Perceptions of interconnected sustainability: Students' narratives bridging transition and education

Janne J. Salovaara [a, *], Janna Pietikäinen [b], Hannele Cantell [c]

[a] University of Helsinki, Faculty of Biological & Environmental Sciences, P.O. Box 65, 00014, Helsinki, Finland
[b] University of Helsinki, Helsinki Institute of Sustainability Science, Faculty of Agriculture and Forestry, P.O. Box 27, 00014, Helsinki, Finland
[c] University of Helsinki, Faculty of Educational Sciences, P.O. Box 9, 00014, Helsinki, Finland

ARTICLE INFO

ABSTRACT

As sustainability becomes a focal point and important aspect of educational development in several disciplines and universities globally, it is important to critically reflect on the different utilisations of sustainability education. Research on educational aims and the potential transformative impact of sustainability courses is quite timely. Among several others, the theory of interconnected learning has been gaining traction as an approach to transformative sustainability education, as it employs a distinct approach to systemic sustainability awareness. This approach aims to further express the plurality of sustainability, with the aim to foster a deeper comprehension beyond the dichotomous thinking often typical in disciplined science. The aim of our research was to study the efficiency of employing the pedagogy of interconnected learning on the types of sustainability transition narratives produced by the students attending an online sustainability course. The sustainability transition narratives, as expressed through fifty-eight students' course assignments, were studied pre- and post-course, and analysed against a collection of established narratives drawn from transition studies. The comparison from the pre-to post-course answers revealed that while some of the student narratives remained unchanged, the majority of the narratives were expanded during the course experience. Our analysis revealed that while most of the students' answers referenced a single type of transition narrative, some students produced narratives that hybridised two or more types of narratives. Additionally, some of the students produced elements of a pathway for a transition narrative that are currently unarticulated in the transition narrative framework employed herein. The elements of this newly articulated narrative focused on changes in the societal mindset, achievable through sustainability education.

1. Introduction

In the urgent search for viable sustainability solutions (Leeuw et al., 2012), education, and specifically higher education, has increasingly been a focal point of attention as a pathway to widespread implementation of sustainability (Lozano et al., 2013). Universities, as the primary institutions of higher education, have responded to the need for education of our future sustainability professionals (Heiskanen et al., 2016). Education for sustainability has, and has had, multiple different implementation strategies, with a focus on institutional structures (for example McMillin and Dyball, 2009) and roles (for example Trencher et al., 2014), or the skills and educational content (for example Trencher et al., 2018), or on the reconceptualization of disciplinarity and interconnectedness (for example Warburton, 2003). Sustainability, in education, and when implemented in educational institutions, appears as transformative and transgressive, largely due to its systemic nature within the structured bounds of sciences and institutions (Lotz-Sisitka et al., 2015). Educating systemic sustainability requires crossing the boundaries that serve as the basis for the typical divisions of classical scientific disciplines (Selby, 2006). Similarly, sustainability urges for strong contextualization, which can be seen as crossing the boundary between the institution itself and society at large. After all, "*Education for sustainability or sustainable development does not define an object of teaching but a goal*" (Albe, 2013, p. 188). This observation illustrates the somewhat newly reconceptualized educational approaches beyond the typical and binding discipline-institution composition.

* Corresponding author.
E-mail address: janne.salovaara@helsinki.fi (J.J. Salovaara).

Sustainability education, with its goal to help build the capacity for sustainability transition (Evans et al., 2017), ought to approach the different dimensions of sustainability as fundamentally interconnected. The interconnected approach practically suggests an education that aims to critically reflect and transcend by integrating classic dichotomies typically employed in scientific thought and education, such as nature-culture, local-global, and individual-social. Rather than focusing on a single dichotomy, the education process—and thus the act therein of sustainability-making—emphasises the systemic and plural nature of sustainability by aiming to integrate these dichotomies, and create new gradients of perspectives between the dichotomies. These wider views emphasise the simultaneous capture of several different dichotomies under the same exploratory process (Lehtonen et al., 2018). Sustainability education is often addressed through its aims for attainment of certain competencies, defined as complexes of skills, knowledge, and attitudes (Wiek et al., 2015). In these complexes the skills, knowledge, and attitudes can take the shape of particular perspectives and aims, rooting from a particular pre-defined problematization of sustainability. In education that is structured to focus on interconnected sustainability there is an overarching exploration of several perspectives leading to a possible problematization. Although all education for sustainability ought to be, in theory, systemic, the interconnected approach differs in practice, for example by reflecting and employing different scientific worldviews or through deliberate exposure to different attitudes. Thus, developing sustainability education that navigates through different dichotomies can evoke new understanding of the utilization of the plural views sourcing from the different dichotomies, and create novel hybrids between the dichotomies. This could further broaden the intended outcome of the sustainability education as a global initiative, from teaching *a* sustainability, to teaching plural views of sustainabilities.

Simultaneously, as sustainability is increasingly implemented in different arenas of society, the discussion resurfaces of what a sustainable future should be or what it should look like. Among several methods concretising sustainability aims, future scenarios in the form of transition narratives offer approachable and comprehensible descriptions of challenges and solutions for a certain future. Luederitz et al. (2017) typologized different academically conceptualized complexes of sustainability change in transition studies, as mainstream types of narratives of transitions (further explained in section 3). Transition narratives can be pieced together into tangible elements of change, which creates a persuasive synopsis of a process-oriented transition plan (Meppem and Bourke, 1999). These transition narratives can also be utilised as a means to verbalise the issues, solutions, and actors of the changes needed to move towards sustainability.

Our aim was to study students' transition narratives and reflect on them utilising the typologized narratives from transition studies (Luederitz et al., 2017). Students' narratives, and changes in these narratives, are used as a means to concretise the transformative potential of interconnected sustainability education. The context of this research is a course run through the Massive Open Online Courses platform (MOOC), that was designed for students in the bachelors, masters, and doctoral level. The course was funded through a national initiative focused on circular economy education. The course had the goal and intention to educate the students—the future sustainability leaders and change-makers (Heiskanen et al., 2016)—to obtain and carry into their studies and career a certain comprehension of sustainability based on the interconnected approach (Lehtonen et al., 2018). The primary material for the research analysis was collected and evaluated through comparative content analysis of the students pre- and post-course assignments. We studied the reproduction, changes, and emerging elements of students' transition narratives during this interconnected sustainability course, by posing these research questions:

1. What are the sustainability narratives that sustainability students reproduce in their rhetoric?
2. How are these narratives different pre- and post-interconnected sustainability education course?
3. What additional elements of transition narratives appeared in the students' rhetorics?

