

Learning for life and sustainability: a theory synthesis to sustainability mindset development in higher education institutions

International
Journal of
Sustainability in
Higher Education

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Received 11 December 2025

Revised 9 March 2026

2 April 2026

20 May 2026

11 June 2026

Accepted 13 July 2026

Abstract

Purpose – This paper aims to explore the synthesis of transformative learning (TL) with curricular nuances and autonomy-supportive learning to develop sustainability mindsets in higher education institutions (HEIs), particularly in teacher education programs, in support of Agenda2030. By situating this exploration within a lifelong learning (LLL) perspective, the paper highlights the importance of fostering sustainability mindsets across the lifespan.

Design/methodology/approach – Jaakkola's (2020) theory synthesis design was implemented. During the synthesis, similarities in approaches and learning strategies for sustainability were identified and integrated into a comprehensive framework, indicating how these theories/concepts interact.

Findings – Evident links exist among these theories/concepts for sustainability mindset development. By highlighting their synergies, the paper proposes a conceptual framework for sustainability mindset development grounded in LLL that prepares individuals of all ages to address global challenges effectively. For effective sustainability mindset development, a comprehensive approach that implements the discussed elements is recommended: embed relevant theories into curricula to provide a strong theoretical foundation, provide ongoing, curricula-aligned professional development and research and evaluation and apply TL approaches, autonomy-supportive teaching and collaborative reflective methods in HEI, specifically in teacher education.

Research limitations/implications – Even though some clear links exist between these theories/concepts of sustainability mindset development, their practical implementation remains vague. While the article broadly discusses different elements involved in fostering sustainability mindsets, this study advocates for HEIs, specifically teacher education, as a starting hub for sustainability mindset development in the LLL cycle.

Practical implications – The synthesis of different theories/concepts offers a new perspective on how sustainability mindsets can be developed in HEIs, particularly in teacher education, and transferred into school contexts through teachers' professional practices and role modelling, thereby further impacting society.



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Conflicts of interest: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

International Journal of
Sustainability in Higher Education
Vol. 27 No. 10, 2026
pp. 603-622
Emerald Publishing Limited
1467-6370
DOI 10.1108/IJSHE-12-2025-1552

Originality/value – The study brings together current theories and concepts to support sustainability mindset development. This study lays the foundation for future research in this area.

Keywords Autonomy-supportive learning, Curricular nuances, Higher education institutions (HEIs), Lifelong learning (LLL), Sustainability mindsets, Teacher education, Transformative learning (TL)

Paper type Conceptual paper

1. Introduction

Quality education is vital to facilitate transformation, from preschool learners to educators at higher education institutions (HEIs). The necessity for quality education, as assigned by Agenda2030's Sustainable Development Goal 4 (SDG4) [United Nations (UN), 2015], is essential (Karuzis, 2020), as it focuses on sustainability in a global context. Therefore, this paper explores the intersection of transformative learning (TL) with curricular nuances and autonomy-supportive learning to develop sustainability mindsets in HEIs, particularly in teacher education programs, in support of Agenda2030. By situating this exploration within a lifelong learning (LLL) perspective, the paper highlights the importance of fostering sustainability mindsets across the lifespan.

HEIs serve as critical intervention points where educators and students engage in more profound epistemic shifts and TL experiences that shape their long-term commitment to sustainability (Leal Filho *et al.*, 2021; Žalėnienė and Pereira, 2021). Starting at a higher education level can strengthen young adults' skills to become influential problem-solvers and decision-makers in favour of reaching Agenda2030 (Briede, 2017). In this article, the focus is on HEIs, with particular emphasis on how teacher education can catalyse the sustainability mindset development among young individuals. This aligns with the concept of LLL (listed in SDG4), which views education as a continuous process across all stages of life assisted by adequate literacy and numeracy, supporting "individuals in gaining and applying knowledge and skills in different situations throughout life" (Grobler, 2022, p. 159), i.e. to adapt to a continuously changing world (Chen *et al.*, 2024). The UNESCO Institute for Lifelong Learning (2022) defines LLL as a process where learning and living are intertwined, encompassing educational activities for people of all ages across diverse contexts and using various methods to address different learning needs. This makes sustainability mindset development relevant throughout the educational journey.

For the purpose of the paper, "educators" refer to both university instructors and school teachers, "learners" refer to individuals learning in school and "students" refer to individuals at the university level. The latter group includes future teachers (pre-service teachers). In light of LLL and educators' role in developing sustainability mindsets, the study employed Jaakkola's (2020) theory synthesis design, which highlights the synergies between different theories and concepts, and integrates them into a framework. Based on the synthesis, this paper proposes a targeted transformation focusing on sustainability mindset development through interactions among TL, autonomy-supportive learning environments and curricular nuances, recommending approaches for higher education as a starting point, to be transferred into school contexts through teachers' professional practices and role modelling, and, more broadly, into society. The aim of the study is to synthesise key elements of TL, curricular nuances and autonomy-supportive learning that collectively contribute to the development of sustainability mindsets in HEIs (including teacher education).

2. Conceptualising sustainability mindsets development within lifelong learning

Sustainability is viewed within the framework of Agenda2030 (UN, 2015) as a holistic and broad concept that involves protecting the planet, supporting people in improving their

quality of life, achieving equal prosperity for all and promoting peace and partnerships (UNESCO, 2019). As sustainability is broader than focusing on the sustainable development of the planet, a sense of sustainability or sustainability mindset is required. Grobler (2024) discussed this concept as limited in the literature, but defined it as the ability to fully acknowledge, understand, appreciate or participate in sustainability practices, which in turn highlights the importance of cherishing sustainability. The paper suggests that having this ability or capacity is not enough; one needs to be completely immersed in the essence of sustainability, living it daily as if it is part of one's identity; having a sustainability mindset.

