial. When formerly unproblematic notions of social or environmental normality are called into question and force learners into a new learning experience, they enter this process by "realiz[ing] that they have, to some extent, lost their way in the world" (Arcilla, 1995, p. 7). In that sense, unpleasant edge-emotions are experienced (Mälkki, 2019). One way forward would be to embrace these emotions and understand them as indicators of learning potential and an invitation to question guiding assumptions in light of the current crisis. Obviously, this process is "not a continuously joyful exercise in creative self-actualization. It is psychologically and politically dangerous, involving risks to one's livelihood, social networks, and psychological stability" (Brookfield, 1990, p. 179). Furthermore, edge-emotions can reveal what situations may cause automated defense reactions. Recognizing these edge-emotions and being able to live with them is an important resource when navigating the liminal space (Mälkki, 2019).

Practical Implications of the Stress-Development Perspective

Using the stress-developmental perspective for creating safe enough spaces helps learners to embrace these edge-emotions as well as other unpleasant emotions in a constructive way.

It supports them in feeling safe enough by assisting them in balancing their own resources with the challenges met. For facilitators and educators, this means helping learners to stay within, or return to, their window of tolerance, or enlarging this window. For transformative learning, it may also mean enabling learners to explore the edge of this window of tolerance, i.e., just at the edge of their own comfort zone (e.g., ibid., p. 62).

This section presents some recommendations regarding how to create safe enough spaces for learners as well as for educators that take these neurobiological insights into account.

Considering the need to balance resources with challenges, we – as learners and educators – can either change or reduce the challenges/stressors, or support regeneration. Stress development and feeling safe are complex mind–body processes, therefore it is generally important to involve the whole body in transformative learning. The crises of unsustainability – i.e., the main stressors – cannot be eliminated, but it is possible to minimize the stress they cause by:

- Providing zones for a temporary time-out, helping to distance oneself from a stressor triggering defense reactions.
- Building in periods where regeneration can take place, e.g., supporting relaxation.
- Facilitating an optimal point of learning where resources and challenges are balanced and e.g., goals are clear and can be met; thus feedback can be received and encouragement be given (Csikszentmihalyi, 2014).

Apart from buffering the challenges, it is necessary to support and activate learners' personal and external resources, by:

- Activating the social engagement system passively using neuroception (Porges, 2021, p. 83ff., 267 ff.) by giving cues of safety and mitigating defense reactions and thus supporting the human need for connecting and engaging socially. Indeed:
    - Experiencing trustful, supportive relationships conveyed through positive interaction, and specifically *via* facial expression, gestures, prosodic vocalization (e.g., melodic intonation), and keeping eye contact. These cues are transmitted *via* audio or visual input channels and used to assess whether the situation is safe enough.
    - Removing auditive (and visual) distractions. Disturbing background noises are additional stressors and can be eliminated or minimized. Furthermore, providing a quiet environment (ibid., p. 267) or calming music (e.g., with melodic intonation) helps calm down (ibid.).
- Activating the social engagement system actively, i.e., voluntarily including training on how to regulate emotions; broadening the window of tolerance, which is only possible when there are enough cues of safety. Learners can be supported by:
    - Specifically strengthening self-awareness and staying present as a key to emotional self-regulation and therewith coregulation: recognizing edge-emotions, or recognizing based on previous experiences that they are about to have a stress reaction that may not be adequate in the given situation. This can be supported by being able to read sensory-motoric signs (e.g., fast heartbeat, muscular tension) in oneself as well as in others and slowing down, as trained by mindfulness practices (Mälkki, 2019).
    - Providing orientation and a feeling of being connected with others: inform learners under stress that the symptoms they are experiencing are functional products of a neural control system that enable them to adapt and survive (Porges, 2017, p. 66ff.). Helping them understand that unpleasant emotions and their reactions are "normal" for a transformative learning process (Mezirow, 2012, p. 89) and that they are not alone.
    - Supporting slowing down and interrupting defense reactions through conscious breathing: slowing down and particularly prolonging exhaling, as well as fostering other physical exercise, can activate the ventral vagal circuit and help to become less reactive to threats (Porges, 2021, p. 83ff., 88ff., 118ff.).
- Supporting positive experiences and pleasant emotions, offering rewards connected with achievement, curiosity, and creativity by trying out new ways of being playful and joyful, involving the whole body. Educators and learners can also reframe the challenges as learning opportunities and possibilities of gaining rewards (Hanson, 2013, p. 31ff.). This also helps the ANS to come back to a window of tolerance more rapidly or to become less reactive to threats, meaning building up resilience (ibid., Siegel, 2020, p. 281ff.; Porges, 2021, p. 61 ff.).

For educators in higher education this intrapersonal perspective on stress regulation means encouraging individual learners as well as themselves (as mutual learners in coregulation) to face the situation of the "liminal spaces of not-knowing" and to embrace unpleasant (edge-)emotions and ongoing stress reactions as well as possible. While the effect of these different practices for creating safe enough spaces depend mainly on the individual learner's window of tolerance, learners are situated in concrete relationships and communicative situations with peer-learners and educators who influence their feelings of safety. The above reflections on the intrapersonal level already show that positive and supportive social embeddedness is crucial for transformative learning. This leads to the second level of creating safe enough spaces: the interpersonal level.

From Rational Discourse to Transformative Conversations – The Interpersonal Level of Safe Enough Spaces

Transformative learning does not come easily, quite on the contrary: "We find it very difficult to stand outside ourselves and see how some of our most deeply held values and beliefs lead us into distorted and constrained ways of being" (Brookfield, 2009, p. 133). To set the stage for this kind of learning experience

(especially) in higher education settings, Mezirow (e.g., 1991) advocates rational, reflective discourse. To reflect on our deeply held beliefs and potentially distorted ways of being and living learners are in need of "a community of rational discourse" (Brookfield, 2000, p. 132) where others "serve as critical mirrors" (ibid, p. 146). It is the coercive power of the better argument and a (tentative) consensus that frame Mezirow (1991, 2012) idea of transformative learning and the space where it can take place. The Habermasian notion of rational discourse with the conception of the ideal speech situation (Habermas, 1984, 1987) is located at the center of the theory (Eschenbacher, 2020).

Mezirow's notion of discourse (e.g., 1991; 2012) is an overly rational and cognitivist framework for dialogue, where somatic, affective, and unconscious dimensions take a back seat, if they are even in the car. The importance of these dimensions has been explained in the previous section. In the context of Mezirow's cognitivist framework, the question of how to create safe enough spaces in interpersonal relationships when there is no ideal speech situation remains unanswered. Yet recent experience shows that for climate communication in the context of sustainability crises, for example, rational arguments are crucial to make the problems clear to the public and to take away the argumentative basis of climate change deniers. However, in transformative learning processes, providing safe enough spaces for learners instead of rationally authoritative channels is a challenge. Can there even be safe enough spaces where we exchange arguments and transform our most deeply held assumptions and beliefs based on the force (!) of the better argument? What if exchanging arguments is helpful and suitable only within a discourse where one can argue from a place of safety and an embodied feeling of coherence (see section "Balancing Challenges and Resources – the Intrapersonal Level of Safe Enough Spaces")? What if learners experience a sense of loss and not only lose their self-understanding but also their place of safety? What if weighing evidence and exchanging arguments is not the only way forward on our road to learning transformatively? What if learners cannot make a choice rationally because they lack the necessary information, e.g., about what their lives will be like and what it will be like to *be them* in the aftermath of learning transformatively?