With this paper, we aim to bridge the gap, in a practical context, between transition studies, which rarely explicitly address education, and sustainability education theories, which rarely explicitly address the potential of sustainability for transition. We studied students' perceptions, and the changes to them, during an online course to better understand how sustainability education utilising an interconnected approach is reflected in students' perceptions of transformation towards sustainability. The focus of the analysis was on the students' own articulations of the issues, actors, and potential actors of sustainability pre- and post-course against a framework of acknowledged transition narrative.

2. Material and methods

2.1. Material

The 5 European Credit and Transfer Accumulation System (ECTS) online course, that was used to gather the material for this study, *Leadership for Sustainability Change* (leadforsust.fi), ran in Autumn 2018, as an elective course, at the University of Helsinki and the University of Tampere in Finland. It was open to all students interested in sustainability, across disciplines and study levels. The intended learning outcomes of this course were presented to the students as follows, "*to explore what are the great challenges of sustainability and how they are related [interconnected], how to lead change in complex systems—such as utilising the circular economy, what skills, knowledge and attitudes does a professional change-maker need, and how to make and collaborate on a concrete sustainability project plan*" (Leadership For Sustainability Change course MOOC page, accessed 10/2018). The course content in the first course section, *Challenges of Sustainability,* progressed from showcasing different environmental processes and issues, to a broadened sustainability perspective, and finally to different applications of sustainability, for example circular economy. The second section, *Leading Societal Transition*, addressed different theories of societal transformation and practices of transition management, mainly through a curated collection of illustrative case studies. The final course section, *Becoming a Sustainability Leader,* concentrated on the science, knowledge, education, and collaboration around enacting sustainability. The final group project was not part of this research design. The overarching structure of the course was designed to introduce sustainability with an interconnected approach—navigating through different scientific dichotomies—with an emphasis on potential solutions, and to foster reflection on the different aspects of the sustainability mindset and professionalism to expand the students' perceptions of sustainability transition. The didactic strategy of the course aimed for an interconnected approach beyond interdisciplinarity in navigating through several different dichotomies along the whole of the course (Fig. 1), having an emphasis on both a *why* and *what* reflection of sustainability, and in promoting deep peer discourse.

The fifty-eight students that completed the course (by this we mean students that handed in all of the mandatory assignments and were ultimately awarded the full 5 ECTS for their participation)
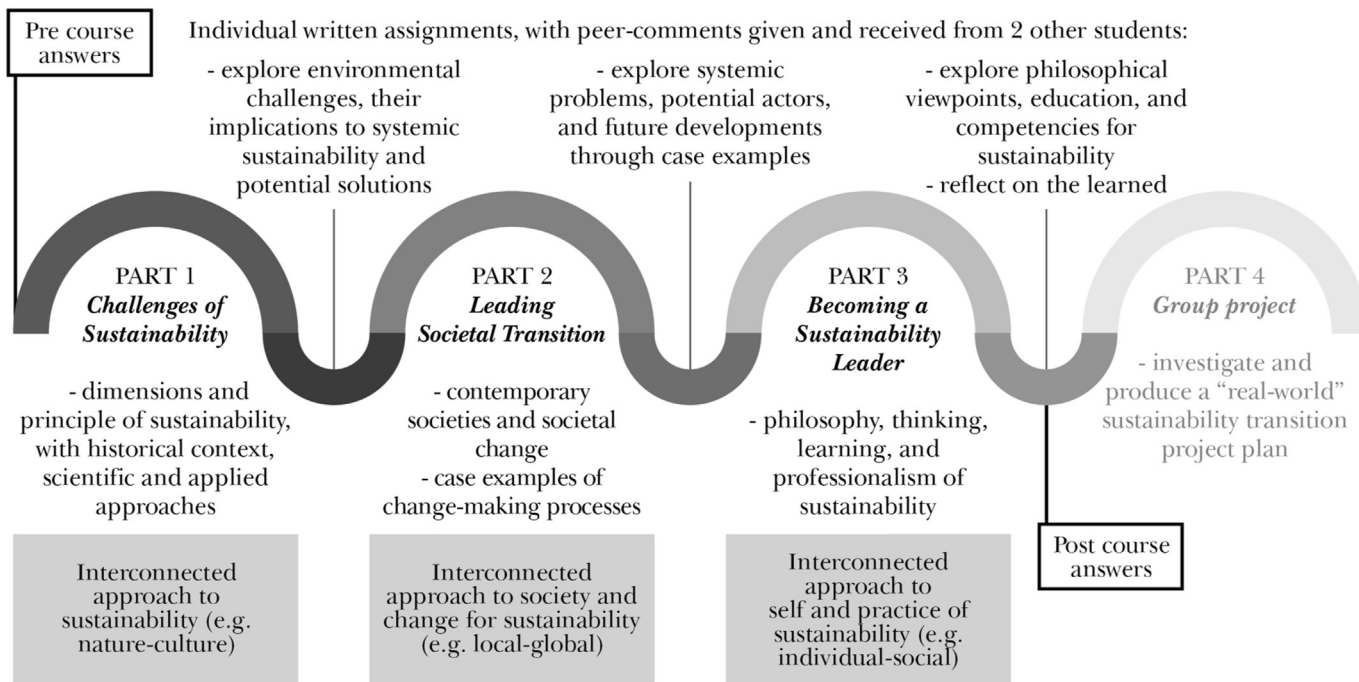
Fig. 1. Course structure, approach, and data collection points.

were studied and their answers compared pre-to post-course. The group includes seven bachelor, forty-three master, and eight doctoral level students, from diverse disciplinary backgrounds (Fig. 2). The students had varying levels of previous knowledge of sustainability subjects through earlier studies and experiences. Based on their pre-course answers, a majority of the students seemed to have a strong sense of some of the core issues, academic discussions, and current trends of sustainability. Other descriptive statistics about the students (i.e. age, gender, etc.) were not collected as these data were deemed not strictly necessary to understand the research questions. The scope of the study was on the possible effects of the course on the enrolled students from various disciplinary backgrounds and on differing study-levels. No comparison group was studied as the purpose of this paper is to specifically highlight the students' perceptions of sustainability and the potential changes to these perspectives through the

participation in this one online course. To continue, a comparison group for similar pre-to post-period comparison study with as large and diverse participants was not viable to assemble.

