Research

International trends on transformative learning for urban sustainability

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Abstract

It is widely assumed that transformative societal action is required to address the world's many sustainability challenges of today. This is especially true in an urban context, since urban sustainability may assist in improving the conditions of the urban environment and the quality of life of humans. Nevertheless, and despite the many advantages that urban sustainability may bring about, there is a need for studies that look at the role that transformative learning may play in influencing it. This study will address this need. It provides an analysis of the subject matter of transformative learning and how it may be practised and experienced in an urban context, thus contributing to urban sustainability in practical terms. It reports on a survey specifically directed to the teaching staff, on the extent to which transformative learning is being deployed in Higher Education Institutions (HEIs) in supporting urban sustainability efforts. In addition, the study ends by listing and presenting examples of approaches, methods, and initiatives in transformative learning within an urban sustainability context, and provides an analysis of its main features and learned lessons. It concludes with some best practices for transformative learning that could assist in designing and implementing urban sustainability teaching at HEIs, on a broader scale. It can be stated that not only can sustainability thought improve the urban conditions, but as the developing world gets further urbanised, sustainability in the urban context specifically becomes a matter of particular relevance.

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1 Introduction

There is an increasing interest in transformative learning for greater understanding and for confronting contemporary global challenges such as urbanisation and climate change. Transformative learning is "the process of using a prior interpretation to construe a new or revised interpretation of the meaning of one's experience to guide future action" (p. 162) [1]. The process expands human consciousness, values, purposes, and meanings through the transformation of their capabilities and worldviews to critically analyse prior interpretations and underlying premises [2]. It entails a deep-rooted, structural adjustment of fixed underlying assumptions, expectations, thoughts, feelings, belief systems, and actions to become more inclusive, reflective, and open [3, 4]. It can help towards significant transformations of human consciousness to permanently alter the perception of and interaction with the natural world and ideas of alternate ways of living, including the focus on social justice, harmony, happiness, and environmental sustainability [4], also accomplished through critical pedagogy. Transformative learning has many applications and is a cross-cutting concept able to be applied in different contexts, providing opportunities for critical thinking, connecting to others going through the same transformative process, or to act on new perspectives [5–7].

Accordingly, transformative learning can be a key to integrating environmental, socio-economic, and political complexities that define how global challenges present themselves in specific urban contexts because it enables the construction and integration of new knowledge within the local context [4]. To adequately confront global sustainability challenges, transformative learning can spur the reflection, differentiation, and integration of experiences that lead to deep and enduring socio-cultural changes at individual, communal, and institutional levels. Such approaches seek to transform places, re-order systems and create fundamental changes within a city system [8]. Urban Sustainability has evolved into a rhetorical and somewhat contested societal discourse [9, 10] where the current socio-environmental problems associated with sustainability must be considered, transcending disciplinary boundaries. To that end, education for sustainability is critical in seeking ways and means of achieving sustainable impacts in all human activities. Additionally, transformative learning considers the city as a learning society that has the potential to chart a new course of orienting, guiding, and educating into new and healing territory [11].

Education is a critical component in the process of transforming society toward sustainability [12]. More effort is needed to radically transform conventional forms of education into vehicles capable of educating students from all disciplines to become future responsible citizens and involve all stakeholders in a global transition [13]. In fact, conventional forms and structures/institutions/organisations are too in need of some critical changes, fostering the ability and skills to perceive, accept, and adjust to the requirements of the learner, while establishing the innovative methods required to address revolutionary challenges and wicked problems that require diversified thinking [14].

Accordingly, this study discusses the importance of transformative learning and reports on an international study aimed at identifying how transformative learning is perceived and to some extent implemented, in a sample of Higher Education Institutions (HEIs), in the context of urban sustainability. Figure 1 conceptualizes the connections explored in this study, and aims to represent the links between transformative learning and urban sustainability, illustrating how both, when combined, can result in behavioural change through reflection on experimentation and practices that case studies allow learning by doing, contributing to better governance towards urban sustainability, strategically matching specific objectives with those of each institution's sustainability goals [15]. However, the connections shown in Fig. 1 also aims to highlight that when discussing governance, urban sustainability, and transformation, the surrounding society also undergoes "transformatively learning" processes. This can mainly happen through information sharing and awareness, collaboration and participation, experimentation and innovation, or even by social movement and advocacy. This is a flexible process, adaptable to local communities sociocultural specificities that should be the main actors towards this transformation. The study explores the role that transformative learning can play in preparing students to better understand matters related to urban sustainability. It presents the results of a global teaching staff survey on the extent to which transformative learning has been employed in teaching about urban sustainability in HEIs. It also discusses the main features of some transformative learning approaches, methods, and initiatives within an urban sustainability context and analyses the lessons learned. The paper concludes with some best practices for transformative learning that could assist in designing and implementing urban sustainability schemes at a broader scale.

Fig. 1 Transformative learning and urban sustainability: some connections and characteristics
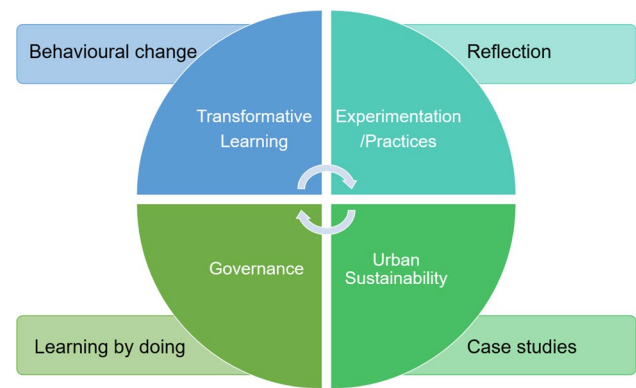
2 Literature review