The very idea of undergoing a transformative experience reflects the aforementioned challenges: If an experience is both personally and epistemically transformative, as defined by Paul (2016), p. 17, it is by definition impossible to make a rational choice regarding whether to undergo the experience or not: "You can't navigate these decisions by stepping back, rationally evaluating your different subjective possibilities, and then choosing the act that maximizes the expected subjective values of your future lived experience. [. . .] Instead, you grope forward in deep subjective ignorance of what your future conscious life will be like" (ibid., p. 110). The experience of *not-knowing* (Eschenbacher and Fleming, 2020) and disorientation is key to transformative learning and very much connected to the liminal space. As is the experience of disorientation: "You know that undergoing the experience will change what it is like for you to live your life, and perhaps even change what it is like to *be* you, deeply and fundamentally" (Paul, 2016, p. 3). The basic unknowability of what one's subjective future will look like *after* the potentially transformative experience comes with an experience of incoherence *before* one enters the transformative learning process, triggered through a disorienting dilemma (Mezirow, 1991). This experience of not-knowing is not only an intrapersonal impression, but it is lived in the very concrete situation of communicating with others while searching for an adequate form of interpersonal dialogue about old and new meaning perspectives.

For this reason, transformative learning has both threatening and empowering dimensions (Mezirow, 1990, p. xiii), as it is not only a dangerous endeavor but also provides a theory of adult learning that fosters liberation and emancipation. From this perspective as well, then, transformative learning requires safe enough spaces; (1) on the intrapersonal level of embodied feelings of safety and stress regulation within the embodied window of tolerance and (2) on the interpersonal level of communication, where learners can engage in critical reflection in their attempt to find themselves and their way in the world again. Bernstein (2016), p. 121, argues that engaging in radical questioning "can be terrifying, dangerous, and liberating: *terrifying* because it means giving up the familiar banisters and guidelines that we normally accept in orienting our lives; *dangerous* because, when such questioning is truly radical, it seems to leave us with nothing; *liberating* because it frees us from illusions and enables us to confront our subjectivity and inwardness without illusions." This learning process, which could ultimately lead to liberation – also from societal conditions in a more socially critical sense (see section "Challenging and Transforming the Embedded Dysfunctional Tendencies in Higher Education From Within – the Systemic Level of Safe Enough Spaces") – requires safe enough spaces on the intrapersonal level (enabling learners to explore their own guiding assumptions), as well as at the interpersonal level (learners in the liminal space of not-knowing should not have to defend their assumptions against the coercive power of the better argument within a group of other learners).

The need for dialogue and interpersonal relationships that provide safe enough spaces for transformation is evident. "In the search for a different format, one that is less limited to rational means, we shift the focus from exchanging arguments within discourse to the concept of conversation" (Eschenbacher, 2020, p. 373), in our case the approach of "transformative conversation" (ibid.). This idea rests on Arcilla (1995) concept of *edifying conversation*, understanding the edifying dimension as central for transformative learning. Conversation, for Arcilla (1995), p. 105, is "the power to converse reasonably with others for the purpose of edifying oneself." It is the desire for self-knowledge gained in a conversing community that paves the way for our learning. Instead of seeing participants as critical mirrors, learners feel they are in need of each other, although in a different way.

Arcilla (ibid., p. 7) argues that learners "all need each other to help them rediscover a sense of self-direction which they must nevertheless claim for themselves." Free from the goal of identifying the better (i.e., more powerful) argument to convince the other or detect potential flaws, one creates space with others to struggle with one's own way of thinking and living. Not having to defend one's own frame of reference gives room for exploring

parts of the frame of reference that is currently in use. In that sense, learning from the other is less about being convinced through arguments. It is more about listening to the conversation, how others are seeking self-understanding and making meaning of what they are experiencing. In the context of unsustainability crises, this could be for example the insight that if we – as learners and educators – do not want to end up in a world of social and ecological collapse (Andreotti, 2021), we have to change our individual and collective ways of consuming, of relating to other human and non-human beings, and of doing politics. But how we exactly do this and what it means for our personal life, is up to our decisions (Vare and Scott, 2007), which in the best case should not just be contested through the force of the better argument (e.g., a low-carbon style of consumption), but explored in their richness of meaning regarding how we relate to these challenges and their potential solutions. We come to realize that there is no such thing as one way of looking at or being in the world. It is about "the invitation to disentangle oneself, for a time, from the urgencies of the here and now and to listen to the conversation in which human beings forever seek to understand themselves" (Oakeshott, 1989, p. 41). This listening to the conversation allows learners to seek self-understanding, to explore the parts of selfhood that are incoherent. It provides a space where exploring their own frames of references becomes a real possibility, not in order to defend it but to understand and eventually transform them. Arcilla (1995) suggests that the adult educator should join that conversation as a fellow conversationalist.

What do edifying conversations look like? In what ways do they differ from a Habermasian notion of discourse that is at the heart of transformative learning as we presently know it from Mezirow? This different type of conversation is "an exploratory, associative, open-ended, tolerant exchange of intimations free from the demand that it issue in conclusions binding on all" (Arcilla, 1995, p. 7). Without the demand for a consensus, even a tentative one, educators and learners create a space to accept the kind of invitation our edge-emotions offer us (Mälkki, 2019). In the context of sustainability, the invitation is to explore assumptions and formerly unproblematic notions of normality, or a sustainable world. Providing an opportunity for edifying conversations as well as staying within the window of tolerance can be identified as preconditions for the transformative learning process when facing crises of unsustainability. Only then can learners enter a process of critical (premise) reflection and radical questioning. They can face the *dangerous*, *terrifying,* and *liberating* dimensions of learning transformatively by edifying themselves, "in response to events that befall us" (Arcilla, 1995, p. 100). Through the process of edification, learners can face the incoherence they experience as disorienting when they face potentially transformative decisions and experiences. As an extension of transformative learning's notion of discourse, the concept of transformative conversation (Eschenbacher, 2020) proposes edification within interpersonal conversations as a means to create safe enough spaces besides the idea of exchanging arguments within rational discourse.

The danger of rational discourse as suggested by Mezirow is that the risk related to changing frames of references is not equally distributed. It solely rests on the learner who has something to learn or to reflect upon critically. As adult educators and learners, we need to be constantly aware that we need to put our own self-understandings at stake. This attitude can best be described as "fellow conversationalists engaged in questioning themselves before taking things for granted, in order to receive their being at a loss as a present" (Arcilla, 1995, p. 2). Only if learners have a chance to rediscover a sense of self-direction and self-efficacy facing the current crises, can they also engage in a rational discourse. When learners – or fellow conversationalists – have this sense of self-direction, they can exchange arguments from a place of safety and better engage in discourses that belong to the public sphere and that ask for a tentative consensus on how *we*, as a society, want to live our lives together.

This perspective on transformative conversations as a complement to rational discourses at the interpersonal level hints to the necessity of establishing a different culture to foster communication about sustainability issues in higher education in order to create safe enough spaces for learners. The following practices can help provide a safe enough space:

- Recognizing that the force of the better argument (i.e., changing lifestyles toward less resource intensive and low-carbon lifestyles) within a rational discourse can make learners feel unsafe and thereby block transformative learning processes and critical thinking;
- Negotiating (or even co-creating) what feels safe enough between educators and learners;
- Practicing open-ended conversations about transformed self-understandings to regain a sense of self-direction;
- Learning to embrace one's being-at-a-loss as an opportunity for transformation;
- Appreciating different ways of making meaning as opportunities to learn from and with fellow conversationalists;
- Seeking self-understanding through listening to and joining edifying and transformative conversations;
- Enabling critical (self-)reflection through edifying conversations;
- Providing a space where learners can disentangle themselves for some time from the urgencies of the here and now;
- Nurturing a culture of edifying conversations in order to gain back feelings of coherence, e.g., through stimulating questions or guidelines for communication within the groups of learners;

Although learning environments in higher education can offer protected contexts where these practices for safe enough spaces at the interpersonal level can be explored, experimented with, and broadened, they also represent organizational and systemic structures that bring along additional challenges, foreground power relations, and may trigger tensions. This is also true for the intrapersonal level. All kinds of intrapersonal and interpersonal practices supporting transformative learning are embedded within a greater system (e.g., academic) and informed by their barriers and conditions. For this reason, it is necessary to look at this organizational and systemic level as well.