To complete the pre-course mandatory assignment students were asked to post a written entry to the course discussion board answering a set of questions: 1. *What do you think are the biggest challenges of sustainability?;* 2. *What do you think has to change?;* and 3. *How do you think the change could be led?* These answers, which were collected prior to the start of the course in the first week of September 2018, served as a baseline for comparison. The students' answers varied in depth and breadth—from a few paragraphs to a page and a half. Even though the way in which the answers were worded was different from student to student, all answers contained similar elements for the analysis of the issues, targets, and actors related to sustainability transitions. The students were instructed to write the answers to the
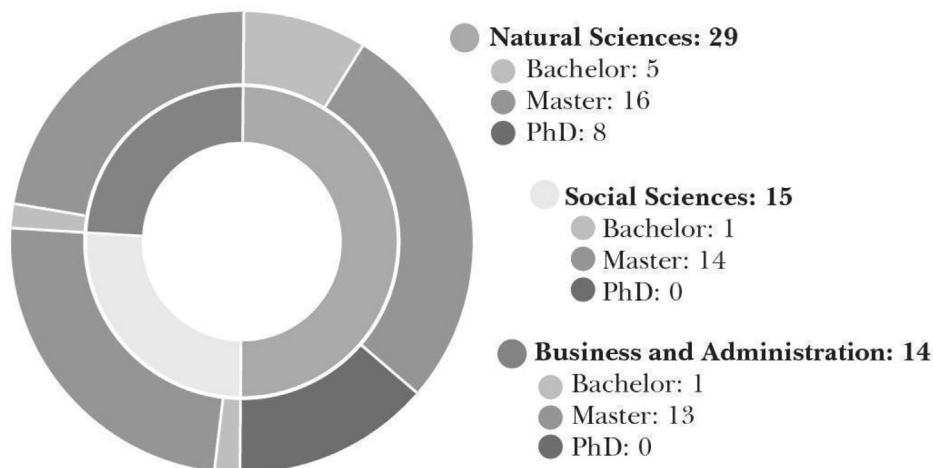

Fig. 2. Students' self-identified discipline/field of study and current study level.

assignment for the course teachers, although the posts were made in an open forum that was accessible by all course participants. The students re-answered the same three questions seven weeks later at the end of the mandatory part of the course. These post-course answers were compared to the pre-course answers for further analysis of the impact of an interconnected sustainability course.

2.2. Methods

To study the students' perceptions of sustainability, narrative analysis was selected as the main analytical method. Narrative analysis—with a focus on the content—was used to tap into the students' perceptions of sustainability transition and the changes in the expression of their sustainability narrative pre-to post-course. Cohen et al. (2011) suggest that narratives serve to uncover broad meanings and interpretations of an abstract concept while staying rooted in a real-world context. Thus, analysing the students' narratives through their answers to the pre-and post-course questions was well suited for a study of students' sustainability perceptions and possible changes to these perceptions. Additionally, as King and Horrocks (2010) suggest, studying narratives is not only useful for an exploration of language, but can also be utilised for theorising typologies across different data sources—in this case the emerging narratives identified through the comparison of the pre-to post-course answers. A set of pre-defined typologies of transition narratives (Table 1), were utilised as the main framework for the qualitative analysis for its structural soundness on the different elements of transitions. The coding of the answers focused on noting comparable elements between the students' answers against the established typologies. In addition to the existing narrative typologies, the uncategorised narrative elements were noted and later grouped and analysed by their content as an extension to the existing analytical framework (Table 1)—as suggested by Hsieh and Shannon (2005).

The three assignment questions were designed to correlate with the transition narrative description including setting, actors, objectives, key actions, and premises of transition pathway narratives (Jones et al., 2014). However, Luederitz et al. (2017) typologized the narratives from transition studies through their interventions to *parameters, flow, design,* and/or *intent* of a transformed societal system (Abson et al., 2016). Parameter interventions focus on changes in mechanistic aspects of a system. Flow interventions focus on the current systems and the ability of this system to change. Design interventions focus on the organisation and management of the system. Intent interventions focus on the aims and goals pointed to by the system design, flow, and parameters. The four-type intervention structure aims to put the narrative to a more practical form for exploring the context in which they ought to take place and their key features (Luederitz et al., 2017). The wording in the three questions posed to students (see chapter 2.1) was simplified in order to secure tangible and comparative answers regardless of their knowledge of the terminology, transition theories, or fluent utilization of sustainability rhetoric.

The pre-to post-course changes were recorded and used to identify the changes that occurred in the student perceptions and narratives over the duration of the course. Although the analysis methodologically utilises the transition narratives framework, interconnected learning in the capacity of a dichotomy-crossing transitional experience, is where we ground the emerging narratives and the reflection on potential changes in the narratives.

3. Theoretical framing

In this section we aim to describe how the theoretical apparatus, introduced below, was utilised in order to form a logical interplay in this study. Where the interconnected learning was put into practice as a didactic approach to the course from which we sourced our materials, the transition narratives were utilised as an analytical framework. Although not directly addressed in the typologized transition narratives, education is typically seen as a vital component of a system-wide transition (see for example Linnér and Wibeck, 2019). Thus, in order to study the relation between the interconnected learning and transition to sustainability, transition narratives are utilised for studying the students' different approaches to sustainability, while interconnected learning is seen as a potential cause to changes in the students' perceptions of sustainability.

3.1. Interconnected learning

The need to evoke transformative thoughts in sustainability education rose from a realization that regardless of the exceedingly alarming sustainability crisis, there is a general tendency to seek quick-fix solutions that arise from ingrained dualistic thinking, rather than an aim to embrace the complexity needed to effectuate sustainability change (Lehtonen et al., 2018). It has also been discussed how dichotomic, individualistic higher education is a partial root cause of the current sustainability issues (Cortese, 2003). Interconnected learning takes a holistic approach, in looking at the world as relational. It recognises the interconnectedness of such

Table 1
Transition narratives compiled from Luederitz et al. (2017).

Narrative (transition types):	Green economy (GE) (e.g. Jänicke, 2012; Vazquez-Brust and Sarkis, 2012)	Low-carbon transitions (LCT) (e.g. Bulkeley et al., 2014; Moloney and Horne, 2015)	Ecotopian solutions (ES) (e.g. Anderson, 2007; Chance, 2009)	Transition movements (TM) (e.g. Taylor, 2012; Michel and Hudon, 2015)
Main issue(s):	Environmental degradation, resource scarcity, and their impact to economy	Climate change and related local impacts	Environmental impacts of unsustainable development trends	Social and environmental impacts of growth-based globalised economies
Target(s) of change:	Unsustainable businesses and industries	(Infra)structures, local enterprises, and actors causing carbon emissions	The status quo of unsustainable traditions, "powers", and belief systems	Conventional practices, interactions, ideas and mindset
Main actor(s) and action(s):	Elites, governments, intergovernmental organisations legislating, and businesses practicing green economy	Cities, municipalities and other local governments and individual actors transitioning to low-carbon practices	Individuals and communities translating ideal alternatives into reality	Citizen led initiatives identifying and counteracting against neoliberal politics and multinational corporations
Aim(s):	Improved environmental efficiency of current economic systems	Societies functioning environmentally sound by low-carbon processes and infrastructure	Socio-ecological autonomous spaces outside the current norms	Society promoting local governance, culture and economy for sustainability

typically dichotomized elements as nature-culture, global-local, and social-individual. This type of inclusive orientation is also coincidentally found in some academic conceptualizations of sustainability science, for example by approaching sustainability through recognised issues at the global, social, and human systems level (Komiyama and Takeuchi, 2006).