Kassel *et al.* (2018) define a sustainability mindset as follows:

A way of thinking and being that results from a broad understanding of the ecosystem's manifestations, from social sensitivity, as well as an introspective focus on one's personal values and higher self, and finds its expression in actions for the greater good of the whole. (p. 7).

This mindset emerges from a nuanced understanding of ecological interdependence, coupled with a profound reflection on your values and purpose, to act responsibly and towards the greater good (Kassel *et al.*, 2018; Molderez *et al.*, 2021), including protecting the planet for future generations (UN, 2015; UNESCO, 2019).

The sustainability mindset comprises three intertwined elements: knowledge, values and competence (Kassel *et al.*, 2018; Molderez *et al.*, 2021). Other authors, however, refer to it in a more personalised capacity as it aligns with the head-heart-hand pedagogical philosophy of sustainability learning (Pestalozzi, 1801/1894; UNESCO, 2017). A sustainability mindset is not compartmentalised into certain aspects of our understanding or behaviour; it becomes who one is in all aspects of our being.

Education is fundamental in fostering sustainability mindsets by including three orders of change in transformation for sustainability:

- (1) education *about* sustainability (knowledge impartation based on repetition);
- (2) education *for* sustainability (the incorporation of techniques and resources that support sustainability); and
- (3) education *as* sustainability (Lange *et al.*, 2021; Wahl and Rudinger, 2025).

The third-order change "education *as* sustainability" encompasses a transformative process that necessitates an epistemic shift for both the individual and the institution, grounded in TL (Mezirow, 2003), and reflected in recent work on transformative education environments for sustainability (Rekalde-Rodríguez, 2026). These three orders are taken further with the relational process of *(be)coming* sustainability encompassing "emotional, ecological, and material relations in [TL] as sustainability" (Lange *et al.*, 2021, p. 43). This indicates the interrelationship among individuals, the environment and the people around them, in which self-organising knowledge emerges, labelled as relational accountability by Lange *et al.* (2021). Recent scholarship views relational accountability as responsibility within interconnected networks (Brant *et al.*, 2026). *Becoming sustainability* through education, based on these principles, leads to *being sustainability*, consisting of *having sustainability mindsets*.

Framing this transformation within an LLL perspective further reinforces the idea that developing a sustainability mindset is not a one-time educational outcome, but a continuous, evolving process across the life course. Sustainability mindsets are defined as embodying knowledge, values, competence and an epistemic shift for holistic transformation toward sustainability (attitudes), achieved through lifelong, profound reflection on values and purpose regarding sustainability. It can be viewed as an identity-based orientation that shapes how individuals live, in this case, in education, but also in society, through continuous

transformation. [Table 1](#) compares the sustainability concepts on different levels discussed above.

While knowledge plays an essential role, values and competences are equally critical, and developing a sustainability mindset necessitates pedagogical approaches that extend beyond mere content delivery (as discussed in this paper). It is also not solely an individual issue, but one that depends on relationships with others, the surrounding environment and processes within these environments. For the purposes of this paper, education is not limited to schools; HEIs also play a crucial role in transforming ethical practices and attitudes towards sustainability. The HEI curriculum, focused on systems thinking, anticipatory and action-oriented (problem-solving) competence ([Žalėnienė and Pereira, 2021](#)) supports the sustainability mindset development. This involves fundamental reshaping of students' perceptions of the world and their roles within it. The following section discusses the methodology applied in this study.

3. Methodology: theory synthesis approach and concept selection

Implementing [Jaakkola's \(2020\)](#) theory synthesis design ([Figure 1](#)) facilitated the synthesis of these theories/concepts, thereby contributing to the discussion on the sustainability mindset development.

The theories/concepts were selected after an extensive literature review during the first author's PhD thesis, in the context of the Agenda2030, with a focus on SDG4 [aimed at achieving quality education and global citizenship through approaches such as education for sustainable development (ESD)]. Through collaboration with the second and third authors, the theories/concepts were selected and expanded. This included theories/concepts that address complementary dimensions of sustainability-related behaviour, including cognitive, motivational and action-oriented components.

An electronic search across major scientific databases, including Google Scholar, EBSCOhost and the online libraries of the authors' universities, was conducted. Keywords

Table 1. Sustainability concept comparison

Concept	Core focus	Role	References
Education about sustainability	Knowledge	Thinks about transformation	Lange et al. (2021)
Education for sustainability	Competence	Enables transformation	Lange et al. (2021)
Education as sustainability	Transformative process for an epistemic shift (values)	Makes transformation possible	Lange et al. (2021) , Mezirow (2003) , Rekalde-Rodríguez (2026) , and Wahl and Rudinger (2025)
Education becoming sustainability	Knowledge, competence and epistemic shift for holistic transformation toward sustainability (attitudes)	Transforms	Lange et al. (2021) and UNESCO (2017)
Sustainability mindset	Knowledge, values competence and epistemic shift for holistic transformation toward sustainability (attitudes)	Being the transformation through lifelong profound reflection on values and purpose regarding sustainability	Kassel et al. (2018) , Molderez et al. (2021) , Pestalozzi (1801/1894) and UNESCO (2017)