Challenging and Transforming the Embedded Dysfunctional Tendencies in Higher Education From Within – The Systemic Level of Safe Enough Spaces

Creating and holding safe enough spaces for transformative learning in higher education for sustainable development (HESD) builds not only on neurobiological foundations on the intrapersonal level and on fostering transformative conversations on the interpersonal level. Safe enough spaces for transformative learning are also necessary on an organizational and systemic level. In the context of higher education systems learners have to deal with inherent tensions and experiences of disorientation. There is a strong call for higher education institutions (HEIs) to take into account sustainable development. Students are very willing to participate in this commitment and an increasing number of HEIs are trying to integrate sustainability at the institutional level. Nevertheless, their efforts are fragmented and rarely do they achieve integration at a systemic level, following a "whole-institution approach" (e.g., Sterling, 2021). This in turn leads to a disconnect between what these HEIs claim and the learning context they offer their students, generating tensions between what students are asked to learn and what they hope to learn, and to experiences of disorientation. From the perspective of strong sustainability, these tensions are caused by the systemic dysfunctionalities of the academic system itself, linked to the rise of neoliberalism in higher education, understood as a specific trend of academic capitalism and respective economization principles, such as competitiveness and the dominating focus on technocratic-rational knowledge approaches (Jessop, 2017). These tendencies contribute to making learning environments in higher education institutions ambivalent and – for some learners – rather unsafe places to develop in.

Economization principles shape dominant discourses in academia that are still driven by rational debates, facts, and logic; they disqualify more emotionally sensitive approaches as ideological (Kläy et al., 2015). In view of the current dominant capitalist market-oriented paradigm of education (Jessop, 2017; Biberhofer, 2019a), structural embedding of transformative learning and creating safe enough spaces is thus challenging. The capitalist market-oriented purpose of education is manifested for instance in dominant framings defining smart growth as the main purpose of higher education and positioning students as future workers with adequate higher skills as the means of reaching the goals of an entrepreneurial, growth-oriented agenda (Biberhofer, 2019b). For example, higher education institutions should act as service providers accountable in particular to the demands of the labor market (Patrick, 2013). Respective learning practices emphasize individualized learning environments and frame students as consumers of knowledge (Biberhofer, 2019b, p. 21). These broader dynamics in higher education institutions – or in the words of Brookfield (2012) the dominant capitalist ideologies – are influencing students and contradicting efforts to seriously address crises of unsustainability within higher education. They are based on the "distinctive academic reward systems of research quality assessment and promotion, improving reputation and status, incentivization through funding and resource flows, and meeting the requirements of educational quality standards and benchmarks" (Bessant et al., 2015, p. 427). Consequently, these neoliberal tendencies also challenge efforts to create safe enough spaces for deeper transformative learning journeys in the context of education for sustainable development (ESD) which integrates more critical perspectives, e.g., on degrowth (Getzin, 2019).

Although the debate about HESD has developed intensely in the last 30 years (e.g., Barth et al., 2016) and has contributed impressively to mainstreaming sustainability in higher education institutions, important issues have been neglected and have brought up the question whether ESD is "business as usual" after all (Huckle and Wals, 2015). The growth tendencies in the economic system function not only as a very stable ideology, hegemony, and paradigm that influences society in general; they are also mirrored in mainstream ESD (Getzin, 2019). As HESD operates within higher education in general, it is often embedded in the dominant, neoliberal paradigm mainly influenced by economic interests (Sterling, 2021). A good example of this is the debate on key competencies for sustainability. There has been a long discussion about which key competencies for sustainability are relevant in the context of higher education, and how they can be operationalized for using them as evaluation schemes for single courses or programs (Wiek et al., 2016). Although we acknowledge that defining and assessing key competencies for sustainability has been important for supporting concrete HESD implementation, focusing only on them does not take into account the areas of tension, ideologies, and dominant discourses in higher education institutions themselves.

Indeed, when competencies are considered in isolation from the tensions and ideologies that prevail in HESD, optimization tendencies dominate over relationality – i.e., the way we are embedded in and relate to our fellow conversationalists, our non-human living environment, our learning organizations, and democracies (Lange, 2004). These tendencies support an overemphasis on individual career potentials instead of collective actions to question and change societal structures or address the above-mentioned dysfunctionalities of academia. Simons and Masschelein (2006), p. 419, argue that the individualization of social problems (i.e., addressing sustainability problems as individual learning problems for which key competencies have to be identified) goes along with the paradigm of entrepreneurial self-government, where "people are not addressed (anymore) as social citizens (whose freedom or autonomy is guaranteed through social normality or who have a normalized relation to the self) but as entrepreneurial selves and entrepreneurs of the self." This thought is in line with the paradigm of ecological modernization within ESD (van Poeck et al., 2014), where social problems are reduced to learning problems that can be solved through adequate competency development.

The identification of systemic dysfunctionalism – for which the economization of higher education (Jessop, 2017) and the connected dominant focus on key competencies are two examples – is also crucial for overcoming predetermined, prescribed, and authoritative approaches toward education and providing safe enough institutional spaces for transformative learning. Therefore it is necessary to "reframe the raison d'être

of higher education institutions based on a profound critique of the capitalist growth paradigm and a debate on the purpose of education beyond creating economic assets" (Biberhofer, 2019a, p. 11). This means focusing on critical thinking as well as recognizing, addressing, and disrupting the embedded culture of neoliberal economization within higher education in general; and this has important implications for educators.

Messerschmidt (2013) argues based on critical theory that within academia educators should not just unfold a distantiated critique of societal developments because then they exclude themselves from the effects of these developments. Instead, they should – in the sense of an engaged critique – explore how they as academics and their higher education institutions are embedded in these processes, how they are influenced by them and how they affect their daily practices (ibid., p. 165ff.). "If teachers convey how they perceive themselves as actors under conditions of neoliberal educational governance, this can lead to a [useful] discussion about their own dealing with this embeddedness under the criticized conditions" (ibid., p. 166, translated by the authors). This practice is crucial for creating and holding safe enough spaces in HESD because it brings together the organizational and systemic level, the interpersonal level, and the intrapersonal level. Educators – in the sense of fellow conversationalists – can then become role models who show how it is possible to deal with these contradictions (including at a very personal level) and illustrate that all are caught in structures that contribute to neoliberal tendencies and fuel crises of unsustainability. For students this may open up important perspectives to reflect on tensions, frictions, and ambivalences they face within their own daily lives in higher education institutions, such as competitiveness or excluding the perspectives of the Global South. If educators make their own ambivalences transparent within such a form of engaged critique, they strongly contribute to creating (and holding) a safe enough space in which fruitful dialogues and transformative conversations can take place without excluding the emotions that students have when they learn about and for sustainability, with the wish of being able to act sustainably at the same time. Additionally, this can make the dysfunctionalities of higher education more visible for students as well as educators, and thereby reduce feelings of uncertainty and insecurity with regard to trying out new approaches to contributing to institutional change.