2.1 Transformativen learning

Instead of learning only via cause-effect thinking and achieving skills or knowledge, the transformative learning process occurs via critical reflections, engaged discourses, and social actions in formal, non-formal, and informal learning settings, resulting in epistemological and ontological shifts [16]. The process, summarised in Table 1, according to the known Mezirow's phases of Transformative Learning, integrates the principles of education for critical understanding, integral creativity, and survival to support behavioural transformation at the individual level, to reorient people to new assumptions, expectations, roles, priorities, and actions for broader change at the communal level, and to envision a better future in the larger natural systems. Its key characteristics include how people learn, i.e. processes, what they learn, i.e. outcomes, and how best to support their learning, i.e. conditions [17]. Societal transformations need to rely on critical reflection allowing learning to adapt to change [18]. Examples of how link societal transformation to transformative learning include civic education or sustainability and ecology being addressed, allowing re-education to embrace the societal dimension, and focusing on social action. Mezirow's transformative learning, whose phases are described in Table 1, is rooted in critical thinking and seems to be helpful to assist on rethink challenging issues at a societal level [19]. Shifts in self-understanding, the ability to challenge accepted positions and behaviours among individuals and groups,

Table 1 The ten known Mezirow's phases of Transformative Learning [adapted from Yıldırım and Yelken (26)]

Phase	Description
Disorientating dilemma	People experience something that does not make part of their system of values and beliefs about the world
Self-examination	People are somewhat forced to reconsider and perform a self-examination to understand and recognise that their perspective is not unique
Critical assessment	Comprises a critical review and validity check of past assumptions orientating people's system of values and beliefs
Recognition	People recognise that others have shared a similar transformation, and this is the next step to understanding that they are not alone in this process
Exploration	Individuals are more likely to experience new roles and actions that should be more compatible with their new skills, seeking to develop deeper relationships with their colleagues
Planning a course of action	The need for a re-adaptation of the new system of values and beliefs, allowing them to make their own decisions
Acquisition of knowledge and skills	The acquisition of knowledge and skills for implementing a new plan of action leads to its application
Trying new roles	People are faced with the real learning process and transformation
Building of competence and self-confidence	Development of competencies and self-confidence where all the changes are acknowledged
Reintegration	Reintegration into a life based on new perspectives grounded in the gained knowledge and learned skills

critical awareness of socially shared and reinforced assumptions, and knowledge of how these assumptions affect both individual and group perceptions, actions, and possibilities are all part of the necessary learning.

In a time where sustainability discourses are well disseminated and a true transition to a more fair, equitable, and sustainable society is needed, transformative learning can play a decisive role, but must be considered as a living theory [20]. Sustainable transformations will unavoidably require discursive transformation [21]. Sustainability education can realise its transformative experience when performed at a stage where people are more open to receiving new information, allowing individual participants to freely express against normative orientations and shape education towards transformative learning [19]. The transformative learning process encompasses various personal and societal objectives, including freedom, democracy, citizenship, social action, and environmental consciousness [22]. It supports the capacity to move beyond the hegemony of dominant forces such as capitalism, the patriarchy, and the elites towards more inclusion and pluralism [23]. Humphries and St Jane [24] argue that sustainability discourses are a mixed "blessing". While able to "modify knowing and being" that have contributed to the current issues confronting humankind, they may also allow us to become more knowledgeable on creative solutions surrounding sustainability at a global level. In sustainability discourses, there is also the risk of imposing different views on those who do not agree or welcome them, and so rhetoric needs to be articulated with educational efforts in transformative learning in such a way that both will not collide [25]. It is necessary to operate changes in the deepest structures of our societies and to be aware that this can be one of the greatest challenges of our times.

Transformative learning is particularly relevant in HEIs in their quest to prepare graduates to become agents of urban sustainability change. Leal Filho et al. [27] studied the role of transformation in supporting and enabling efforts towards education for sustainability. The results demonstrated that the transformation process offers an opportunity to rethink educational practices. The same study also identified the need for a commitment of the faculty and academics to foster transformation in learning and education for sustainability.

It is known that sustainability challenges involve not only technical challenges in terms of knowledge transformational but also social ones. The latter requires a transformation in various areas, from social to economic and ethical, which implies the experience of some of the ten phases [26] described before in Table 1. The adoption of sustainability patterns is a process of a paradigm shift, integrating a critical assessment of society, resulting in a processual, questioning, interactional and long-term pathway [28]. This can take place at a multilevel scale, such as at a micro level, i.e., individual or collective, meso level, i.e., state, civil society, market, or macro level, i.e., institutions and social practices. The phenomena are relevant at both, the macro level and micro levels, since social practices are intertwined. To enable transformative learning to transform society, it is necessary to combine both natural and social sciences in a holistic approach, conditions that are based on global sustainability and that must be considered in the scope of urban sustainability.

Bostrom et al. [28] reviewed the conditions for transformative learning for sustainable development. The conditions include having an interactive and long-term process that is deployed at all societal levels and spheres, such as the market, civil society, and the state. The same authors contend that such transformative learning should involve not only accumulating scientific knowledge but also seeking local values while escalating structural and socio-cultural constraints. Although transformative learning can contribute to overall social transformation through education, studies on the subject focus mainly on classroom teaching [29], healthcare [30–33], lifestyle, and social and community transformation, namely empowering women victims of violence, teen mothers, poorly educated students and migrants [34–39]. But also through non-formal education, challenging traditional and formal systems, by creating awareness and critical thinking, which are important skills to support capacity building for urban sustainability [40]. Nevertheless, and despite the importance associated with transformative learning through studies in specific subjects, less attention has been given to the role that may be played by transformative learning in influencing urban sustainability.

2.2 Transformative learning and sustainability in an urban context

According to Pisters et al. [41] (p. 2), the concept of sustainability refers *"to a process that ideally leads to a world in which individuals, communities, villages, cities, regions, countries and so on embody diverse regenerative ways of living on this planet that builds on the premises of cooperation, diversity, abundance, and health and wellbeing"*. As more humans live in urban areas across the globe, it is especially relevant to consider how to balance environmental, economic, and social well-being in urban settings. Urban environments are characterised by societies organised around non-agricultural activities, and they have a denser population concentration when compared to rural areas [42]. Urban centres range from mid-sized towns to large cities, and urban planners are often faced with multiple conflicting goals related to ensuring equitable access to education, health care, shelter, and jobs, maintaining the ecological integrity of natural resources and reducing

pollution, and creating positive economic development opportunities for all [43]. Making cities more sustainable is a global goal, with the premise of shaping more inclusive, resilient, and resource-efficient cities [44–46], and transformative learning can contribute to this change.