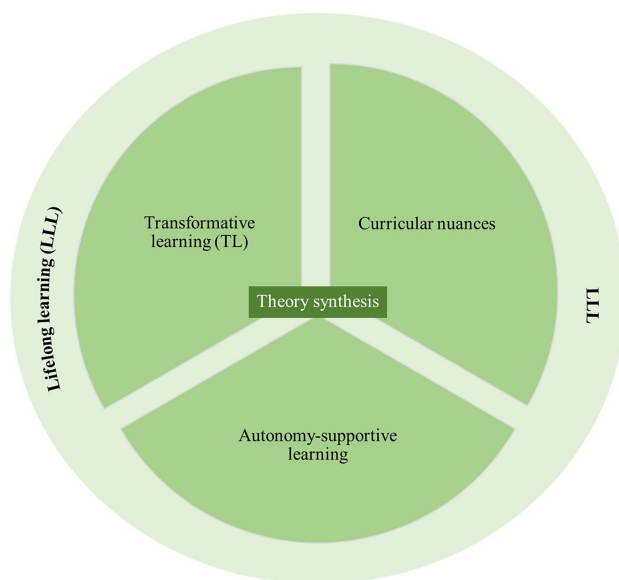


Figure 1. Theory/concept synthesis for sustainability mindset development
Source(s): Authors' own work

searched for included: “transformative learning”, “sustainability mindset”, “sustainability education”, “environmental education”, “education for sustainable development”, “curriculum development”, “transformative curriculum”, “curriculum issues”, and “early childhood development for sustainability”. After initial screening of the literature, theories/concepts were organised into groups based on overlapping approaches that could contribute to sustainability mindset development. Three main theories/concepts (based on the groupings) were identified and constructed: TL, curricular nuances and autonomy-supportive learning. The synthesis focused on individual-level constructs within HEIs, more specifically, teacher education, and (to be transferred into) schools and society. As transformation is viewed as an LLL process, the study was positioned across the lifespan. During the synthesis, similarities in approaches and learning strategies for sustainability were identified and integrated into a comprehensive framework, indicating how these theories/concepts interact. In the next sections, these theories/concepts are discussed.

4. Dimensions of sustainability mindset development

4.1 Transformative learning as the overarching change process

TL, as defined by Mezirow, can provide a valuable framework for fostering the mindset shifts and behavioural changes necessary to advance sustainability. Considering the focus on TL for sustainability, it is acquired because of the realisation of the transformational potential of the SDGs (Hajer *et al.*, 2015). In 1978, Mezirow (2003) developed this concept to challenge learners and educators alike to critically reflect on their assumptions and beliefs, thereby transforming their viewpoints or perspectives (Odell *et al.*, 2020). Furthermore, in 2010 and 2011, Sterling (2011, p. 21) developed a framework to outline the “levels of

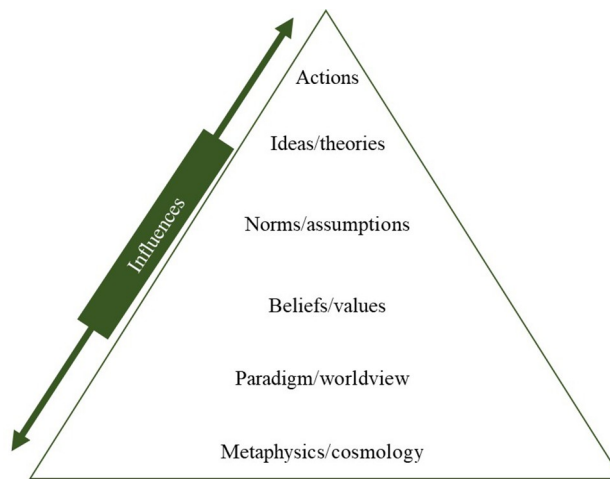


Figure 2. Levels of knowing in transformative learning (TL)
Source(s): Authors' own work, adapted from [Sterling \(2011, p. 21\)](#)

knowing” ([Figure 2](#)) based on Bohm’s interpretation of quantum mechanics ([Seager, 2018](#)). This framework indicates that different levels of knowledge influence one another:

It demonstrates that deeper levels of knowing, such as worldview, influence those above, including the more immediate levels at the top such as actions taken, so that learning can take place at different levels of knowing ([Odell et al., 2020, p. 908](#)).

This framework indicates that “all levels of knowing”, grounded in deeper foundations of knowledge, influence actions and vice versa. This can support awareness, understanding and implementation of sustainability in an educational context. However, to make it practical, curricular nuances, together with TL strategies, are explored, including critical and ecological thinking, psychological and neuroscientific perspectives on responsible behaviour, relational accountability, problem-identification and -solving, and ESD.

4.2 Curricular nuances for sustainability-orientated learning content and practices

The subsequent discussion explores theories/concepts grouped under curricular nuances and examines their implementation in educational experiences, ultimately highlighting their potential impact on trajectories, together with TL, for sustainability mindset development.

4.2.1 Critical and ecological thinking. Environmental education has been part of sustainability education for decades (see timeline in [Grobler, 2024](#)) and ecological thinking is a key to transformative action ([Karuzis, 2020](#)), enabling individuals to think critically about sustainability and its implications for life on earth. It encourages individuals to critically reflect on their impact on the environment and their role in solving the challenges they face by recognising their potential to bring about change ([Sterling, 2011](#)). [Karuzis \(2020\)](#) further explains that ecological thinking and education are inseparable components necessary for achieving the SDGs ([Karuzis, 2020](#)). Ecological thinking considers the environment and nature to be interconnected with human experience and further development, promoting sustainability ([Karuzis, 2020](#)). An example of ecological thinking, doing and experience is closely related to initiatives on campuses, such as greening

campaigns, organizational structures and community engagement focused on sustainability (Leal Filho *et al.*, 2019).