What can transformative learning contribute to this kind of engaged critique that challenges the systemic dysfunctionalism of neoliberal higher education institutions? How can transformative learning experiences allow students and educators to explore and find their way through these ambiguous and conflicting arenas? And what key points must HESD integrate in the context of transformative learning in order to deal with the above-mentioned tensions and conflicting arenas? Transformative learning could offer a way to address these tensions because it provides opportunities, on the one hand, to question individual frames of reference and their connectedness to and embeddedness in collective structures, and on the other to highlight the disjunction between them and the vision of sustainability. Brookfield (2012) argues for seeing frames of reference not only as influenced by biographical experiences but also by the capitalist ideologies many societies are based on. "Ideologies are manifest in language, social habits, and cultural forms. They legitimize certain political structures and educational practices so that these come to be accepted as representing the normal order of things" (Brookfield, 2000, p. 129). Mezirow (2012) asks learners to engage in critical self-reflection and critical discourse with others in order to uncover and change previous meaning perspectives into more adequate ones, as well as to be open to experimenting and trying out new ways of being. This can best be enabled if learners and educators work as "fellow conversationalists" who cooperatively explore the ways in which neoliberal tendencies influence their own meaning perspectives and how they relate to sustainability values. An example of such a neoliberal meaning perspective is the overemphasis on individual consumer responsibility. This means that students are individually responsible for solving the climate crisis by lowering their own carbon consumption, without having to reflect on, question, challenge, and contribute to changing the dominant growth paradigm, structures, and political discourses, even within the university. When educators start to engage in such critique (i.e., in recognizing that they themselves are also sometimes entangled in this narrative) and follow the ambition of being a fellow conversationalist (not striving for a consensus about controversial issues but encouraging students to self-reflectively explore ways of supporting each other in their edification) they can also open up space for communication that feels safe enough for students to engage in self-questioning.

This could serve as an ideal starting point for educators and learners to reflect upon how higher education institutions could be opened to a higher degree of participation, where all people involved can start to engage in challenging and disrupting the systemic dysfunctionalities. For Brookfield, transformative learning and ideology critique is closely connected to transformative action: "Without consequent social action, critical reflection is castigated as liberal dilettantism, a self-indulgent form of speculation that makes no real difference to anything" (Brookfield, 2000, p. 143). What would universities as learning environments look like if they were to resist neoliberal tendencies of economization and enable such transformative action? How can students and educators challenge hegemonic discourses within their own institutions and what forms of empowerment do they need in order to establish counter-hegemonic discourses? How could concrete structures be changed to help HEIs adopt a whole-institution approach?

Based on the notion of an engaged critique and the attempt to support learners in transformative actions, discussions can emerge on how to change dysfunctional discourses as well as hidden power structures within higher education institutions. Transformative actions could for example include initiating and/or strengthening advisory competence and institution-wide funding schemes supporting initiatives to address unsustainability crises within different study programs or research projects. The basic aim of these transformative actions should be the empowerment of all people involved. Empowerment is described as "a process in which participation is believed to lead to great perceived control in social and

political systems" (Christens et al., 2013, p. 171). Empowerment within higher education institutions implies that participation should not only be about being part of innovative initiatives but also about questioning power structures within the higher education system, and about gaining control over how the social and political systems that we are embedded in develop (Avelino, 2021). Such an understanding strengthens the collective dimensions of empowerment, avoiding an instrumental (neoliberal) logic of simply changing some elements in the structure (such as focusing only on individual competencies), and enabling the creation of safe enough spaces as deliberate *transformative* spaces as a starting point for institutionalizing change (Pereira et al., 2020). Pereira et al. suggest that these "transformative spaces are designed to generate ideas that challenge the *status quo* and the dominant systems, and hence change the systems conditions that created the problems in the first place" (ibid., p. 174). Transformative spaces are communicative spaces for knowledge generation where people strive for "designing the engagement and dialogues in ways that involve and consider emotions and allowing for empathy" (ibid., p. 173) in order to create a viable culture of finding solutions to sustainability problems that accepts contestation and negotiation about different strategies, without being trapped in the search for consensus (ibid., p. 172).

We build on Pereira et al.'s (ibid.) definition of transformative spaces to suggest recommendations for creating (staging) and maintaining safe enough spaces for transformative learning on the organizational and systemic level. This demands that learners and educators start with a different mindset and actions than those expected of learning and teaching in the neoliberal HE context. In particular, for educators it means fostering safe enough spaces through practices that allow learners (and themselves) to:

- Recognize the unsustainable effects of neoliberal tendencies and the dynamics of economization;
- Accept that these dysfunctionalities affect all actors involved in higher education institutions in subtle ways;
- Start to question dominant and hegemonic discourses as well as power structures together, as fellow conversationalists;
- Strengthen engaged critique by opening up self-reflective explorations of how the more systemic dynamics are affecting individual and collective meaning perspectives (in the sense of ideologies);
- Open up space for participation and empowerment designed to change prevalent discourses and structures, to gain back control of the social system of the educational institution;
- Cultivate transformative spaces as starting points for institutional change for sustainable development.

We are aware that higher education institutions are a privileged and protected space for experimenting with respective forms of institutional change. Nevertheless, cultivating and creating such transformative, safe enough spaces where systemic