Recent research has begun to investigate the role of transformational approaches in influencing urban sustainability, although examples of implementation are still scarce [8]. For example, there is some evidence of the potential of transformative learning to enhance climate change adaptation [47, 48]. By pursuing fundamental and structural shifts in urban processes, transformative learning could provide a much more radical change in climate adaptation compared to incremental approaches [8]. Transformative learning facilitates social learning, the importance of experience, the bottom-up vision, and the development of sustainability skills [22]. One key aspect is learning from local agents in order to better understand the factors that can contribute to transforming the place into a sustainable city [49]. Similarly, the ability of transformative capacity to support and enable continuous experimentation, the exchange of information, and different ways of thinking can facilitate urban sustainability initiatives [50]. As an example, an urban community garden in southwest Virginia, United States, acted as a venue for transformative learning for sustainability in which residents were enabled to grow organic food, promote human health, and ensure environmental sustainability [23]. Thus, cities can be learning laboratories that activate city-scale transformation [50]. Figure 2 provides an outline of some of the key factors to foster transformation in urban sustainability, able to contribute to effective change in urban sustainability.

3 Methodology

In order to meet the aims of the study and investigate to what extent HEIs are deploying transformative learning methods, tools, and practices in the teaching and research process for urban sustainability, an online survey was developed. This method was employed to allow for sampling a variety of universities across different countries and it was specifically directed to targeting teaching staff at HEIs. For the exploratory component, and based on a review of the literature aimed at identifying knowledge gaps and the need to collect data on teaching and research practices, the survey was organised into 3 different sections, focused on simplicity:

I)   the integration of urban sustainability in teaching practices: this section explored the extent to which teaching staff has been involved in programs and courses that teach on urban sustainability and the urban sustainability themes covered in the courses. This section aimed to present an overview of the current situation in the studied sample;

II) transformative learning tools: this section explored the perception of respondents in terms of the potential of transformative learning tools such as self-evaluation, narratives, art-based techniques, and metaphors and the extent to which they have been using these tools. In addition to presenting international trends in this context, the results of this section were also aimed at offering insights on the most common practices which might represent useful strategies for teaching staff revising their teaching methods;

Fig. 2 Transformative approaches relevant in the context of urban sustainability
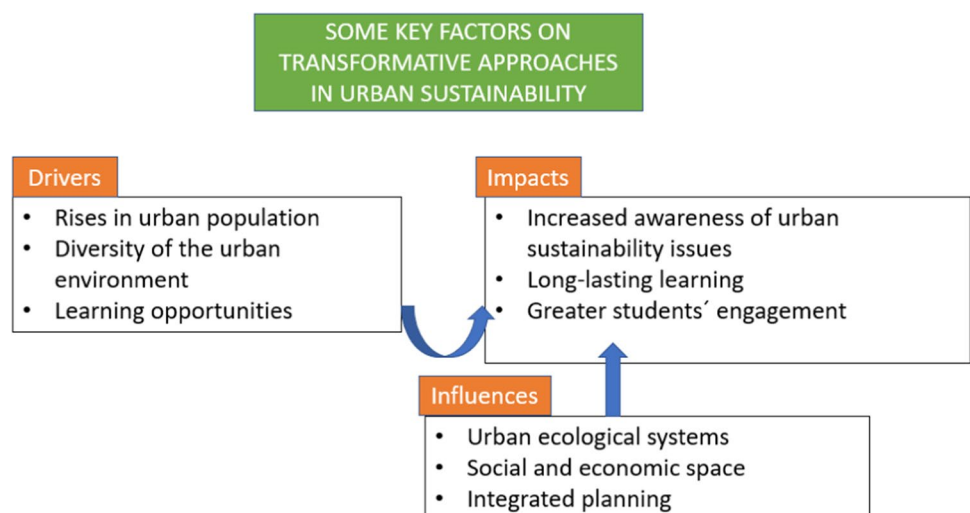
III)   barriers and opportunities: with one question for each topic, this section was interested in understanding the challenges teaching staff usually face when integrating transformative learning for urban sustainability, and how these challenges can be overcome; and, lastly

The first set of questions and options was initially proposed by the multi-national team of authors based on an iterative process. The urban sustainability themes considered were based on Sharifi [51], who analysed the development of the field by means of a bibliometric analysis. Regarding approaches for transformative learning and possible classroom assignments, options were based on Yıldırım and Yelken [26] and Romano [52], respectively. The questionnaire was then revised, following the pre-test with sustainability researchers and teaching staff and their recommendations for minor adjustments in terms of language and scope. In addition to those questions, the respondents' country and position in their universities were also assessed for sample description.

The final part of the questionnaire allowed respondents to share experiences related to transformative learning/teaching or research on urban sustainability in their universities. Some of these cases are also discussed as part of the results.

The survey was applied through Google Forms and the responses were collected from November 2020 to January 2021. The survey invitation was initially shared with all members of the Inter-University Sustainable Development Research Programme (IUSDRP, https://www.haw-hamburg.de/en/ftz-nk/programmes/iusdrp/), a specialist network, and with the contacts within each co-author's institution, representing a snowball sampling strategy, similar to the one used in previous works [53, 54] to achieve the maximum number of possible answers, being a non-probabilistic approach [55]. Despite some limitations that can be pointed out, such as the risk of bias and the impossibility to generalize the results achieved, this strategy is efficient and simple to implement, providing a diversity of viewpoints in a very limited amount of time.