The key feature and distinction of interconnected learning is found in its critical reflection and navigation through the different dichotomies (Fig. 3). The dichotomies are studied as interconnected, allowing the construction of a systemic and plural view that better corresponds to the systemic and plural nature of sustainability. Where higher education has earlier struggled to grasp the systemic paradigm (Coops et al., 2015), interconnected learning is specifically suggested for the kind of sustainability education where holism through systems thinking, and interconnectedness over dichotomies are foundational (Lozano et al., 2013). This foundation is seen as the decisive element for comprehending the given knowledge, for attaining the needed skills, and for evoking the right attitudes—in short, constructing effective competencies for sustainability (Wiek et al., 2015).

Similar to how Luederitz et al. (2017) have constructed the transition narratives, interconnected learning finds justification by describing the need to go beyond simply learning about the issues by exploring deeper dynamics of humans as actors of unsustainability and as narrators of the sustainable future. The core issues, processes, and aims of sustainability science (Jerneck et al., 2011) are well nested in the conceptualization of interconnected learning, which aims for holistic understanding, for example, of dynamics like nature-culture. Interconnected learning, conceptualized around the idea of dismantling dichotomies of science and thinking, could be a necessary element to effectuate radical sustainability transformation. The justification of interconnected learning in itself can be seen as following an altogether different transition narration, suggesting that sustainability issues ought to be (re)explored with a new, interconnected mindset. Thus, the two different approaches to the transition process, first—transition narratives as change-plans, but also as expressions of sustainability comprehension, and second—education as one form of execution of a sustainability change, but also as a shaping element of the comprehension of what is needed to change, seem to both reach towards the request of a more transformative sustainability.

3.2. Transition narratives

Transition narratives conceptualise different approaches to bending the acknowledged and predicted negative development curves to sustainable ones, which aim for sustaining and even improving earth's life-support systems and living resources to meet
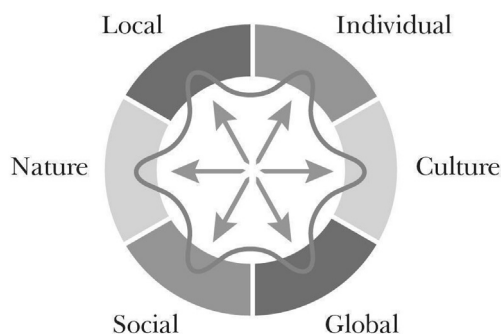

Fig. 3. Examples of a focus on modern dichotomic ends, versus an interconnected approach that navigates through the dichotomies (adapted from Lehtonen et al., 2018).

humanity's needs (Kates and Parris, 2003). Luederitz et al. (2017) typologized four different transition narratives, each conceptualizing a specific pathway to sustainability that integrates ecological integrity with social viability. Transition narratives were selected for the analytical framework of this study, as this particular categorization represents a wide body of academic work on transition studies, with a focus on sustainability transitions.

Different dichotomies juxtaposed within the acknowledged pool of sustainability theories are specifically interesting for constructing a transition pathway and the narratives that describe the pathway. As such, the *competing* theories of sustainability, for example weak or strong sustainability, technocentric or ecocentric perspectives, and transition as a reformist adaptation or as a radical transformation, seem to follow the same dichotomous approach pattern. However, these different narratives or dichotomies within sustainability are not to be understood as competing, but rather complementary in approaching adoption of holistic sustainability transition in the long term (Luederitz et al., 2017).

Luederitz et al. (2017) recognize a few shortcomings in the meta-narration of the different sustainability transitions in their study. For example, these pathways tend to focus on reform rather than transformation in their approach to sustainable solutions, and the changes highlighted by the narratives alone do not necessarily represent the whole of the transformation needed to reach sustainability. As mentioned earlier, while the academic consensus on sustainability education recognises its importance to sustainability (for example Jones et al., 2010), the selected transition narratives do not explicitly make this same recognition. However, Lehtonen et al. (2018) address the issue of dichotomic, disciplinary sustainability education as a force that is somewhat hindering the ability of education to engender radical changes. To tackle this issue Lehtonen et al. (2018) suggest interconnected learning as an approach to frame a more transformative pedagogy of sustainability. Here we see a potential connection point between the aforementioned shortcomings that are general to the aforementioned transition narratives—wherein education is merely implicit—-and transformative education that engenders a broadened pathway to transformation through fundamentally different mindsets.

4. Results

The study results are presented in three separate sections, formulated around the three guiding research questions. We first look at the transition narratives reproduced in the students' pre-course answers, then observe changes between the pre-to post-course answers, and lastly, we explore any uncategorised narrative elements, and aim to categorize them into an *in-situ student perspective* (further explained in the discussion chapter) to the transition narratives.

4.1. Transition narratives

The students' answers on the main issues, needs for change, and actors of sustainability coincided well with the typologized transition narratives identified in the academic literature. Predominantly the students' transition narratives reproduced elements of the GE narrative (See Fig. 4). A common answer to the biggest challenges of sustainability, revolves around the causal relations of consumerism, supply-demand, production-consumption, and environmental changes—acknowledging biodiversity loss as one major issue. For example, "*I would say that the greatest challenge in sustainability is consumption with its many variations*" (Bachelor level student of Energy and Environmental Engineering #1). The GE narratives reproduced by the students follow the given focus on environmental repercussions of the problematic processes and

took a less critical stance on the current economic system and power structures. Although critical elements such as attitudes and mindsets occasionally were referenced at the beginning of the narrative structure, they were further utilised as reasons for a certain kind of consumer behaviour, which was then taken as the main cause of the repercussions and the focus of the narration. For example, *"For me, the biggest challenge for sustainability is changing people's habit[s] from overconsumption to sustainable one"* (Bachelor level student of Energy and Environmental Engineering #2). These narratives further reference the conceptualization of the GE narrative in suggesting such solutions as green and clean technologies, environmental taxation, and other economic tools to manage the environmental impacts of economic processes. For example, *"If states and huge companies are not willing to make a change to start providing sustainable solutions and services, it is extremely difficult for the citizens to live a sustainable life"* (Master level student of International and European Relations #1). These were at the core of the student reproduced GE narratives, along with other direct indications of responsibilities that businesses have concerning sustainability issues.