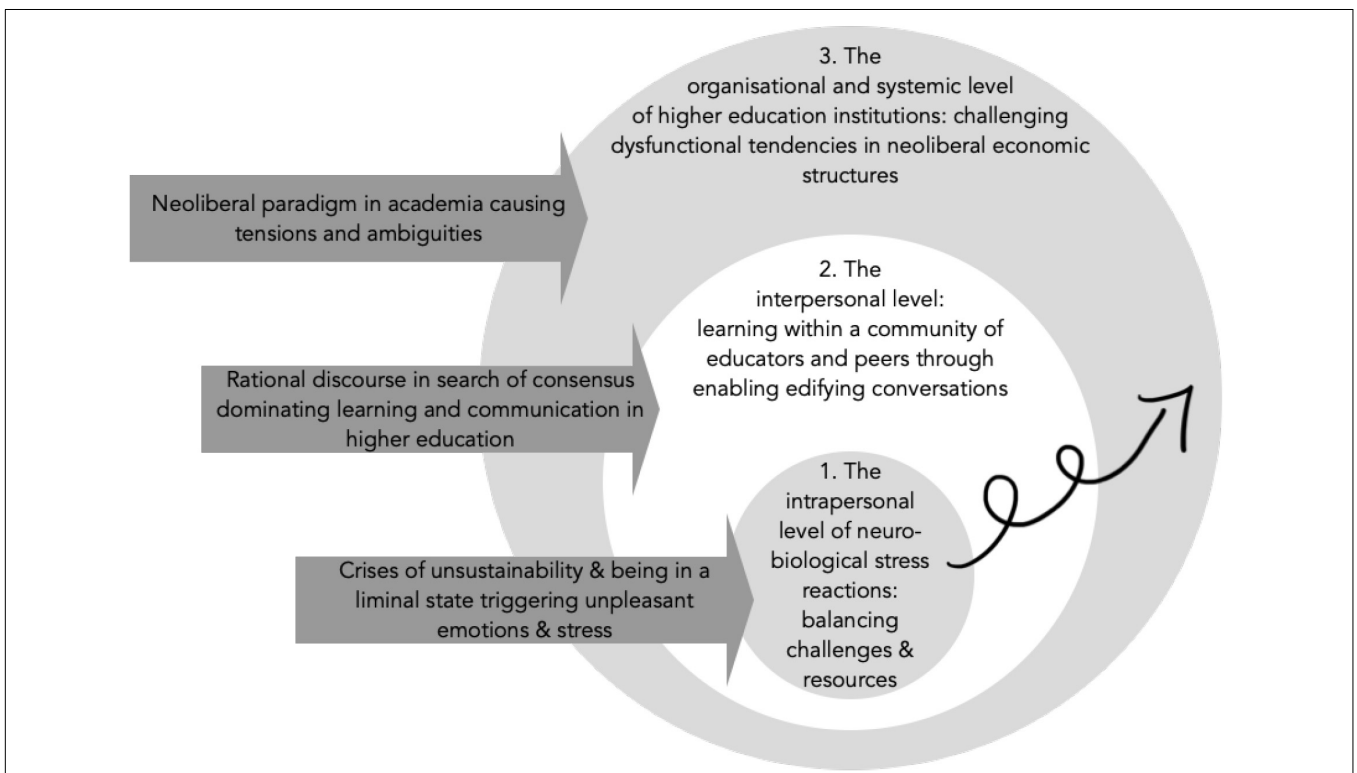

FIGURE 3 | Three levels of safe enough spaces for navigating the transformative learning journey, including challenges to be tackled.

change can be initiated requires high sensitivity and skills among educators, as well as their willingness to guide such processes and serve as a role model. The transformation of higher education institutions itself is therefore a challenge and will face a number of hurdles and obstacles.

The complexity of challenging and transforming the dysfunctional systemic and institutional level of higher education goes hand in hand with the other two levels of safe enough spaces in HESD discussed earlier in this article. Challenges need to be faced at all levels: not only at the organizational and systemic level of higher education institutions, but also at the intrapersonal and the interpersonal level (see **Figure 3**). While the crises of unsustainability and being in a liminal state evoke unpleasant emotions, cause stress, and challenge the process of balancing stress factors and resources on the intrapersonal level, the dominance of rational discourse that rules over learning

TABLE 1 | Recommended practices for creating and maintaining safe enough spaces on all three levels.

1. Intrapersonal: Neurobiological/stress reactions (see section "Balancing Challenges and Resources – the Intrapersonal Level of Safe Enough Spaces")	**2. Interpersonal: Edifying conversations (see section "From Rational Discourse to Transformative Conversations – the Interpersonal Level of Safe Enough Spaces")**	**3. Organizational/Systemic: Higher education institutions (see section "Challenging and Transforming the Embedded Dysfunctional Tendencies in Higher Education From Within – the Systemic Level of Safe Enough Spaces")**
What are the main challenges?		
Stressors: crises of unsustainability and being in a liminal state, in particular: - uncertainty, not-knowing, complexity, multiple losses. . . - unpleasant emotions and stress	Rational discourse in search of consensus dominating learning and communication in higher education; liminal state of not-knowing	Neoliberal paradigm in academia, causing tensions and ambiguities
What does "space" mean in each case?		
An individual, intrapersonal, physiological state where someone feels bodily safe – for a certain time – and where growth, learning, creativity, regeneration, and access to internal and external resources are possible	The interpersonal space of dialogue where learners can disentangle themselves for some time from the urgencies of the here and now, and experience edifying conversations	Higher education institutions as open learning environments, where their respective discourses can be challenged and changed
What constitutes a safe enough space?		
Feeling bodily safe, as a physiological state of the ANS: - ventral vagus circuit of ANS is in charge, allowing one to cope with challenges in the "window of tolerance" - social engagement system is activated and enables us to connect with others, - not being in defense mode Having (subjectively) sufficient resources to cope with the challenges	Negotiating (or even co-creating) what feels safe enough between educators and learners Edifying conversations that enable participants to regain a sense of self-direction and self-coherence while facing a feeling of loss and not-knowing	Pedagogical approaches that address the dysfunctionalities in the system and use the educational institution as a starting point for change
What practices can create and maintain safe enough spaces?		
Balancing challenges and resources Change/reduce challenges: - Providing temporary zones for "time-out" from stress(ors) - Building in periods for regeneration - Facilitating an optimal point of learning where resources and challenges are balanced Activate/provide resources: Activating the social engagement system passively through - Trustful, supporting relation- ships conveyed *via* cues of safety - A quiet environment, removing distractions Activating the social engagement system actively by - Strengthening self-awareness, staying present and self-/co-regulation - Providing orientation and a feeling of not being alone - Slowing down and interrupting defense reactions Supporting positive experiences, pleasant emotions connected with achievement, creativity, reward and joyfulness. Reframing challenges into opportunities Overall: involving the whole mind–body in transformative learning	From rational discourse to transformative conversations - Recognizing that the force of the better argument within a rational discourse can make learners feel unsafe and block transformative learning processes - Negotiating (or even co-creating) what feels safe enough between educators and learners - Practicing open-ended conver-sations about transformed self-understandings to regain a sense of self-direction - Learning to embrace one's being at a loss as an opportunity for transformation - Appreciating different ways of mak-ing meaning (that do not necessarily have to converge in consensus) as opportunities to learn from and with fellow conversationalists - Seeking self-understanding through listening and joining edifying and transformative conversations - Enabling critical (self-)reflection through edifying conversations - Providing a space where learners can disentangle themselves for some time from the urgencies of the here and now - Nurturing a culture for edifying conversations in order to gain back feelings of coherence	Challenging and transforming the embedded dysfunctional tendencies in higher education - Recognizing the neoliberal tendencies and dynamics of economization and their unsustainable effects - Accepting that these dysfunctionalities affect all actors involved in higher education institutions in subtle ways - Starting to question hegemonic discourses as well as power structures together, as fellow conversationalists - Strengthening engaged critique by opening up self-reflective explorations into how systemic dynamics are affect-ing individual and collective meaning perspectives (in the sense of ideologies) - Opening up space for participation and empowerment designed to change prevalent discourses and structures, in order to increase control over the social system within the educational institution - Cultivating transformative spaces as starting points for institutional change

and communication challenges the emergence of edifying conversations on the interpersonal level. However, it is the neoliberal paradigm in academia that constitutes the base layer and fundamental limitation for all of the three levels, causing tensions and ambiguities that cannot be addressed by individuals on their own. All of the three levels are intertwined and thus efforts to create and maintain safe enough spaces need to tackle all levels in their interconnectedness.

RECOMMENDATIONS FOR CREATING AND MAINTAINING SAFE ENOUGH SPACES

The sections above have investigated the question how to create and maintain safe enough spaces in view of crises of unsustainability in order to embark on intertwined individual and collective transformative learning journeys on three complementary levels: (1) balancing resources with the challenges in order to feel bodily safe enough on the intrapersonal level, (2) enabling transformative (edifying) conversations in addition to rational discourse on the interpersonal level, and (3) challenging the dysfunctionalism of the academic system at the organizational and systemic level. The findings are summarized below in the form of recommendations for practice (**Table 1**) and discussed with a particular focus on the educator.

The practices on the different levels are intertwined and reinforce each other. For example, the social engagement system (ventral vagus circuit) can be activated through open-ended edifying conversations, and feeling connected and not alone as a member of an HEI. Vice versa, if someone experiences a trustful, supporting relationship and their ANS is mitigated by the ventral vagus circuit, edifying conversations can take place and tensions and dysfunctionalities in an HEI can be addressed constructively. Using edifying conversation on the interpersonal level can support questioning dominant discourses on the organizational and systemic level while staying in the window of tolerance of the ANS.