In total, 100 responses were received from 27 countries: Australia, Austria, Brazil, China, Colombia, Côte d'Ivoire, Croatia, Germany, Ghana, Hong Kong, India, Iran, Italy, Latvia, Malaysia, Mexico, Nepal, Nigeria, Philippines, Portugal, Saudi Arabia, South Africa, Spain, Switzerland, Uganda, UK, and the United States, as shown in Fig. 3. Regarding the respondents' primary position in their universities, 42% of them indicated the educator role, followed by 24% as researchers and 12% of respondents with an administrative role. The combination of education and administration roles was indicated by 2% of the sample, while educators/researchers represent an additional 16% of the group. A few respondents (4%) indicated having a combination of all roles. Because all these experts were assessed via the IUSDRP network, we have confidence in the roles mentioned by the participants.

The following section presents the data descriptive analysis and discusses the main insights generated from this global survey overview on transformative learning for urban sustainability. The examples of approaches, methods, and initiatives in transformative learning within an urban sustainability teaching context commented on by the respondents were analysed using qualitative content analyses [56]. After careful analysis of all answers, these were coded into four major clusters, considering their approach and impact in teaching, research, outreach, and campus categories.

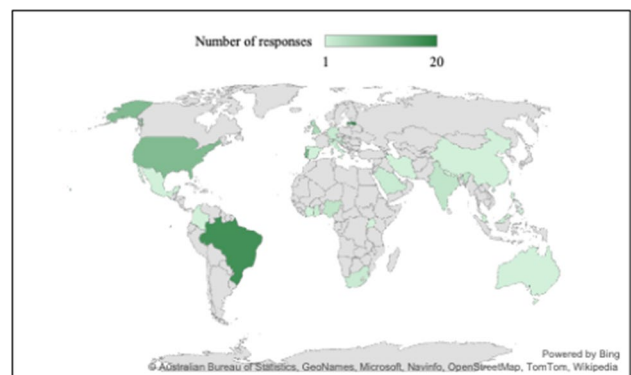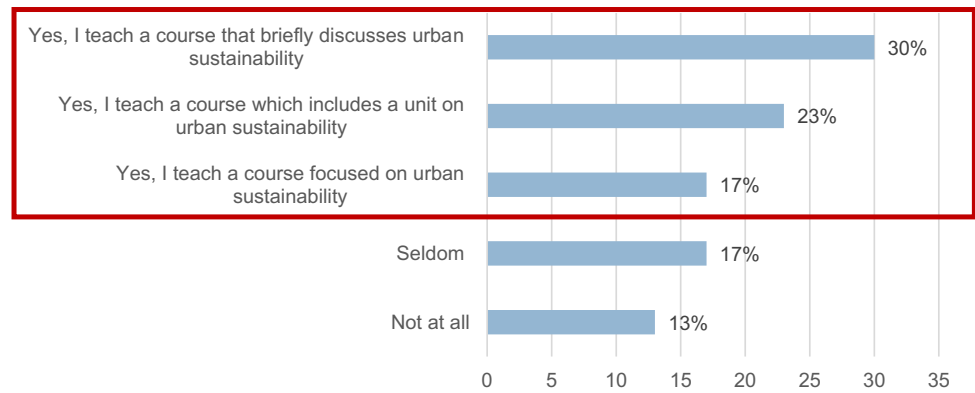**Fig. 3** Participating countries according to the number of responses

Fig. 4 Integration of urban sustainability into the respondents' courses

Table 2 Urban sustainability themes taught in respondents' course

Theme	Percentage
Environmental protection and restoration	12.3
Energy consumption	12.1
Renewable energy	11.7
Waste management	9.9
Urban planning processes	9.7
Sustainable transport	9.2
Green economies including clean technologies, green tax policies, green infrastructure, etc	7.2
Environmental justice and equity	6.6
Preservation of public space, cultural and natural heritage	6.4
Protection and preservation of water resources including groundwater	6.0
Local food systems in urban areas	4.1
Other	4.9
Total	100.0

4 Results and discussion

This section outlines and discusses the main findings obtained from the survey applied to the teaching staff in HEIs on transformative learning for urban sustainability. Firstly, it presents urban sustainability issues at the HEIs. Further, the findings related to transformative learning theory and urban sustainability in teaching and research are discussed. Finally, various initiatives on transformative learning within an urban sustainability context are presented.

4.1 Urban sustainability in the sampled higher education institutions

On the topic of urban sustainability integrated into teaching programmes at the respondents' universities, the majority of the sample (91%) provided an affirmative answer; however, 36% consider the integration to be of a limited extent. Regarding their courses, 70% of the respondents indicated that the courses have some kind of integration; 30% teach a course that briefly discusses urban sustainability and only 17% teach a course focused on this issue. Figure 4 shows the results obtained from this question. The main themes addressing urban sustainability that the respondents teach in the courses are environmental protection and restoration (60%), energy consumption (59%), renewable energy (57%), waste management (48%), urban planning processes (47%), and sustainable transport (45%). Table 2 presents all the listed themes.

4.2 Transformative learning in an urban sustainability context

Regarding the usefulness of transformative learning tools, 97% indicated that the related tools encourage students to be able to contribute to urban sustainability efforts, 49% to some extent, and 39% to a great extent. This result reinforces Sterling's [11] findings that transformative learning strategies coupled with urban territories have the potential to chart a new course of education for urban sustainability. Transformative learning can facilitate not only scientific learning but also social development at individual, communal, and institutional levels, as defended by Aboytes and Barth [22] and Zografos et al. [8].

The results pointed to the fact that most of the enquired participants (60%) have incorporated transformative learning theory and tools in the teaching of urban sustainability. More than one-third (36.7%) of the affirmative respondents report using a transformative learning approach in courses that briefly discuss urban sustainability, 25% of them in courses focused on urban sustainability, and the same percentage in courses that include a specific unit about this issue. When the respondents were asked about how long they have been implementing the transformative learning aspects in urban sustainability teaching, 17% of them indicated 'up to 1 year', 42% indicated an implementation of 2 to 4 years, and 41% of 5 years or more, revealing that these are recently practices.