Aside from the majority of students reproducing the GE narrative, and related hybrids, the remaining narratives varied. Students who reproduced the elements of LCT narrative mostly referenced the main issues of sustainability as related to energy, fossil-fuels, oil-based products, and greenhouse gas emissions. For example, *"I think that our whole society is basically run by the fossil capitalist economic system. This has to change. We can't base our economy and society on fossil fuels and fossil industries anymore"* (Master level student of Responsible Business). In addition, the students also referenced other LCT transition elements, such as governance and regulations, regarding local life and industry. The students reproducing the TM narrative cited a variety of issues as adding to the sustainability crisis, ranging from plastics and overpopulation, to growing social inequality. For example, *"I think the greatest challenge in sustainability is to reform society's current status quo and economic framework. Humans have developed the belief that*

economic growth is needed to achieve wellbeing." (Master level student of Business). Those rare students that reproduced the ES narratives, in some hybridised form, mostly referenced the more radical changes to the culture-nature status quo, in suggesting societies ought to find a wholly new intent. For example, *"The courage to make more radical decisions and to mobilize all people to make climate friendly actions requires multidisciplinary cooperation and cooperation in every level of society."* (Master level student of International Relations #2).

The biggest group of hybrid narratives were based on GE narratives that also referenced those issues typical to the LCT narrative. In all these cases the students referenced energy, fossil-fuels, and oil-based products as a target and means of economic processes harmful to the environment. Their responses had a mix of approaches, including consumer-awareness, local to global production, and business regulations as targets of change. The rest of the narratives were hybrids of narratives consisting of elements from at least two narrative types, or took a different approach to the issues, targets, and agents of change, referencing uncategorised elements beyond the existing narrations framework.

4.2. Changes in the narratives

When comparing the pre- and post-course answers, we identified three different reactions: 1. Those whose transition narration did not change; 2. Those whose transition narrative developed—meaning they added features from other narratives or concentrated on a narrower set of features in their own narrative; and 3. Those whose transition narration type changed. Here, in creating change in the reproduced narratives, we see the interconnected approach as having had a major impact in the students' narrative development. In total, twenty-three students' narratives remained unchanged (Fig. 4). Only three students expressed explicitly that their views on the major issues of sustainability remained unchanged throughout the course. However, the majority of the students added new elements to their narratives or adopted a
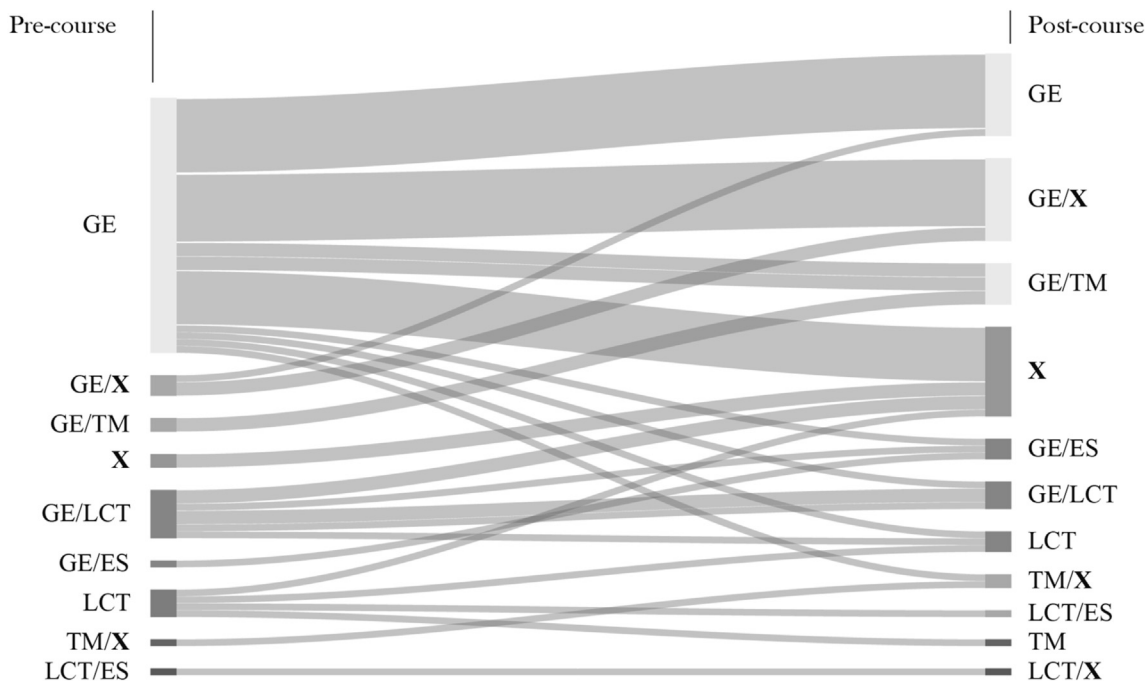

Fig. 4. Student's narratives pre-course and post-course: GE = Green Economy, LCT = Low-Carbon Transition, ES = Ecotopian Solutions, TM = Transition movements, X = uncategorised features, and hybrids of the narratives.

different narrative. Eight out of the fifteen students who came into the course with a hybrid narrative, kept their narrative unchanged. Additionally, those six students whose narrative was markedly constructed of the uncategorised elements, kept their narrative post-course.

For the purpose of analysing the potential impact of the course on the students' perceptions of sustainability, our analysis focused on changes from one type to another. The disciplinary background seemed to have no effect on the changes or pluralisation of the narrative. For example, of the students who reproduced the GE narrative pre-course and remained with the GE narrative post-course, six were from natural sciences, four from business and management, and three from social sciences background, which represents the general background disciplinary representation of the enrolled students. The study level—bachelor, master, or doctoral—seemed to have no decisive effect on a shift in personal sustainability narrative. From the seven bachelor students, four remained unchanged, two developed their existing narration and one changed completely. Out of the forty-three master level students, fifteen remained unchanged, sixteen developed their narrative, and twelve changed completely. Out of the eight doctoral students, three remained unchanged, four developed their narrative, and one changed completely.