Taking into account the intrapersonal, interpersonal, and organizational and systemic levels, safe enough spaces are thus framed as temporal, physical, mental, individual, and communal "islands" within a situation that is not safe *per se* and that is exposed to multifaceted crises of unsustainability. These islands allow both learners and educators to distance themselves temporarily from the mentioned stressors on all three levels in order to experience regeneration in a mutual learning setting. This allows them to embrace unpleasant (edge-)emotions and stress as a starting point for transformation while navigating through the crucial phase of liminality within transformative learning. If facilitated well at all three levels, a transformative learning process will support the mutual learners as well as their higher education institution on their intertwined individual-collective journey by enabling them to:

1. Recognize, accept, and be with "what is": the unpleasant (edge)-emotions, or stress reactions caused by incoherence or dysfunctionalities connected with tensions and ambiguities.
2. Reframe these (temporarily) as invitations for transformative learning rather than as (life-) threats calling for defense reactions.
3. Embrace and balance them voluntarily as well as possible, rather than polarize them or act (involuntarily, automatically) with defense reactions.
4. Explore multiperspectivity within themselves and within a group, not necessarily striving for consensus, rather for better and deeper understanding and new ways of meaning-making within oneself, in a group of learners, and in the educational system.
5. Experiment with new forms of being, thinking, feeling, and acting in a group with mutual support and connectedness, without being directly exposed to inadequate assessment procedures and forced into defense reactions.

To sum up, learners and educators can regain the control needed for changing their meaning perspectives intrapersonally, interpersonally, or systemically. All three levels support self-coherence, self-efficacy, self-directedness, and critical (self-)reflection and therewith emancipation – which is key to transformative learning theory (e.g., Mezirow, 1991, 2012). At the same time the three levels offer the possibility of acknowledging our imperative for being (inter)connected with other humans (Porges, 2017) but also beyond, being embedded in complex social–ecological–technological systems. And we address the importance of integrated mind–body transformative

TABLE 2 | Responsibilities for creating and maintaining safe enough spaces for transformative learning.

Who	Educators	Learners and peer-learners	Institutions
Respon-sibilities	- Ensure that they "feel safe enough" themselves - As coaches/facilitators of transformative learning: be with "what is" and take responsibility for the overall learning process - Negotiate (or even co-create) what feels safe enough between educators and learners - Integrate and lead practices for establishing and maintaining safe enough spaces in an educational setting that is dysfunctional - Encourage learners to co-create safe enough spaces	- Ensure that they feel "safe enough" themselves - Take responsibility for their own learning process Participate in the practices - Engage in negotiating and co-creating safe enough spaces (e.g., by avoiding trying to position themselves as having the better argument) - Engage supportively with peer-learners	- Acknowledge the necessity of, allow and provide resources for safe enough spaces/"islands" - Be open to changing discourses and practices

learning, taking (edge)-emotions seriously, and fostering positive experiences and emotions.

We would like to stress here that educators, learners, and their educational institutions need to engage together in creating and maintaining safe enough spaces for transformative learning journeys to face the multifaceted crises of unsustainability. **Table 2** gives an overview of who is responsible for what practice at each of the three levels.

To be able to provide and maintain safe enough spaces and at the same time to feel safe enough themselves, all involved parties, and particularly educators, need to develop competences according to their responsibilities. They must also be aware of their limitations. It is particularly important for educators to develop their competences for facilitating transformative learning, including coaching skills (Förster et al., 2019), and to balance this with their other roles, e.g., as evaluators. In particular, it is crucial that:

1. Educators do not intentionally trigger a crisis or a massive disorientation to force learners into a transformative learning process. Rather, the goal is to support people for whom a disorientation or a crisis has already occurred (Mälkki and Green, 2014, p. 20).
2. Educators are able "to be (present) with" the learner's state of not-knowing, not judging but accepting it. This includes understanding that learners must face disorientation, a feeling of loss or incoherence, or tensions and stress reactions. Educators must respect and trust the self-efficacy and self-directedness of the learners and at the same assist their process. Therefore educators must be careful in applying "the being with," e.g., by listening with active intervention and by engaging the learner in edifying conversations.
3. Educators strive on the one hand to feel safe enough themselves to be able to support others' transformative learning journeys; on the other, it is crucial that they be supported by their institution.

The basis for being able "to be with" the learner is "to be with" oneself, which is a mind–body state. This requires cultivating and practicing self-awareness and presence to oneself, as well as self-regulation and self-reflection. In this manner, educators are able to (a) better recognize whether learners are in a transformative learning process, and (b) perceive their emotional and stress reactions. This includes recognizing one's own reactions in contact with learners in the liminal state, as well as one's own stress. Indeed, this influences the important ability to co-regulate the ANS toward feeling bodily safe enough.

At the same time, we would like to unburden educators and make a plea for humbleness in facilitating transformative learning. Here are some points to consider:

- What is possible for each individual learner is not in the educator's sole and mighty hands.
- Each learner may be in a different state of transformative learning and even if there are general models of the steps in a transformation process, in reality such processes are very personal, unique, and context-bound (Förster et al., 2019).
- Educators intervene in complex systems and effects are not linear.
- Educators can provide a space over time to strengthen individuals' self-efficacy and resources, and alleviate stressors, but whether it really functions is not in their hands.
- Supporting transformative learning in the current educational system is a transformative learning journey in itself and the educator is wearing multiple hats, e.g., as an evaluator, facilitator, or mutual learner, which may cause stressful tensions.

Last but not least: our plea for safe enough spaces is not a plea to abandon reason-driven and deliberative debates in higher education institutions. On the contrary, critical thinking and accessing emotions belong together. For critical thinking we humans need the ability to regulate emotions and stress. This requires feeling safe enough and knowing how to return to our window of tolerance or enlarge its width when faced by unpleasant emotions or stress-reactions. Therefore, emotional education is an important complement to rational education, also within HESD.

CONCLUSION

The multifaceted crises of unsustainability in general and the climate crisis in particular trigger different forms of stress and unpleasant emotions among learners in higher education. There is a need for other pedagogical approaches that enable learners to cope with these emotions constructively so that they can contribute to critical thinking and transformation. Based on the theory of transformative learning we have suggested creating and maintaining safe enough spaces in which learners are encouraged to change their meaning perspectives. We have elaborated on what these safe enough spaces can look like (1) on an intrapersonal level of feeling bodily safe, (2) an on interpersonal level of engaging in edifying conversations besides rational debates, and (3) on a more organizational and systemic level, where neoliberal ideologies can be addressed and challenged. These different levels do not follow a sequential order but are deeply intertwined and influence each other. Based on these elaborations, this manuscript also offers recommendations regarding how learners, educators, and higher education institutions can create and maintain safe enough spaces.

For higher education, especially HESD, creating and maintaining safe enough spaces holds huge potential, as it offers the possibility of addressing the students' emotions and empowering them to help change their universities and – at a larger scale – the socio-economic system we live in. This does not mean eliminating rational considerations on problems of unsustainability. On the contrary: Transformative learning theory emphasizes that the aim of any educational process should be a more reflexive, inclusive, and rational way of seeing the world and being in the world. However, emotions can also hinder critical thinking and block transformative learning, leading to denial or cognitive dissonance (Mälkki, 2019). For this

reason we acknowledge the critical importance of emotions in transformative learning and the need for safe enough spaces to deal with stress. Opening up safe enough spaces within higher education institutions would therefore also mean to acknowledge the importance of stress, emotional responses, and embodied reactions to wicked problems such as climate change. These emotions are usually ignored in the logic of rational dominance in higher education, and addressed only to a limited extent in HESD. These safe enough spaces should allow all learners and educators to find themselves and gain new stability in relations, as well as develop a culture of safety to cope with stressful situations. As a result they can reenter the (more public) discourses about sustainability, elaborate solutions more bravely, and engage in the transformation processes of sustainability.