Several transformative learning tools were reported, and the most incorporated ones in urban sustainability teaching are project-based learning, collaborative learning, action-based learning, scenario planning, experimental learning, and action research. These tools are also mentioned by Su [16] and Aboytes and Barth [22] as being important to provide critical reflections, engaged discourses, and personal and societal objectives within the sustainability consciousness. Figure 5 presents the transformative learning tools incorporated by the sample.

When asked specifically about fieldwork, 82% of the respondents stated that they use this strategy to engage their students in urban sustainability research or teaching, with 20% indicating to a great extent, 26% to some extent, and 36% to a limited extent.

Regarding the assessment of the outcomes of the transformative learning strategy, 18% of the sample consider their performance in integrating transformative learning into urban sustainability teaching to be adequate, 30% consider it probably adequate, and 25% consider it possibly adequate. One-fifth of the respondents consider their personal experience to probably not be enough to assess students, and 2% consider it definitely not enough. In order to identify the outcomes of incorporating transformative learning, classroom assignments have been used by the participants, providing feedback to students on the extent to which their perspectives have changed. Figure 6 presents the most reported assignments used to provide feedback to students.

The above results mean that class/group projects and discussions of concerns are the most used assignments providing feedback to students, followed by critical thinking ones, i.e., term papers/essays, personal journals, a period of deep thought, assigned readings, and personal reflection; support, self-assessment in courses, and logbooks or self-report, i.e., the discovery of own voice.

Despite the awareness of the concept of transformative learning since the 1990s [1] (Mezirow), the evident opportunity to rethink approaches to education for sustainability, and the need for a commitment of HEIs to foster transformation

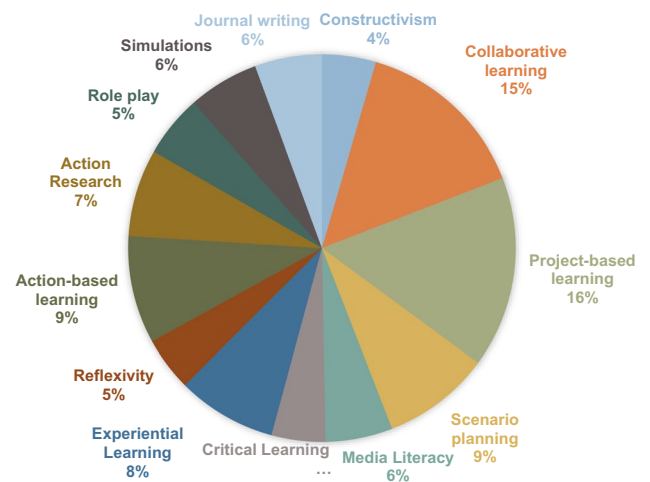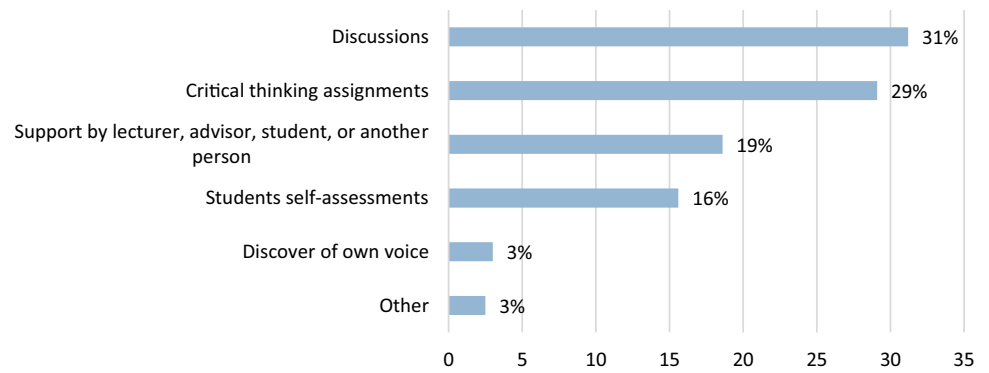**Fig. 5** Transformative learning tools incorporated into the respondents' courses

Fig. 6 Most common assignments used to provide feedback to students

Table 3 Possible reasons why respondents have not yet incorporated transformative learning tools into urban sustainability teaching

Theme	Percentage
Lack of institutional support to improve my learning practices	21.4
Limited by student learning outcomes set by teaching programmes	19.0
Limited incentives to change my syllabus	9.5
Resistance to changing attitude	7.1
Prefer to rely on traditional teaching styles	7.1
Low self-efficacy	6.0
Resistance to attending in-service or professional courses on learning	6.0
Disinterest	3.6
Fear of endorsing and promoting genuine change	1.2
Other	16.7
Total	100.0

[27], the results show that 40% of the sample have not yet incorporated transformative learning tools in the teaching of urban sustainability. The most reported reasons for why they have not integrated this approach into teaching are the lack of institutional support for improving learning practices, the limitation in the student learning outcomes set by teaching programmes, and the limited incentives to change the syllabus. Table 3 shows the pinpointed reasons and the respective frequencies and percentages. Almost 40% of the sample who has yet not integrated transformative learning in urban sustainability does teach a course that briefly addresses this issue.

Finally, regarding the barriers and challenges encountered when embedding transformative learning for urban sustainability in teaching and research, 22% of the sample pointed out that addressing transformative learning tools requires much more preparation time than traditional lecturing, and 21% indicated the difficulty of carving out time to experiment with new methods because of their heavy workload, 18% identified as a barrier the fact that students are not used to these new methods and may find them difficult or challenging, and 18% pinpointed that other faculty tend to be resistant to change.

When asked how transformative educators can expand the way they research transformative learning for urban sustainability, the respondents suggested attending professional development courses on transformative learning (20%), sharing experiences about transformative learning with academics from other faculties (17%), and with the same faculty (14%), and involving students in the design of their courses (12%). Interaction and long-term processes are the conditions for incorporating transformative learning approaches into urban sustainability teaching and research [28]. Avelino and Wittmayer [49] also argued that learning from other stakeholders is elementary for a better understanding of the factors that can contribute to transformative learning.