4.3. Additional elements and student perspectives

As mentioned, several students brought up elements outside the selected transition framework. These uncategorised elements were predominantly present in the answers to the first question, "*what do you think are the biggest challenges of sustainability?*" Students stated the main issues of sustainability were profoundly related to human processes. As an example, this means a clearer focus on the growth or fossil-based economies as causes for the environmental issues—rather than the other way around. These students were explicit in the issues to be rooted in the mindset, attitude, knowledge and awareness behind the unsustainable human processes. With the second question, "*what do you think has to change?*", the expressed narratives brought up such suggestions as education, knowledge distribution and collaboration as a society-wide practice. To the last question, "*how do you think the change could be led?*", the responses pointed to institutional and educational actors such as schools and universities—generally through their responsibility to educate professionals and inform the society. In these responses, other sub-sectors of society were also named as potential actors. Here we see that the theory of interconnected learning and thinking, especially in its aims to transformatively educate the relational nature-culture existence, takes its place not only as a didactic approach, but also as wordings in students' rhetorics.

These uncategorised elements of the students transition narratives were 'intent intervention' oriented, as they based their narrative on changes in beliefs, mindsets, and goals, which then led to change other elements in support of sustainability (Table 2). Societal norms and practices were the target of the change, meaning that the narratives saw potential solutions for the unsustainable societies and practices to emerge through these 'sustainability enlightened' mindsets—enlightened in the sense of aiming to deepen the understanding of the reality of things, rather than focusing solely on specific applications (Clark et al., 2016). In these narratives, the other elements, if directly addressed, were similar to those in the other recognised narratives. For example, "*I think the first major problem in the society is the lack of knowledge and wrong attitudes towards sustainability issues. These need to be changed, before we can tackle the real issues such as climate change*" (Master level student of Leadership in Change). However, education as a

transition element was brought up repeatedly. For example, "*Still my opinion is that the biggest challenges are the unsustainable mindset of societies and unsustainable actions of the multinational corporations. Education is the key word for leading the change*" (Master level student of Sustainable Business), and "*Definitely the first things that have to be affected are the attitudes amongst people. [...] The sustainability education should be integrated into the society and it should affect all people all the way from academics to the implementing parties*" (Master level student of Wood Technology). To generalise, education was added as an overarching element, by students of each transition narration category. The commonly cited actors ranged from individuals with an enlightened mindset to new networks of collaboration. Most commonly education and educational institutions were identified as key actors to lead the change. The more unique features of these narratives were found in the intent and aims of the change. In other words, to move to a radically new society where the awareness, attitudes, and enactment of sustainability is not only embedded into, but are the focus of the human process.

5. Discussion

As Luederitz et al. (2017) conclude, the different narratives should not be understood as competing, rather as complementary. These narratives approach transition from varying angles and ultimately the overall scheme for transition can be found in the meta-narrative that emerges from several different narratives. Similarly, these students utilised different narrative elements in parallel and created hybridised narratives. Overall changes in the groups' narratives were relatively small, especially among those referencing the GE narrative (Luederitz et al., 2017), even though at times they added elements to their narratives. A reason we would like to highlight, among several possible reasons, for the repeated reproduction of GE could stem from the realization that the current sustainability rhetoric often concentrates, or is bound to, the environment-economy dilemma (Young, 2006). To an extent, this common rhetoric consistently holds economic growth as the highest priority and as an indisputable and unchanging source of human wellbeing. In the face of such entrenched rhetoric, to further the conversation around how to best advance sustainability transition, we would need to plug in a richer, interconnected narrative that could lead to critically reflect on what are the root causes of our concurrent sustainability crisis (Feola, 2020). Here we see a connection to the elements that emerged from the students' narratives that explicitly highlight the issue and expected effect of education to further support a dichotomic interpretation rather than support an interconnected mindset of our societies. In light of this observed issue, we suggest interconnected education as a suggested solution. This approach could potentially bring about the needed sustainability enlightenment through its embedded comprehensive, systemic, and holistic perspectives (Guerra and Smink, 2019).

In this case, connecting education to transition narratives can be seen as an addition to the sustainability transitions that comes from an *in-situ* student perspective. This student perspective is rooted in the course experience and the student position, and focuses on additional elements, rather than offering a fully fleshed out narrative. Surely, education for sustainability, with a general acknowledgement and sustainability awareness, must be held as a premise to all of the transition narratives (Leal Filho et al., 2016)—whether the change happens through attitudes and beliefs (Tang, 2018), or practice and habits (Chuvieco et al., 2018). Here we see similarities with the student-emerged narrative on education as a transition precursor and the suggestion by Luederitz et al. (2017) that collaboration between researchers and other actors is of key

Table 2
Hybridising the additional elements with commonly reproduced elements of the recognised transition narratives.

Narrative (intent):	Sustainability enlightened societies
Main issue(s):	Similar to the other narratives, such as environmental impacts, failing economies, unequal societies—caused by wrong mindsets
Target(s) of change:	Similar to the other narratives, such as production, consumption, economic system—caused by the unsustainable intent of the status quo
Main actor(s) and action(s):	Education on all levels shaping the citizens and professionals for sustainability-oriented societies—as an implicit basis to the other narratives
Aim(s):	A radical transformation to yet unknown society of sustainability enlightened privates and professionals that functions on fundamentally different values, aims, and processes.

importance in achieving transition. Although this premise is not highlighted in the typologized narratives, it emerged from the student answers, and it is acknowledged in sustainability education research. This can be summarized that through education we aim to change the overarching societal intent towards sustainability (Wals and Jickling, 2002). While we have not yet seen the full extent of sustainability comprehension possible in an educated mind that is native to sustainability thinking, we feel that being explicit on the importance of education, as a precursor to the sustainability transition, is a worthy endeavour.

As we seem to already know enough of the symptoms of our current human-nature relationship, focusing on developing narratives around the paradigms we hold constant and unchangeable could be a source of inspiration for planning a new kind of interconnected sustainability (Lehtonen et al., 2018) didactic leading us to new education, and ultimately solutions, that go beyond the end-of-the-pipe symptoms of our processes (Hansmann et al., 2012). Although interconnected learning has practical facets, such as a methodological framework and educational practises, at the moment it stands as a more theoretical contribution. Rather than studying what is, or criticising how these study objects ought to be—or at worst—accepting the unsustainable status quo, education could aim for producing interconnected perspectives to what the culture-nature, among several perspectives on this existence, ought to be and what kind of a reality is drawn based on the reframed perspectives. Of which, the narrative that emerged, focused first on sustainability as a societal intent, with the technical expression to follow, can already be seen as an example of such a perspective. It seems unclear to us, how radical an education can become and remain relevant and impactful to its base aims. However, during these times of global distress—environmental crisis, societal unrest, economic turbulence, and a global pandemic—it seems clear to us that a fundamentally new understanding of the interconnected existence is needed to better understand and treat these issues.