One of the central arguments is the integration of natural and social environments, both inside and outside the learning environment, where human interconnections and interactions with other emotional beings are central to learning (De la Sienra, 2020). Furthermore, Karuzis (2020) states that humans can be defined by their ecological thinking and awareness. Additionally, individuals should have opportunities to learn about relevant and practical subjects that can lead to meaningful career paths (García-González *et al.*, 2020; Karuzis, 2020). Implementing collaborative activities and practical subjects that foster ecological thinking can support TL (Karuzis, 2020) by enabling knowledge-based learning and interactive participation in sustainability projects.

Another approach that can stimulate ecological thinking is early childhood education for sustainability practices, such as education *in*, *about* and *for* the environment (UNESCO, 2014). These pedagogies are designed to support children in developing their values and actions by participating in learning which further develops “democratic decision-making skills and collaborative action-oriented learning” (Spiteri, 2020, p. 192). Early childhood education is not only the foundation for LLL but also for environmental education, which benefits from being embedded early and nurtured continuously as part of an LLL trajectory. To further support these processes, psychological and neuroscientific perspectives are also embedded in the curriculum for responsible behaviours grounded in sustainability mindsets.

4.2.2 Psychological and neuroscientific perspectives on responsible behaviour. Luetz *et al.* (2020) contend that perspectives informed by psychology and neuroscience for human behaviour change for sustainability involve individuals taking into account their community consciousness, group dynamics and social cognition. It can also include herd mentality, as others can influence human behaviour (Earls, 2009; Hirshleifer and Teoh, 2003). Hirshleifer and Teoh (2003) state that how one thinks, feels and acts could be influenced by others’ spoken thoughts, feelings, actions and the consequences of their actions. Luetz *et al.* (2020) note that social influence goes far beyond mere influence and can lead individuals to either adopt the behaviours of those around them (convergence) or deliberately act in ways that diverge from them (divergence). This again signifies the value of collaborative sustainability activities and subject projects as discussed previously.

Additionally, most people desire to leave a positive legacy in the world (Luetz *et al.*, 2020). With this statement, it is hoped that observing the consequences of people’s actions will lead to positive convergence, and that TL can play a role in the psychological and neurological aspects of developing sustainability mindsets. Furthermore, it could be observed as a curricular nuance by automatically incorporating social cognitive theory, group dynamics and community consciousness into a school or HEI curriculum (through group projects, peer discussions and mentorship activities). Campuses implement greening campaigns, such as recycling and social equity initiatives, which can contribute to the herding effect through social influence (Karuzis, 2020; Žalėnienė and Pereira, 2021), providing opportunities to develop sustainable problem-solving skills (Miller *et al.*, 2021). This cannot occur without considering relations to others and the planet; relational accountability is necessary.

4.2.3 Relational accountability. Lange *et al.* (2021) describe relational accountability as the ethical foundation of transformative sustainability education. They emphasise teaching approaches that deepen individuals’ connections with others and the natural world through compassion, respect and slow pedagogy. This approach embraces the rhythms of learning and encourages an embodied, relational understanding of sustainability. As an approach to learning for sustainability, relational accountability (Brant *et al.*, 2026; Lange *et al.*, 2021),

emphasises the interconnectedness and ethical responsibilities in educational practices. It involves understanding and valuing people and relationships within contexts such as HEIs, communities and schools. It adds the emotional and ethical dimensions to realising the essence of sustainability. During learning, this can be stimulated by fostering connections and focusing on principles such as accountability, empathy and compassion (Lange *et al.*, 2021), which underlie principles of the Agenda2030 (UN, 2015), and could enhance a profound transformation in sustainability mindsets. By reflecting on aspects such as behaviour and relationships, problem-identification and -solving can occur for sustainability practices.

4.2.4 *Problem-identification and problem-solving.* Tejedor *et al.* (2019) suggest that active learning strategies, such as problem-based learning (PBL) and project-based learning (PjBL), can effectively develop sustainability competences in students and learners. Learning centred on problem-solving is a pedagogical approach rooted in socio-constructivist theory (Section 4.3.1) (Barrows, 1996; Krajcik and Shin, 2016) that enhances the ability to identify and solve problems practically. Taimur and Sattar (2020) put this concept into an example, noting that active learning pedagogies engage learners through real-world experiences that prioritise critical problem-solving and experiential learning.

PBL is student-centred with the educator acting as a facilitator; it involves learning in small groups, where open-ended, real-life issues are introduced at the start as a tool for discovery; and students learn new content through self-directedness by solving these authentic problems (Barrows, 1996; Calis and Ergul, 2012; Fitria *et al.*, 2022; Hmelo-Silver and Barrows, 2006). There is evidence that PBL, when implemented through projects, encourages students and learners to become more effective researchers and problem-solvers, while fostering higher-order thinking and promoting effective interpersonal communication (Bell, 2010; Loyens *et al.*, 2023). This implementation can develop sustainability mindsets.

Blumenfeld *et al.* (1991) define PjBL as a teaching approach that engages students and learners in investigating authentic issues. PBL and PjBL are aligned insofar as a real-life problem is presented to the individuals within the project or activity, necessitating discussion and resolution in a group context. Schunk (2000) and Børte *et al.* (2023) further claim that most people are active learners who learn through doing, actively acquiring new knowledge and remembering, rather than passively listening and watching, a claim supported by the PjBL approach. This is already embedded in the curricula and could further support the development of sustainability mindsets during TL through ecological and critical thinking-promotive projects.