Nevertheless, the ambition to create and maintain safe enough spaces has some limitations. Firstly, this perspective may be mainly useful for learners in countries of the Global North. Learners in countries of the Global South may have different needs that should be considered. On the one hand they are least responsible for global dynamics of unsustainability, but are often hit by the most serious consequences, which brings the issue of global environmental justice to the forefront of debates. On the other hand, some of the educational formats in countries of the Global South might well be more advanced than current Global North formats in supporting sustainable development. Secondly, it is necessary to repeat that educators are not therapists. They should continuously and carefully consider the thin line between emotional sensitiveness in pedagogical approaches for transformative learning and therapeutic intervention. As they normally have neither the mandate nor the training for therapeutic intervention, they should cautiously observe learners' reactions and signs that they are leaving their "windows of tolerance," and avoid digging deeper if learners show signs of fight-or-flight reactions such as resistance to questions, exhaustion, or even panic. Additionally they need to recognize if and when it is necessary to recommend therapeutic support. Thirdly, the ambition to create and maintain safe enough spaces for transformative learning involves providing further training and supportive institutional conditions for educators so that they can work on their personal development as professionals. This task is embedded in an academic system where research and citation rates are privileged quality developments in higher education. Therefore, it is also necessary to change the structure of incentives in the sense of "transformative science" (Schneidewind et al., 2016).

Our analysis and suggestions are mainly derived from different theoretical perspectives. We strongly recommend that empirical research be conducted to further understand how to create safe enough spaces in education and society and how to concretely implement the above-mentioned practices. Empirical studies could include group discussions as well as biographical interviews with learners, educators, and leaders within higher education institutions, to deepen our insights about how to create and maintain safe enough spaces for transformative learning in light of the multiple crises of unsustainability.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

RF contributed to the section "Balancing Challenges and Resources – The Intrapersonal Level of Safe Enough Spaces" and "Recommendations for Creating and Maintaining Safe Enough Spaces". SE contributed to the section "From Rational Discourse to Transformative Conversations – The Interpersonal level of Safe Enough Spaces". PB, SG, and MS-B contributed to the section "Challenging and Transforming the Embedded Dysfunctional Tendencies in Higher Education From Within – The Systemic Level of Safe Enough Spaces". MS-B was responsible for the introduction and the conclusion as well as for the coherence of the whole article. RF and SG designed the figures. All authors developed the idea of this publication and proofed the final manuscript.

FUNDING

We acknowledge support from the Open Access Publication Fund of Freie Universität Berlin and from the Swiss Academic Society for Environmental Research and Ecology (saguf).

ACKNOWLEDGMENTS

We thank Anne B. Zimmermann for her fruitful comments on earlier versions of the manuscript.

REFERENCES

Andreotti, V. D. O. (2021). The task of education as we confront the potential for social and ecological collapse. *Ethics Educ.* 16, 143–158. doi: 10.1080/17449642.2021.1896632

Arcilla, R. V. (1995). *For the Love of Perfection: Richard Rorty and Liberal Education*. New York, NY: Routledge.

Avelino, F. (2021). Theories of power and social change. power contestations and their implications for research on social change and innovation. *J. Political Power* 14, 425–448. doi: 10.1080/2158379X.2021.1875307

Barth, M., Michelsen, G., Rieckmann, M., and Thomas, I. (2016). *Routledge Handbook of Higher Education for Sustainable Development*. New York, NY: Routledge. doi: 10.4324/9781315852249

Bernstein, R. J. (2016). *Ironic Life*. Cambridge: Polity Press.

Bessant, S. E. F., Robinson, Z. P., and Ormerod, R. M. (2015). Neoliberalism, new public management and the sustainable development agenda of higher education: history, contradictions and synergies.

Environ. Educ. Res. 21, 417–432. doi: 10.1080/13504622.2014.993933

Biberhofer, P. (2019a). *Transformative Learning at the Science-society Interface in Higher Education for Sustainable Development*. dissertation thesis, Vienna: University of Economics and Business.

Biberhofer, P. (2019b). *The Economization of Education and the Implications of the Quasi-commodification of Knowledge on Higher Education for Sustainable Development*. Vienna: WU Vienna University of Economics and Business. SRE - Discussion Papers, 2019/01.

Britzman, D. P. (1998). *Lost Subjects, Contested Objects: Toward a Psychoanalytic Inquiry of Learning.* Albany, NY: State University of New York Press.

Brookfield, S. D. (1990). "Using critical incidents to explore learners' assumptions," in *Fostering Critical Reflection in Adulthood: A Guide to Transformative and Emancipatory Learning*, ed. J. Mezirow (San Francisco, CA: Jossey-Bass), 177–193.

Brookfield, S. D. (2000). "Transformative learning as ideology critique," in *Learning as Transformation: Critical Perspectives on a Theory in Progress*, ed. J. Mezirow (San Francisco, CA: Jossey-Bass), 125–148.

Brookfield, S. D. (2009). "Engaging critical reflection in corporate America," in *Transformative Learning in Practice. Insights from Community, Workplace, and Higher Education*, eds J. Mezirow and E. W. Taylor (San Francisco, CA: Jossey-Bass), 125–135.

Brookfield, S. D. (2012). "Critical theory and transformative learning," in *The Handbook of Transformative Learning. Theory, Research, and Practice*, eds E. W. Taylor and P. Cranton (San Francisco, CA: Jossey-Bass), 131–146.

Bryan, A. (2020). Affective pedagogies: foregrounding emotions in climate change education. *Policy Practice. Dev. Educ. Rev.* 30, 8–30.

Christens, B. D., Collura, J. J., and Tahir, F. (2013). Critical hopefulness: a person-centered analysis of the intersection of cognitive and emotional empowerment. *Am. J. Community Psychol.* 52, 170–184. doi: 10.1007/s10464-013-9586-2

Csikszentmihalyi, M. (2014). *Applications of Flow in Human Development and Education*. Dordrecht: Springer. doi: 10.1007/978-94-017-9094-9

Cunsolo, A., Harper, S. L., Minor, K., Hayes, K., Williams, K. G., and Howard, C. (2020). Ecological grief and anxiety: the start of a healthy response to climate change? *Lancet Plan. Health* 4, 261–263. doi: 10.1016/S2542-5196(20)30144-3

Eschenbacher, S. (2020). Transformative learning theory and migration: having transformative and edifying conversations. *Eur. J. Res. Educ. Learn. Adults* 11, 367–381. doi: 10.3384/2000-7426.ojs1678

Eschenbacher, S., and Fleming, T. (2020). Transformative dimensions of lifelong learning: Mezirow, Rorty and Covid-19. *Int. Rev. Educ. J. Lifelong Learn.* 66, 657–672. doi: 10.1007/s11159-020-09859-6

Förster, R., Zimmermann, A. B., and Mader, C. (2019). Transformative teaching in higher education for sustainable development: facing the challenges. *GAIA - Ecol. Perspect. Sci. Soc.* 28, 324–326. doi: 10.14512/gaia.28.3.18

Getzin, S. (2019). *Shifting Education Towards Sustainability. How Degrowth can Transform Education for Sustainable Development*. dissertation thesis, Zurich: University of Zurich, Faculty of Arts and Social Sciences.

Habermas, J. (1984). *The Theory of Communicative Action. Reason and the Rationalization of Society*. Boston: Beacon Press.