The fifty-eight-students of the course that served as our case, produced the presented narratives that led to our conclusions. However, we acknowledge that the sample size of our data is a limitation to the conclusions—also in regard to the simplified formulation of our data collection questions and the variety of breadth and depth between the answers. Although this course was specifically planned as an intensive and interconnected course, utilising several different concepts, phenomena, and approaches to sustainability, we acknowledge the issue of isolated impact of this course to the students' narratives, among other potentially simultaneously running courses. Thus, we see research of sustainability education, focusing on the quantitative effect of the interconnected approach on students' perception of sustainability which could lead to more generalisable results, and prolonged impacts of the changed perception to the students future study and career paths, as future iterations of this study.

6. Conclusion

Analysis of the students' narratives, who participated on the pilot

course, revealed the chosen transition narrative framework to be suitable for the study of students' perceptions of sustainability and the changes to these perspectives. In studying the potential impact of interconnected sustainability education, we conclude that even though these students naturally reproduced several of the pre-selected academic transition narratives, their narratives were expanded through engagement with the course. Regardless of the disciplinary background or current study level, the interconnected sustainability study experience seemed to broaden rather than redirect their sustainability perceptions. Similar to the pluralistic ideology of interconnected learning, several students added elements from other narratives discovered in the students' pre-course assignments.

The *in-situ* perspective to the sustainability transition that the students produced spoke of change that has an aim to educate a global society of sustainability minded decision makers, professionals, consumers, and citizens—in short—a sustainability enlightened society. However, some level of sustainability education is necessary and foundational to all types of transition narratives. Thus, it ought to be made more explicit as a transformative element, not only in sustainability education, but also in transition studies and narrations of sustainability. It seems apparent that interconnected sustainability education, highlighting the systemic aspects of sustainability issues in a contextualised manner, while also giving emphasis on reflecting the underlying mindsets to sustainability, has the potential for enriching the students' comprehension of the matters of interests. These enriched understandings could further open students to be able to recognize and explore new perspectives to produce innovative solutions for sustainability.

CRediT authorship contribution statement

Janne J. Salovaara: Conceptualization, Methodology, Writing - original draft, Investigation, Formal analysis, Visualization, Resources. **Janna Pietikäinen:** Supervision, Methodology, Writing - review & editing, Resources. **Hannele Cantell:** Supervision, Methodology, Writing - review & editing, Resources.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

throughout the writing process, and the anonymous reviewers for their insightful comments that helped us to improve our article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2020.125336.

References

Abson, D., Fischer, J., Leventon, J., Newing, J., Schomerus, T., Vilsmaier, U., Wehrden, H., Abernethy, P., Ives, C., Jager, N., Lang, D., 2016. Leverage points for sustainability transformation. Ambio 46 (1), 30–39. https://doi.org/10.1007/s13280-016-0800-y.

Albe, V., 2013. On the road to science education for sustainability? Cult. Stud. Sci. Educ. 8, 185–192. https://doi.org/10.1007/s11422-012-9449-4.

Anderson, J., 2007. Elusive escapes?. In: Leonard, L. (Ed.), Utopias, Ecotopias and Green Communities: Exploring the Activism, Settlements and Living Patterns of Green Idealists (Advances in Ecopolitics, vol. 1. Emerald Group Publishing Limited, pp. 64–82. https://doi.org/10.1108/S2041-806X(2007)0000001006.

Bulkeley, H., Castan Broto, V., Maassen, A., 2014. Low-carbon transitions and the reconfiguration of urban infrastructure. Urban Stud. 51, 1471–1486. https://doi.org/10.1177/0042098013500089.

Chance, T., 2009. Towards sustainable residential communities: the beddington zero energy development (BedZED) and beyond. Environ. Urbanization 21, 527–544. https://doi.org/10.1177/0956247809339007.

Chuvieco, E., Burgui-Burgui, M., Da Silva, E., Hussein, K., Alkaabi, K., 2018. Factors affecting environmental sustainability habits of university students: inter-comparison analysis in three countries (Spain, Brazil and UAE). J. Clean. Prod. 198, 1372–1380. https://doi.org/10.1016/j.jclepro.2018.07.121.

Clark, W., Tomich, T., Noordwijk, M., Guston, D., Catacutan, D., Dickson, N., McNie, E., 2016. Boundary work for sustainable development: natural resource management at the consultative group on international agricultural research (CGIAR). PNAS 113 (17), 4615–4622. https://doi.org/10.1073/pnas.0900231108.

Cohen, L., Manion, L., Morrison, K., 2011. Research Methods in Education, seventh ed. Routledge, New York.

Coops, N., Marcus, J., Construt, I., Frank, E., Kellett, R., Mazzi, E., Munro, A., Nesbit, S., Riseman, A., Robinson, J., Schultz, A., Sipos, Y., 2015. How an entry-level, interdisciplinary sustainability course revealed the benefits and challenges of a university-wide initiative for sustainability education. Int. J. Sustain. High Educ. 16 (5), 729–747. https://doi.org/10.1108/IJSHE-04-2014-0059.

Cortese, A., 2003. The critical role of higher education in creating a sustainable future. Plann. High. Educ. 3, 15–22.

Evans, N., Stevenson, R., Lasen, M., Ferreira, J.-A., Davis, J., 2017. Approaches to embedding sustainability in teacher education: a synthesis of the literature. Teach. Teach. Educ. 63, 405–417. https://doi.org/10.1016/j.tate.2017.01.013.

Feola, G., 2020. Capitalism in sustainability transitions research: time for a critical turn? Environ. Innovat. Soc. Transit. 35, 241–250. https://doi.org/10.1016/j.eist.2019.02.005.

Guerra, A., Smink, C., 2019. Students' perspectives on sustainability. In: Leal Filho, W. (Ed.), Encyclopedia of Sustainability in Higher Education. Springer Nature, Switzerland, pp. 1560–1568.

Hansmann, R., Mieg, H., Frischknecht, P., 2012. Principal sustainability components: empirical analysis of synergies between the three pillars of sustainability. Int. J. Sustain. Dev. World Ecol. 19 (5), 451–459. https://doi.org/10.1080/13504509.2012.696220.

Heiskanen, E., Thidell, Å., Rodhe, H., 2016. Educating sustainability change agents: the importance of practical skills and experience. J. Clean. Prod. 123, 218–226. https://doi.org/10.1016/j.jclepro.2015.11.063.

Hsieh, H., Shannon, S., 2005. Three approaches to qualitative content analysis. Qual. Health Res. 15 (9), 1277–1288. https://doi.org/10.1177/1049732305276687.