These curricular nuances discussed above all play a role in sustainability mindset development and are all directly linked to ESD (Figure 3):

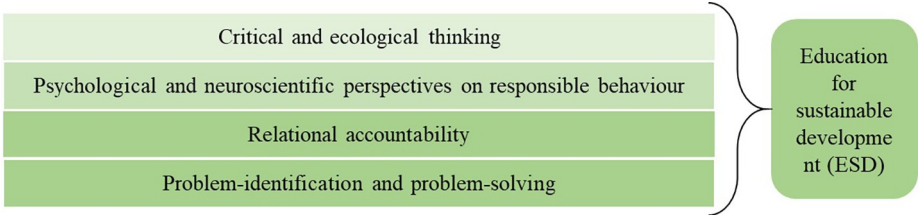


Figure 3. Curricular nuances as education for sustainable development (ESD) skills/attributes
Source(s): Authors’ own work

Figure 3 illustrates how desired skills and attributes, or in this case, curricular nuances such as social accountability, critical thinking and problem-identification and problem-solving, are often encouraged as competences to be reflected on in ESD to realise responsible actions towards people and the planet (UNESCO, 2020, 2021b).

4.2.5 Education for sustainable development (ESD). In SDG4, ESD is identified as essential for building the knowledge and skills needed for sustainability (UN, 2015). According to UNESCO (2023), ESD equips individuals of all ages with the competences and agency to address global challenges and take action for a more just and sustainable world. Beyond this, ESD fosters cross-cultural and intergenerational understanding, encouraging respect for diversity and promoting equity and peace (Kumar, 2020). As an integral part of quality education, ESD spans cognitive, emotional and behavioural dimensions across formal, non-formal and informal learning. This positioning reinforces ESD's transformative potential throughout LLL, which is also listed as an SDG4 principle (UN, 2015). Several global declarations emphasised the importance of integrating ESD in HEIs (López *et al.*, 2019) and schools (El Youssfi *et al.*, 2024). It contributes to realising the SDGs by making education more relevant and context-specific, enabling people to act on everyday challenges (Kumar, 2020; UNESCO, 2021a). Additionally, Block *et al.* (2019) recommend PBL practices for effective ESD, suggesting a strong connection between ESD and PBL.

The approaches align with the core principles of TL, based on collaborative and reflective problem-solving, interdisciplinary approaches, and real-world relevance, while enabling a profound structural shift in sustainability mindsets and the development of the necessary skills.

4.3 Autonomy-supportive learning as the enabling learning environment

Given that the LLL process begins at a young age and will continue throughout one's life, this article explores the relevance of socio-constructivism and socio-constructionism. Additionally, it examines how self-directed learning (SDL) and slow pedagogy can foster autonomy-supportive environments that develop sustainability mindsets.

4.3.1 Socio-constructivism and socio-constructionism. Socio-constructivism is described as a learning theory, a philosophical attitude towards human knowledge, and an approach to social inquiry (Taber, 2011). Constructivism is defined as the process by which information and experience are introduced to learners, building on their cultural knowledge and experiences gained through social interactions (Schunk, 2000; Vygotsky, 1978). It is a learning theory that utilises social tasks to discover and process knowledge by applying skills and prior knowledge (Savery and Duffy, 1995). In the Agenda2030 context, educators can tap into this knowledge to enhance problem-solving skills by, for example, linking the challenges identified in the SDGs to enhance awareness, critical thinking and a sustainability mindset. This can be done through a combination of individual and group tasks.

Vygotsky also emphasised the importance of language in socio-constructivism, as it develops through social interactions between individuals and cultures for communication (Weiten, 2010). He believed language plays two critical roles in cognitive development: First, as a means for adults to transmit knowledge – where the educator acts as a mediator – and second, as a tool for conceptual change, helping individuals integrate new information with prior knowledge (Weiten, 2010). This process unfolds within Vygotsky's Zone of Proximal Development (ZPD) (Figure 4), where individuals progress most effectively when supported/facilitated by educators. The language used by educators to frame environmental challenges and sustainability issues, linked to Agenda2030, can significantly shape individuals' sustainability mindsets from an early age.

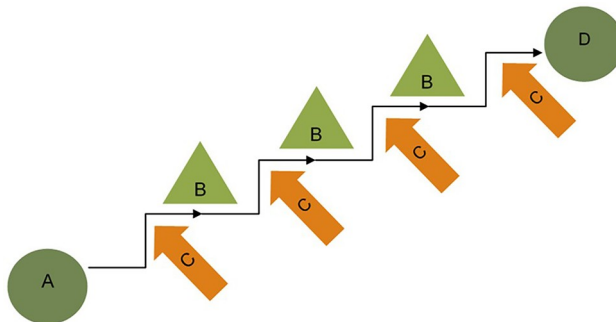


Figure 4. Zone of proximal development (ZPD) and scaffolding

Note(s): Each individual possesses a current level of development (A) that can be improved (B) through facilitation and ongoing support, using resources (scaffolding) (C), to achieve a specific outcome (D).

Source(s): Authors' own work, adapted from [Vygotksy \(1978\)](#)

The theory of socio-constructionism draws from socio-constructivism, which explains how individuals learn by creating mental models to better understand content ([Triantafyllou and Timcenko, 2013](#)). [McNamee \(2004\)](#) states that socio-constructionism is grounded in individuals' internal cognitive processes. Educators play a crucial role in education by providing students/learners with new content knowledge and teaching them about the global crisis and the SDGs. As educators are key to this transformation, inspiring and preparing students to develop a sustainability mindset in their future classrooms will encourage critical thinking about global issues. This approach can lead to problem-solving within the framework of the SDGs and help them understand what quality means in their society.