4.3 Initiatives in transformative learning within an urban sustainability teaching

When it comes to the projects or initiatives involving transformative learning in urban sustainability teaching, only one-third of the sample indicated that their university has had some experience in this issue. This is in line with Zografos et al. [8] study, which reported the shortage of examples of the implementation of transformational approaches in influencing

urban sustainability. The examples provided by the respondents were grouped in the following clusters and can assist in designing and implementing future HEIs initiatives at a broader scale.

- Living labs (campus): using the campus as a living laboratory to study and address social and environmental problems. Some reported examples: Field activities to analyse real situations and propose solutions; Masterplan for the International Hub for Sustainable Development using Living Lab methodologies; University with sustainable management of resources that paved the way to become the national champion for the most eco-friendly and most sustainable university in the country
- University-community collaborative projects (outreach): developing projects in collaboration with the local municipality, involving field activities to analyse real situations and propose solutions. Some examples: are designing community gardens and renewable energy projects, off-the-grid electrification projects, and sustainable urban mobility.
- Core content and a new model of teaching and learning (teaching): this initiative involves new technologies and tools, teaching focused on making students agents of change, laboratories prepared for new forms of learning, and content that serve directly local communities. The initiative is widely supported by the university in terms of investment and professorial capacities. Some examples: Use of video technology in research-based online learning environments to impart sustainability competencies to large groups of students; Serious game (learning tool) for local energy transition; Massively-scaled, a new model of transformative learning that annually matches 25–30 courses across 10 different academic disciplines to one community in our State to work on community-defined sustainability goals; Regular faculty "learning" workshops that focus on exchanging how to teach from learning/transforming perspectives; Laboratories prepared for new forms of learning; Education courses that serve directly with alternating local communities.
- Multidisciplinary research on urban sustainability (research): initiatives that encourage students and professors to engage and raise awareness in various research ranging from urban climate, pollution, and mobility to urban heat islands and their effects on human health in urban areas. Example: a cross-faculty research group that feeds into learning and teaching.

All these approaches have in common the need for institutional support and engagement from the HEIs to deal with transformative learning, as well as the efforts to develop skills on transformative learning for professors, reflected in students raising awareness on sustainability issues, reinforcing the vision of Leal Filho et al. [27] that call the attention for this necessity. Another aspect that emerges from these practices is related to the focus on solutions or understandings of social and environmental problems in the local community. This point reveals the reach of students and teachers, who are more concerned with discussing and solving problems that they experience, thus highlighting the importance of successfully implementing transformative learning in an urban sustainability context.

5 Conclusions

The present study explores the roles that transformative learning in HEIs can play in contributing to advancing urban sustainability. It presents the findings of a global survey aimed at enquiring teaching staff on the extent to which transformative learning has been employed in teaching in HEIs, addressing urban sustainability. It also discusses the main features of some transformative learning approaches, methods, and initiatives within an urban sustainability context and analyses the lessons learned. The results obtained show that most of the participants (60%) have already incorporated transformative learning theory and tools in the context of urban sustainability. It also identified the fact that transformative learning aspects in urban sustainability teaching have been implemented for 2 to 5 years or more in over 80% of the cases, illustrating how recent these practices still are.

The main themes addressing urban sustainability that the respondents teach in the courses are environmental protection and restoration, energy consumption, renewable energy, waste management, urban planning processes, and sustainable transport, which serves to illustrate their potential. Also, the fact that a variety of tools are being deployed, e.g., project-based learning, collaborative learning, action-based learning, scenario planning, experimental learning, and action research, shows that a wide range of approaches can lead to a successful inclusion of urban sustainability issues in transformative learning and teaching programmes. According to the findings of this study, HEIs are already playing an important role in advancing urban sustainability through transformative learning initiatives at various levels of implementation. Ongoing work within less organized countries should be encouraged.

But there are also some challenges that need to be addressed. For instance, attempts to include urban sustainability issues in transformative learning are being hindered by problems such as the lack of institutional support to improve learning practices, constraints in setting-up specific student learning outcomes, and limited incentives to change the syllabus [57, 58].

The study has some limitations. Firstly, the size of the sample, composed of 100 responses, cannot be regarded as representative of teaching practices, despite referring to an impressive number of 27 countries. Secondly, since the data collection instrument used was an online questionnaire, no personal interviews or interactions with the respondents were attempted. Such limitations may provide a fertile ground for future studies that may draw from larger and more diverse samples. But notwithstanding these constraints, the present study provides a valuable contribution to the literature based on the fact that it has collected data from a significant number of countries representing various geographical regions, and the fact that the experts comprising the sample have considerable experience in matters related to sustainability-focused urban issues. Moreover, the research has allowed us to identify some of the constraints that appear when attempting to implement matters related to urban sustainability in the transformative learning scope.

Overall, embedding transformative learning into urban sustainability curricula can be a powerful way to foster critical thinking, creativity, and a deeper understanding of complex sustainability challenges. Some recommendations for better embedding transformative learning into urban sustainability curricula are:

a. Use engaging approaches such as experiential learning and problem-based learning, to encourage students to explore and analyse problems from multiple perspectives.
b. Adopt interdisciplinary approaches, integrating multiple disciplines such as environmental science, urban planning, sociology, economics, and architecture, among others. This approach provides students with a holistic understanding of urban sustainability issues and encourages them to think beyond siloed perspectives.
c. Foster community engagement and connections with local communities and organisations working on sustainability initiatives. This engagement may help students develop empathy, understand diverse perspectives, and see the real-world impacts of their actions.
d. Make greater use of reflective activities and practices such as group discussions, and self-assessments, encouraging students to critically reflect on their learning experiences, their assumptions, and their personal beliefs about sustainability.
e. Leverage technology tools such as interactive simulations, data visualisation, and virtual reality to enhance learning experiences.

Also, one may consider exploring the ethical dimensions of urban sustainability and encourage students to reflect on the social, economic, and environmental impacts of different approaches, helping them to develop a sense of responsibility.