Jerneck, A., Olsson, L., Ness, B., Anderberg, S., Baier, M., Clark, E., Hickler, T., Hornborg, A., Kronsell, A., Lövbrand, E., Persson, J., 2011. Structuring sustainability science. Sustain. Sci. 6, 69–82. https://doi.org/10.1007/s11625-010-0117-x.

Jones, M., McBeth, M., Shanahan, A., 2014. Introducing the narrative policy framework. In: Jones, M., Shanahan, A., McBeth, M. (Eds.), The Science of Stories: Applications of the Narrative Policy Framework in Public Policy Analysis. Palgrave Macmillan, New York, pp. 1–26.

Jones, P., Selby, D., Sterling, S., 2010. Sustainability Education: Perspectives and Practice across Higher Education. Earthscan.

Jänicke, M., 2012. Green growth": from a growing eco-industry to economic sustainability. Energy Pol. 48, 13–21. https://doi.org/10.1016/j.enpol.2012.04.045.

Kates, R., Parris, T., 2003. Long-term trends and a sustainability transition. Proc. Natl. Acad. Sci. Unit. States Am. 100 (14), 8062–8067. https://doi.org/10.1073/pnas.123133110.

King, N., Horrocks, C., 2010. Interviews in Qualitative Research. Sage, London.

Komiyama, H., Takeuchi, K., 2006. Sustainability science: building a new discipline. Sustain. Sci. 1 (1), 1–6. https://doi.org/10.1007/s11625-006-0007-4.

Leal Filho, W., Shiel, C., Paço, A., 2016. Implementing and operationalising integrative approaches to sustainability in higher education: the role of project-oriented learning. J. Clean. Prod. 133, 126–135. https://doi.org/10.1016/j.jclepro.2016.05.079.

Lehtonen, A., Salonen, A., Cantell, H., Riuttanen, L., 2018. A pedagogy of interconnectedness for encountering climate change as a wicked sustainability problem. J. Clean. Prod. 199, 860–867. https://doi.org/10.1016/j.jclepro.2018.07.186.

Leeuw, S., Wiek, A., Harlow, J., Buizer, J., 2012. How much time do we have? Urgency and rhetoric in sustainability science. Sustain. Sci. 7 (Suppl. 1), 115–120. https://doi.org/10.1007/s11625-011-0153-1.

Linnér, B.-J., Wibeck, V., 2019. Sustainability Transformations: Agents and Drivers across Societies. Cambridge University Press, UK. https://doi.org/10.1017/9781108766975.

Lotz-Sisitka, H., Wals, A., Kronlid, D., McGarry, D., 2015. Transformative, transgressive social learning: rethinking higher education pedagogy in times of systemic global dysfunction. Curr. Opin. Environ. Sustain. 16, 73–80. https://doi.org/10.1016/j.cosust.2015.07.018.

Lozano, R., Lukman, R., Lozano, F., Huisingh, D., Lambrechts, W., 2013. Declarations for sustainability in higher education: becoming better leaders, through addressing the university system. J. Clean. Prod. 48, 10–19. https://doi.org/10.1016/j.jclepro.2011.10.006.

Luederitz, C., Abson, D., Audet, R., Lang, D., 2017. Many pathways towards sustainability: not conflicting but co-learning between transition narratives. Sustain. Sci. 12, 393–407. https://doi.org/10.1007/s11625-016-0414-0.

McMillin, J., Dyball, R., 2009. Developing a whole-of -university approach to educating for sustainability: linking curriculum, research and sustainable campus operations. J. Econ. Sustain. Dev. 3, 55–64. https://doi.org/10.1177/097340820900300113.

Meppem, T., Bourke, S., 1999. Different ways of knowing: a communicative turn toward sustainability. Ecol. Econ. 30, 389–404. https://doi.org/10.1016/S0921-8009(99)00053-1.

Michel, A., Hudon, M., 2015. Community currencies and sustainable development: a systematic review. Ecol. Econ. 116, 160–171. https://doi.org/10.1016/j.ecolecon.2015.04.023.

Moloney, S., Horne, J., 2015. Low carbon urban transitioning: from local experimentation to urban transformation? Sustainability 7, 2437–2453. https://doi.org/10.3390/su7032437.

Selby, D., 2006. The catalyst that is sustainability: bridging permeability to disciplinary boundaries. Planet 17 (1), 57–59. https://doi.org/10.11120/plan.2006.00170057.

Tang, K., 2018. Correlation between sustainability education and engineering students' attitudes towards sustainability. Int. J. Sustain. High Educ. 19 (3), 459–472. https://doi.org/10.1108/IJSHE-08-2017-0139.

Taylor, P., 2012. Transition towns and world cities: towards green networks of cities. Int. J. Justice Sustain. 17 (4), 495–508. https://doi.org/10.1080/13549839.2012.678310.

Trencher, G., Vincent, S., Bahr, K., Kudo, S., Markham, K., Yamanaka, Y., 2018. Evaluating core competencies development in sustainability and environmental master's programs: an empirical analysis. J. Clean. Prod. 181, 829–841. https://doi.org/10.1016/j.jclepro.2018.01.164.

Trencher, G., Yarime, M., McCormick, K., Doll, C., Kraines, S., 2014. Beyond the third mission: exploring the emerging university function of co-creation for sustainability. Sci. Publ. Pol. 41, 151–179. https://doi.org/10.1093/scipol/sct044.

Vazquez-Brust, D., Sarkis, J., 2012. Green growth: managing the transition to sustainable economies. In: Vazquez-Brust, D., Sarkis, J. (Eds.), Green Growth: Managing the Transition to a Sustainable Economy. Springer, Dordrecht.

Wals, A., Jickling, B., 2002. "Sustainability" in higher education: from doublethink and newspeak to critical thinking and meaningful learning. Int. J. Sustain. High Educ. 3 (3), 221–232. https://doi.org/10.1108/14676370210434688.

Warburton, K., 2003. Deep learning and education for sustainability. Int. J. Sustain. High Educ. 4 (1), 44–56. https://doi.org/10.1108/14676370310455332.

Wiek, A., Bernstein, M., Foley, R., Cohen, M., Forrest, N., Kuzdas, C., Kay, B., Withycombe Keeler, L., 2015. Operationalising competencies in higher education for sustainable development. In: Barth, M., Michelsen, G., Rieckmann, M., Thomas, I. (Eds.), Handbook of Higher Education for Sustainable Development. Routledge, London, UK, pp. 241–260.

Young, R., 2006. Sustainability: from rhetoric to reality through markets. J. Clean. Prod. 14, 1443–1447. https://doi.org/10.1016/j.jclepro.2005.11.021.