4.3.2 Self-regulation and self-directed learnings. [Nyikos and Hashimoto \(1997\)](#) suggest that self-regulation in the classroom context can be represented as the process by which an individual finds their authentic voice during problem-solving through language mediation. Depending on their attitude and intelligence, self-regulating individuals use certain learning styles to acquire knowledge ([Schunk, 2000](#)). This means that individuals must possess self-awareness to determine which strategy will be most effective and suitable for them. SDL can support self-regulation and vice versa (including skills such as independent thinking and self-discipline).

SDL refers to the:

[...] process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes ([Knowles, 1975](#), p. 18).

In essence, SDL supports curriculum development within a critical paradigm because individual needs are prioritised and contextualised rather than predetermined by a limited, prescribed (instrumentalist) curriculum ([Verster, 2025](#)). SDL in school settings has often been described as interpretivist-oriented, supported by social constructivism ([Verster, 2025](#)). However, even within social-constructivism, the full potential of SDL is limited by prescriptive curricula ([Verster et al., 2024](#)). However, recent developments in support of authentic and deeper engagement among students and educators include open educational resources (OERs), open educational practices (OEPs) and massive open online courses

(MOOCs) (Shareefa *et al.*, 2023; Yetunde and Adefunke, 2021), making teacher education in some contexts not as prescriptive as in some school curricula.

4.3.3 Slow pedagogy. An aspect mentioned by Lange *et al.* (2021) in their discussion of relational accountability and ethical cores in sustainability education and teaching approaches is slow pedagogy, which can foster autonomy in sustainability mindsets. Collett *et al.* (2018) explored how slow pedagogy can enable disengagement from an instrumentalist approach to teaching and learning, resulting in a different way of being and creating space for authentic, deeper engagement. It reconsiders the relationship between time and pedagogical practice (Collett *et al.*, 2018). Furthermore, slow pedagogy challenges the education sector to consider the consequences of rushing towards achievement for productivity and efficiency (Sorrells and Madrid Akpovo, 2024).

Slow pedagogy refers to the “right tempo” where a person is “fast when it makes sense to be fast, and [...] slow when slowness is called for” (Honoré, 2005, p. 13), and can encourage deep engagement with sustainability concepts by including hands-on activities, outdoor learning and experimentation (Payne and Wattoo, 2009). This can be linked to the three intertwined elements: knowledge, values and competence (Kassel *et al.*, 2018; Molderez *et al.*, 2021), which align with the head-heart-hand pedagogical philosophy of sustainability learning (Pestalozzi, 1801/1894; UNESCO, 2017). It can also foster critical thinking by allowing time and space to reflect on experiences and the implications of one’s actions (Ailwood and Ford, 2021). This could enhance an individual’s autonomy, enabling them to make effective choices regarding sustainability and contribute to improving society.

5. Synthesised framework for sustainability mindset development

Figure 5 highlights the relationships among the three major concepts identified in the initial phase of the theory synthesis and how they can be integrated to support sustainability mindset development throughout the LLL process.

The integration of TL, autonomy-supportive learning and curricular nuances leads to sustainability mindsets. Through LLL, sustainability mindsets can be developed from a young age throughout one’s life; TL approaches can be implemented in higher education (specifically teacher education) to create adults with sustainability mindsets and further cultivate them in future generations by transferring them into society (and into school contexts through teachers’ professional practices and role modelling). This means that these aspects, interacting with one another, serve as an approach to developing sustainability mindsets. One cannot function without the other, and it is a cyclical process where these aspects support each other.

The following interpretation of Dewey and Small (1897) on quality education, predating Agenda2030, aligns well with the context of sustainability and the SDGs, as they believed that proper education occurs by stimulating learners’ “powers” in social situations where they are to act as members of a unit and regard themselves (within a social group) from the perspective of the group’s welfare. This perspective ties together TL (Mezirow, 2003; Sterling, 2011), socio-constructivism (Vygotsky, 1978) and socio-constructionism (McNamee, 2004; Triantafyllou and Timcenko, 2013), which can support the goals of Agenda2030 (UN, 2015) by promoting education as dynamic, socially interactive and profoundly transformative. When these approaches are situated within an LLL perspective, they underscore the need to revisit and deepen sustainability education throughout the individual’s life.

To effectively implement approaches to develop a sustainability mindset, educators must be well prepared and have a nuanced understanding of how to support TL as an LLL. The theory synthesis shows that TL is already embedded in the curricular nuances. Autonomy-supportive learning can be used to foster this TL from an early age. These synergies between TL and autonomy-supportive learning exist and can be integrated with curricular nuances:

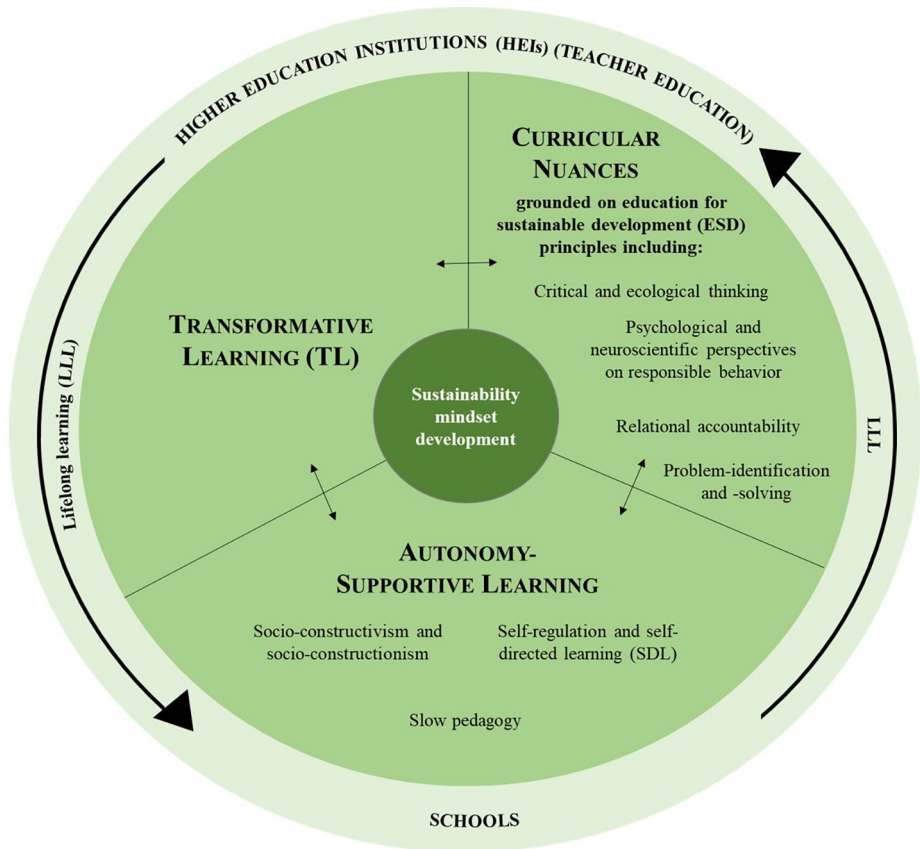


Figure 5. Theory synthesis on developing sustainability mindsets
Source(s): Authors' own work

- Critical and ecological thinking that facilitates a shift in behaviour towards sustainability (Lange *et al.*, 2021; Tejedor *et al.*, 2019; UNESCO, 2014). By implementing collaborative activities and practical subjects that foster ecological thinking can support TL (Karuzis, 2020) by enabling learning from knowledge and interactive participation in sustainability projects and by implementing this already in the early childhood education through education in the environment, about the environment, and for the environment (UNESCO, 2014), the LLL process will be initiated. Once critical and ecological thinking are stimulated, they could further promote self-regulation and SDL by fostering an understanding of what is necessary and important for society. Additionally, self-regulated learning and SDL can support critical and ecological thinking competences from a young age.
- Psychological and neuroscientific perspectives that stimulate behavioural change towards sustainability (Luetz *et al.*, 2020), which again signifies the value of collaborative sustainability activities and subject projects as discussed in critical and ecological thinking for TL. Furthermore, it automatically incorporates social

cognitive theory, group dynamics and community consciousness into a school or HEI curriculum (through group projects, peer discussions, and mentorship activities), thereby promoting relational accountability and problem-identification and -solving for transformation. Slow pedagogy from a young age could influence one's psychological and neuroscientific perspectives on sustainability and, furthermore, on relational accountability.

- Relational accountability in sustainability education that emphasises the essence of ethical and compassionate interactions within learning communities (Brant *et al.*, 2026; Lange *et al.*, 2021). It can be supported through approaches that deepen individuals' connections with others and the natural world, including slow pedagogy, PBL and PjBL. During learning, this can be stimulated by fostering connections and focusing on principles such as accountability, empathy and compassion (Lange *et al.*, 2021), which underlie the transformative principles of the 2030 Agenda (UN, 2015) and could foster a profound transformation in sustainability mindsets.
- Problem-identification and -solving approaches that pose real-life problems to foster discussion and group-based problem-solving (Barrows, 1996; Bell, 2010; Calis and Ergul, 2012; Fitria *et al.*, 2022; Hmelo-Silver and Barrows, 2006; Krajcik and Shin, 2016; Savery and Duffy, 1995; Taimur and Sattar, 2020). Learning centred on problem-solving is a pedagogical approach rooted in socio-constructivist theory (Barrows, 1996; Krajcik and Shin, 2016) that enhances the ability to identify and solve problems practically. This could further support the development of self-regulation and SDL within sustainability mindsets during TL through ecological and critical-thinking-promotive projects.

ESD, which contributes to realising the SDGs by making education more relevant and context-specific for people to act on everyday challenges (Kumar, 2020; UNESCO, 2021a) is found to consist of these aspects above.

Despite many HEI programs supporting sustainability, there remains a significant need for a transformative shift to achieve sustainability mindsets (Leal Filho *et al.*, 2021; Ransome, 2025). Therefore, TL, as articulated by Mezirow (2003) and Sterling (2011), can be understood as the overarching outcome of applying the approaches identified as curricular nuances and autonomy-supportive learning. The integration of these theories/concepts can be applied to teacher education programs to challenge students to reflect more critically on their assumptions and beliefs (Odell *et al.*, 2020). It could support educators (future teachers) in thinking critically about the topics and in engaging diverse perspectives on sustainability for further application in schools. Educators should also understand that specific theories/concepts play a role in the sustainability mindset development and the LLL process, such as socio-constructivism (Vygotsky, 1978), socio-constructionism (McNamee, 2004; Triantafyllou and Timcenko, 2013), self-regulation (Nyikos and Hashimoto, 1997; Schunk, 2000), SDL (Knowles, 1975) and slow pedagogy (Collett *et al.*, 2018; Lange *et al.*, 2021; Sorrells and Madrid Akpovo, 2024). This integrated framework shows that these theories and concepts are interconnected and cannot be viewed in isolation.

6. Implications for HEIs, teacher education and lifelong learning

The proposed conceptual framework outlines how theories and concepts can be integrated to achieve transformative LLL for sustainability mindset development. The integration of theories/concepts within this conceptual framework enables educators to embed them in their curricula to develop sustainability mindsets.