As to future research, it seems appropriate to provide a greater emphasis on urban sustainability when adjusting current teaching programmes or designing new ones, specifically considering transformative learning. This is because a greater understanding of these topics may put HEIs in a position to take greater advantage of the teaching and learning opportunities that urban sustainability provides.

Author contributions WLF: conceptualization, supervision, writing—reviewing; LLB: writing, analysis; MAPD: writing—reviewing; DGV: writing—reviewing; AP: writing; VL: writing; ALS: writing—reviewing, methodology; VK: writing, methodology; LVA: writing, analysis; BF: writing, analysis; IRA: writing; PP: writing.

Data availability Data to be made available on reasonable request.

Code availability Not applicable.

Declarations

Ethics approval and consent to participate The nature of the research, the methods used, and the fact that no personal data was stored or can be traced back to individuals, conforming with GDPR standards, means that the study is not subject to an ethics permit as specified by the Association of Medical Ethics Committee in Germany, the body responsible for such assessments in the country which led the study.

Consent for publication Consent was waived due to the point described above.

Competing interests The authors declare that they have no competing interests.

References

1. Mezirow J. Contemporary paradigms of learning. Adult Educ Q. 1996;46(3):158–72.
2. Elias D. It's time to change our minds: an introduction to transformative learning. ReVision. 1997;27(20):2.
3. Mezirow J. Transformative learning as discourse. J Transform Educ. 2003;1(1):58–63.
4. O'Sullivan E, Morrell A, O'Connor MA. Expanding the boundaries of transformative learning. New York: Palgrave; 2002.
5. Sherman GL. Transformative learning and well-being for emerging adults in higher education. J Transform Educ. 2020;19(1):29–49.
6. Tisdell EJ. Re-searching spirituality and culture: transformative pilgrimage learning and living answers into big questions. J Study Spiritual. 2020;10(1):84–94.
7. Marouli C. Critical pedagogy for environmental and social change: what Helps? What obstructs? Theory and practice in dialogue. In: Roij AB, editor. Transformative research and higher education. Bingley: Emerald Publishing Limited; 2022. p. 45–72.
8. Zografos C, Klause KA, Connolly JJT, Anguelovski I. The everyday politics of urban transformational adaptation: struggles for authority and the Barcelona superblock project. Cities. 2020;99:102613.
9. Lobner N, Seixas PC, Dias RC, Vidal DG. Urban compactivity models: screening city trends for the urgency of social and environmental sustainability. Urban Sci. 2021;5:83.
10. Sommier M, Wang Y, Vasques A. Transformative, interdisciplinary and intercultural learning for developing HEI students' sustainability-oriented competences: a case study. Environ Dev Sustain. 2022. https://doi.org/10.1007/s10668-022-02208-7.
11. Sterling S. Transformative learning and sustainability: sketching the conceptual ground. Learn Teach High Educ. 2011;5(11):17–33.
12. Bonatti M, Erismann C, Askhabalieva A, Borba J, Pope K, Reynaldo R, et al. Social learning as an underlying mechanism for sustainability in neglected communities: the Brazilian case of the Bucket Revolution project. Environ Dev Sustain. 2022. https://doi.org/10.1007/s10668-022-02167-z.
13. Corazza L, Cottafava D, Torchia D. Education for sustainable development: a critical reflexive discourse on a transformative learning activity for business students. Environ Dev Sustain. 2022. https://doi.org/10.1007/s10668-022-02335-1.
14. Haley D. Unconventional educational approaches: an eco-pedagogy to address our transformative challenges. In: Leal Filho W, Azul AM, Brandli L, Özuyar PG, Wall T, editors. Quality education. Cham: Springer International Publishing; 2020. p. 917–29. https://doi.org/10.1007/978-3-319-95870-5_59.
15. Filho WL, Abubakar IR, Mifsud MC, Eustachio JHPP, Albrecht CF, Dinis MAP, et al. Governance in the implementation of the UN sustainable development goals in higher education: global trends. Environ Dev Sustain. 2023. https://doi.org/10.1007/s10668-023-03278-x.
16. Su YH. The learning society as itself: lifelong learning, individualization of learning, and beyond education. Stud Contin Educ. 2007;29(2):195–206.
17. Mezirow J. An overview on transformative learning. In: Illeris K, editor. Contemporary Theories of Learning. Milton Park: Routledge; 2008. p. 40–54.
18. Thieme S, Fry PE. Teaching transdisciplinary competencies for sustainability transformation by co-producing social learning videos. GAIA Ecol Perspect Sci Soc. 2023;32(1):154–61.
19. Formenti L, Hoggan-Kloubert T. Transformative learning as societal learning. New Dir Adult Contin Edu. 2023;2023(177):105–18. https://doi.org/10.1002/ace.20482.
20. Anand TS, Anand SV, Welch M, Marsick VJ, Langer A. Overview of transformative learning I: theory and its evolution. Reflective Pract. 2020;21(6):732–43. https://doi.org/10.1080/14623943.2020.1821942.
21. Riedy C. Discursive entrepreneurship: ethical meaning-making as a transformative practice for sustainable futures. Sustain Sci. 2022;17(2):541–54. https://doi.org/10.1007/s11625-021-00978-z.
22. Rodríguez Aboytes JG, Barth M. Transformative learning in the field of sustainability: a systematic literature review (1999–2019). Int J Sustain High Educ. 2020;21(5):993–1013.
23. McGonagle MQ. The role of the farmacy garden as a site for transformative learning for sustainability. Blacksburg: Virginia Tech; 2020.
24. Humphries M, St Jane M. Transformative learning in troubling times: investing in hope. Soc Bus Rev. 2011;6(1):27–38. https://doi.org/10.1108/17465681111105814.