Habermas, J. (1987). *The Theory of Communicative Action. Lifeworld and System. A Critique of Functionalist Reason*. Boston: Beacon Press.

Hanson, R. (2013). *Hardwiring Happiness: The New Brain Science of Contentment, Calm, and Confidence*. New York, NY: Harmony Books / Penguin Random House.

Huckle, J., and Wals, A. E. J. (2015). The UN decade of education for sustainable development: business as usual in the end. *Environ. Educ. Res.* 21, 491–505. doi: 10.1080/13504622.2015.1011084

Jessop, B. (2017). Varieties of academic capitalism and entrepreneurial universities. on past research and three thought experiments. *High. Educ.* 73, 853–870. doi: 10.1007/s10734-017-0120-6

Kläy, A., Zimmermann, A. B., and Schneider, F. (2015). Rethinking science for sustainable development: reflexive interaction for a paradigm transformation. *Futures* 65, 72–85. doi: 10.1016/j.futures.2014.10.012

Land, R., Rattray, J., and Vivian, P. (2014). Learning in the liminal space: a semiotic approach to threshold concepts. *Higher Educ.* 67, 199–217. doi: 10.1007/s10734-013-9705-x

Lange, E. A. (2004). Transformative and restorative learning: a vital dialectic for sustainable societies. *Adult Educ. Quarterly* 54, 121–139. doi: 10.1177/0741713603260276

Lenton, T. M., Rockström, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W., et al. (2019). Climate tipping points — too risky to bet against. *Nature* 575, 592–595. doi: 10.1038/d41586-019-03595-0

Mälkki, K. (2019). "Coming to grips with edge-emotions: the gateway to critical reflection and transformative learning," in *European Perspectives on Transformation Theory*, eds T. Fleming, A. Kokkos, and F. Finnegan (Cham: Springer International Publishing), 59–73. doi: 10.1007/978-3-030-19159-7_5

Mälkki, K., and Green, L. (2014). Navigational aids. *J. Transformative Educ.* 12, 5–24. doi: 10.1177/1541344614541171

Messerschmidt, A. (2013). "Bildungspolitische normalisierungen – pädagogische mittäterschaften und bewegungen in widersprüchlichkeiten," in *Normativität und Normative (in) der Pädagogik*, eds T. Fuchs, M. Jehle, and S. Krause (Würzburg: Königshausen & Neumann).

Mezirow, J. (1990). "Preface," in *Fostering Critical Reflection in Adulthood. A Guide to Transformative and Emancipatory Learning*, ed. J. Mezirow (San Francisco, CA: Jossey-Bass).

Mezirow, J. (1991). *Transformative Dimensions of Adult Learning*. San Francisco, CA: Jossey-Bass.

Mezirow, J. (2012). "Learning to think like an adult: core concepts of transformation theory," in *The Handbook of Transformative Learning: Theory, Research, and Practice*, eds E. W. Taylor and P. Cranton (San Francisco, CA: Jossey-Bass), 73–95.

Mezirow, J., and Taylor, E. W. (2009). "Preface," in *Transformative Learning in Practice: Insights from Community, Workplace, and Higher Education*, eds J. Mezirow and E. W. Taylor (San Francisco, CA: Jossey-Bass).

Oakeshott, M. (1989). "A place of learning," in *The Voice of Liberal Learning: Michael Oakeshott on Education*, ed. T. Fuller (New Haven: Yale University Press), 17–42.

Ogden, P., Minton, K., and Pain, C. (2006). *Trauma and the Body. A Sensorimotor Approach to Psychotherapy*. New York, NY: Norton.

Ojala, M. (2016). Facing anxiety in climate change education: from therapeutic practice to hopeful transgressive learning. *Can. J. Environ. Educ. (CJEE)* 21, 41–56.

Ojala, M., Cunsolo, A., Ogunbode, C. A., and Middleton, J. (2021). Anxiety, worry, and grief in a time of environmental and climate crisis: a narrative review. *Annu. Rev. Environ. Resour.* 46:1. doi: 10.1146/annurev-environ-012220-022716

Patrick, F. (2013). Neoliberalism, the knowledge economy, and the learner: challenging the inevitability of the commodified self as an outcome of education. *ISRN Educ.* 2013:108705. doi: 10.1155/2013/108705

Paul, L. A. (2016). *Transformative Experience*. Oxford: Oxford University Press.

Pereira, L., Frantzeskaki, N., Hebinck, A., Charli-Joseph, L., Drimie, S., Dyer, M., et al. (2020). Transformative spaces in the making: key lessons from nine cases in the Global South. *Sustain Sci.* 15, 161–178. doi: 10.1007/s11625-019-00749-x

Porges, S. W. (2017). *The Pocket Guide to the Polyvagal Theory: The Transformative Power of Feeling Safe*. New York, NY: WW Norton & Co.

Porges, S. W. (2021). "Polyvagal theory a primer," in *Polyvagal Safety. Attachment, Communication. Self-regulation*, ed. S. W. Porges (New York, NY: WW Norton & Co), 253–270.

Rockström, J., Steffen, W., Noone, K., Persson, A., Chapin, F. S., Lambin, E. F., et al. (2009). A safe operating space for humanity. *Nature* 461, 472–475. doi: 10.1038/461472a

Rothberg, M. (2019). *The Implicated Subject: Beyond Victims and Perpetrators.* Stanford, CA: Stanford University Press.

Schneidewind, U., Singer-Brodowski, M., Augenstein, K., and Stelzer, F. (2016). *Pledge for a Transformative Science - A Conceptual Framework*. Wuppertal: Wuppertal Institute for Climate, Environment and Energy.

Semmer, N. K., and Zapf, D. (2018). "Theorien der stressentstehung und -bewältigung," in *Handbuch Stressregulation und Sport*, eds R. Fuchs and M. Gerber (Berlin: Springer), 34–50. doi: 10.1007/978-3-662-49322-9_1

Siegel, D. J. (2020). *The Developing Mind. How Relationships and the Brain Interact to Shape who we are*. New York, NY: Guilford Publications.

Simons, M., and Masschelein, J. (2006). The learning society and governmentality: an introduction. *Educ. Philos. Theory* 38, 417–430.

Stein, S., Andreotti, V., Suša, R., Ahenakew, C., and Čajková, T. (2020). From "education for sustainable development" to "education for the end of the world as we know it". *Educ. Philos. Theory* 54, 274–287. doi: 10.1080/00131857.2020.1835646

Sterling, S. (2021). *Educating for the Future we Want" Opening Essay for GTI Forum "The Pedagogy of Transition," Great Transition Initiative (February 2021)*. Available online at: https://greattransition.org/gti-forum/pedagogy-transition-sterling (accessed September 29, 2021).

van Poeck, K., Vandenabeele, J., and Bruyninckx, H. (2014). Taking stock of the UN decade of education for sustainable development: the policy-making process in Flanders. *Environ. Educ. Res.* 20, 695–717. doi: 10.1080/13504622.2013.836622

Vare, P., and Scott, W. (2007). Learning for a change. *J. Educ. Sustainable* 1, 191–198. doi: 10.1177/097340820700100209

Verlie, B. (2019). Bearing worlds: learning to live-with climate change. *Environ. Educ. Res.* 5, 751–766. doi: 10.1080/13504622.2019.1637823

Wiek, A., Bernstein, M. J., Foley, R. W., Cohen, M., Forrest, N., Kuzdas, C., et al. (2016). "Operationalising competencies in higher education for austainable development," in *Routledge Handbook of Higher Education for Sustainable Development*, eds M. Barth, G. Michelsen, M. Rieckmann, and I. Thomas (London: Routledge), 241–260.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.