There is still a lack of professional development opportunities in the field of sustainability and given the complex nature of the SDGs, this will require professional development opportunities (Reeve and Cheon, 2021). Therefore, it is recommended that professional development on the essence of these theories/concepts and their application in teaching be revised. Awareness of these theories/concepts and how they interact could lead to the understanding that TL is essential to ensure lifelong learning, expanding the “potential for intellectual and personal growth” (Slavich and Zimbardo, 2012, p. 599), which can be leveraged for sustainability mindset development. This conceptual framework can shape educators’ perceptions of sustainability mindset development, as well as their behaviour, teaching practices, curriculum design and engagement with ESD, focusing on real-world challenges, and motivates the internalisation of the values that accompany them (Wang *et al.*, 2022), thereby strengthening the achievement of Agenda2030.

Anderson (2016) concluded (from a study in teacher training) that ESD was successful in changing sustainability-related beliefs, norms and attitudes of students, indicating the need for continued professional development opportunities. The benefit of ongoing professional development in ESD and sustainability mindsets is that educators remain informed about recent research and literature as environmental demands evolve (Cedeño-Rivadeneira and Mendoza-Loor, 2024). This framework could be operationalised through interdisciplinary models within HEIs and schools, for example, food systems. Educators would develop sustainability knowledge within disciplinary studies, design autonomy-supportive, inquiry-based learning tasks within subject didactics and engage (together with students and learners) in critical reflection on values and professional responsibility within educational sciences.

Teaching from an autonomy-supportive model has been shown to benefit educators, learners/students and overall classroom dynamics (Reeve and Cheon, 2021). A study by Cheon *et al.* (2024, p. 7) demonstrated that autonomy-supportive education can foster prosocial behaviour in individuals, creating a “pay it forward effect” that aligns with the theories discussed in this article and contributes to a more sustainable future. Sustainability-focused autonomy and personalised learning, including micro-credential courses, could be offered as electives at HEIs, allowing educators and students to learn on their own time and in their own place. The outcomes of these courses can promote critical and ecological thinking, responsible behaviour, accountability and problem-identification and -solving when they are designed based on the principles of the proposed conceptual framework. Additionally, collaborative approaches such as group-based reflection may support the sustainability mindset development in teacher education.

However, it also depends on educators’ commitment to applying these approaches (Reeve and Cheon, 2021). This commitment can be supported through coherent governmental and HEI policies that create enabling conditions for sustainability-oriented teaching. Grobler (2024) recommends a reference concept for change based on the United Nations Sustainable Development Group (UNSDG) (2016) theory of change. This concept initially emphasises quality education as a central hub, defining the UN’s comparative advantages and key concepts, and emphasising the importance of sustained collaboration and continuous evaluation within systems. Given that this approach may entail substantial financial costs and require extensive persuasive efforts, the paper proposes a targeted transformation focused on sustainability mindset development through interactions among TL, autonomy-supportive learning environments and curricular nuances by viewing the entire HEI/school as a holistic model for sustainability and understanding how they influence the LLL process of students and educators concerning sustainability.

As HEIs/schools should be viewed as holistic models from psychological and neuroscientific perspectives, sustainability can be promoted through staff members leading

by example to support thinking and behavioural patterns. Furthermore, to promote social impact, HEI educators and students are encouraged to collaborate with schools on projects focused on supporting societal sustainability, targeting other SDGs, such as initiatives to clean and green the environment (SDG12) and support hungry and poor communities (SDGs 1 and 2). When planning and further developing learning programs, designers can take this framework into account to ensure that TL occurs through the application of the integrated approaches in the proposed conceptual framework. Future research will explore the practical application of this conceptual framework, particularly how it can be leveraged to support LLL pathways and transformative sustainability education, which fosters the correlation between TL and sustainability education, as discussed by Burns (2018).

7. Conclusion

The conceptual paper aimed to synthesise key elements of TL, curricular nuances and autonomy-supportive learning that collectively contribute to the development of sustainability mindsets in HEIs (including teacher education). For the purpose of this paper, sustainability mindsets are defined as embodying knowledge, values, competence and an epistemic shift for holistic transformation toward sustainability (attitudes), achieved through lifelong, profound reflection on values and purpose regarding sustainability. For effective sustainability mindset development, a comprehensive approach that implements the discussed elements is recommended:

- embed relevant approaches based on these theories/concepts into the learning process to provide a strong theoretical foundation;
- provide ongoing, curricula-aligned professional development and research and evaluation; and lastly; and
- use TL approaches, autonomy-supportive and collaborative reflective models holistically in HEI and schools.

It is part of the LLL, which recognises that developing sustainability mindsets is an ongoing, iterative process that spans all stages of life, enabling adaptation and addressing the challenges of a rapidly changing world.

Sustainability mindsets can be cultivated from a young age, but the study advocates for HEIs, specifically teacher education, as a starting hub for this cycle. The proposed framework (Figure 5), developed through theory synthesis, offers a new perspective on how individuals can be engaged as lifelong learners in sustainability mindset development. One major limitation is that, although clear links exist among these theories/concepts for sustainability mindset development, their practical implementation remains vague, as each learning context has unique needs and varying approaches to teaching and learning. This overview offers various possibilities for HEIs, schools and educators to cultivate comprehensive sustainability mindsets. Future research will be aimed at the integration of these theories/concepts to observe how they interact with one another and how they could promote the sustainability mindset development.

Funding

No funding was provided for this study.

Ethical approval and informed consent statements

No ethical approval was necessary for this conceptual paper.

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