25. Blythe J, Silver J, Evans L, Armitage D, Bennett NJ, Moore ML, et al. The dark side of transformation: latent risks in contemporary sustainability discourse. Antipode. 2018;50(5):1206–23. https://doi.org/10.1111/anti.12405.
26. Yıldırım M, Yelken TY. The development of transformative learning scale for information and communication technologies. Technol Knowl Learn. 2020;25(4):989–1006. https://doi.org/10.1007/s10758-019-09424-7.
27. Leal Filho W, Raath S, Lazzarini B, Vargas VR, de Souza L, Anholon R, et al. The role of transformation in learning and education for sustainability. J Clean Prod. 2018;199:286–95.
28. Boström M, Andersson E, Berg M, Gustafsson K, Gustavsson E, Hysing E, et al. Conditions for transformative learning for sustainable development: a theoretical review and approach. Sustainability. 2018;10:4479.
29. Nielsen NM. Problem-oriented project learning as a first year experience: a transformative pedagogy for entry level PPL. Educ Sci. 2020;10:6.
30. Ng E, Hu T, McNaughton N, Martimianakis (Tina) MA. Transformative learning in an interprofessional student-run clinic: a qualitative study. J Interprof Care. 2021;35(5):701–9.
31. Kerins J, Smith SE, Phillips EC, Clarke B, Hamilton AL, Tallentire VR. Exploring transformative learning when developing medical students' non-technical skills. Med Educ. 2020;54(3):264–74.
32. Tsimane TA, Downing C. A model to facilitate transformative learning in nursing education. Int J Nurs Sci. 2020;7(3):269–76.
33. Zafran H. A narrative phenomenological approach to transformative learning: lessons from occupational therapy reasoning in educational practice. Am J Occup Ther. 2020;74(1):7401347010p1-6.
34. Bridwell SD. I am not alone: expanding the epistemological framework for supporting marginalized women's transformative learning. J Transform Educ. 2020;18(3):190–208.
35. Cheung H, Langner MR, Braun JE. Methodology to assess "no-touch" building audit software using simulated utility data. Sci Technol Built Environ. 2020;26(7):873–87.
36. Neve H, Hanks S, Heath M, Smith W. 'Today's shook me up a lot inside…it's definitely changed me': emotional responses and transformative learning through working with disadvantaged communities. Educ Prim Care. 2020;31(6):358–64.
37. Prandini M, Baconguis RDT. Changing lives: transformative learning and financial attitudes of filipino women migrants in Italy. Stud Educ Adults. 2021;53(1):61–81.
38. Taylor EW. An update of transformative learning theory: a critical review of the empirical research (1999–2005). Int J Lifelong Educ. 2007;26(2):173–91.
39. Singer-Brodowski M. The potential of transformative learning for sustainability transitions: moving beyond formal learning environments. Environ Dev Sustain. 2023. https://doi.org/10.1007/s10668-022-02444-x.
40. Singer-Brodowski M. The potential of transformative learning for sustainability transitions: moving beyond formal learning environments. Environ Dev Sustain. 2023. https://doi.org/10.1007/s10668-022-02444-x.
41. Pisters SR, Vihinen H, Figueiredo E. Place based transformative learning: a framework to explore consciousness in sustainability initiatives. Emot Space Soc. 2019;32:100578.
42. Weeks JR. Defining Urban Areas. In: Rashed T, Jürgens C, editors. BT—remote sensing of urban and suburban areas. Dordrecht: Springer; 2010. p. 33–45.
43. Levesque VR, Bell KP, Calhoun AJK. Planning for sustainability in small municipalities: the influence of interest groups, growth patterns, and institutional characteristics. J Plan Educ Res. 2016;37(3):322–33.
44. Lüthi C, Willetts J, Hoffmann S. Editorial: city-wide sanitation: the urban sustainability challenge. Front Environ Sci. 2020;8:585418.
45. Marvuglia A, Havinga L, Heidrich O, Fonseca J, Gaitani N, Reckien D. Advances and challenges in assessing urban sustainability: an advanced bibliometric review. Renew Sustain Energy Rev. 2020;124:109788.
46. Portney KE, Berry JM. Participation and the pursuit of sustainability in U.S. Cities. Urban Affairs Rev. 2010;46(1):119–39.
47. Orderud GI, Naustdalslid J. Climate change adaptation in Norway: learning–knowledge processes and the demand for transformative adaptation. Int J Sust Dev World. 2020;27(1):15–27.
48. Minh Quang N, de Wit J. Transformative learning and grassroots climate adaptation: case studies in Vietnam's Mekong delta. Nat Conserv. 2020;39:19–43.
49. Avelino F, Wittmayer JM. Shifting power relations in sustainability transitions: a multi-actor perspective. J Environ Planning Policy Manage. 2016;18(5):628–49.
50. Borgström S. Balancing diversity and connectivity in multi-level governance settings for urban transformative capacity. Ambio. 2019;48(5):463–77.
51. Sharifi A. Co-benefits and synergies between urban climate change mitigation and adaptation measures: a literature review. Sci Total Environ. 2021;750:141642.
52. Romano A. Transformative learning: a review of the assessment tools. J Transform Learn. 2018;5(1):53–70.
53. Leal Filho W, Azul AM, Wall T, Vasconcelos CRP, Salvia AL, do Paço A, et al. COVID-19: the impact of a global crisis on sustainable development research. Sustain Sci. 2021;16(1):85–99.
54. Salvia AL, Leal Filho W, Brandli LL, Griebeler JS. Assessing research trends related to sustainable development goals: local and global issues. J Clean Prod. 2019;208:841–9.
55. Parker C, Scott S, Geddes A. Snowball sampling. In: Atkinson P, Delamont S, Cernat A, editors. SAGE research methods foundations. London: SAGE Publications; 2019.
56. Bontoux L, Bengtsson D. Using scenarios to assess policy mixes for resource efficiency and eco-innovation in different fiscal policy frameworks. Sustainability. 2016;8(4):309.
57. Keeler LW, Beaudoin F, Cid A, Cowley R, Fahy S, Lerner A, et al. Building transformative city-university sustainability partnerships: the Audacious Partnerships Process. Urban Transform. 2023;5(1):1. https://doi.org/10.1186/s42854-022-00045-5.
58. McCormick K, Neij L, Anderberg S, Coenen L. Advancing sustainable urban transformation. J Clean Prod. 2011;19(13):I–II.