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Connecting Competences and Pedagogical Approaches for Sustainable Development in Higher Education: A Literature Review and Framework Proposal

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Abstract: Research into and practice of Higher Education for Sustainable Development (HESD) have been increasing during the last two decades. These have focused on providing sustainability education to future generations of professionals. In this context, there has been considerable progress in the incorporation of SD in universities' curricula. Most of these efforts have focussed on the design and delivery of sustainability-oriented competences. Some peer-reviewed articles have proposed different pedagogical approaches to better deliver SD in these courses; however, there has been limited research on the connection between how courses are delivered (pedagogical approaches) and how they may affect sustainability competences. This paper analyses competences and pedagogical approaches, using hermeneutics to connect these in a framework based on twelve competences and twelve pedagogical approaches found in the literature. The framework connects the course aims to delivery in HESD by highlighting the connections between pedagogical approaches and competences in a matrix structure. The framework is aimed at helping educators in creating and updating their courses to provide a more complete, holistic, and systemic sustainability education to future leaders, decision makers, educators, and change agents. To better develop mind-sets and actions of future generations, we must provide students with a complete set of sustainability competences.

Keywords: Higher Education for Sustainable Development; competence; pedagogy; teaching and learning; curriculum planning; educational outcomes

1. Introduction

Research into and practice of Higher Education for Sustainable Development (HESD) have been increasing during the last two decades. These have focused on providing sustainability education to future generations of professionals [1] and integrating sustainable development (SD) into the system elements of Higher Education Institutions (HEIs), including education, research, operations, community outreach, assessment and reporting, collaboration with other universities, making SD an integral part of the institutional framework, on-campus life experiences, and 'Educate-the-Educators' programmes [2–4].

In this context, there has been considerable progress in the incorporation of SD into universities' curricula (see [4–7]. Some examples of such progress include the assessment of the state of corporate social responsibility (CSR) education in Europe [8]; the development of an e-learning introductory course on sustainability [9]; courses on CSR and sustainability [10]; the use of active learning methods for addressing the legitimacy and practicability of an introductory course on sustainability in business [11]; the application of Bloom's Taxonomy of Educational Objectives to a six-course design [12]; an 'Educate the Educators' programme [13]; an alumni survey to explore the corporate sustainability practice experiences of their MBA graduates [14]; the development of a course on organisational change management for sustainability [15]; the development of an Engineering for Sustainable Development degree [16]; and the effect of sustainability courses on students' sustainability competences. Some authors use the term competencies or make distinctions between competences and competencies; however, this paper uses the term competences, as specified by the Oxford English Dictionary [17]

The incorporation of SD into curricula requires systems thinking and interdisciplinary approaches [2] and calls for pedagogical innovations that provide interactive, experiential, transformative, and real-world learning [18]. Most of the efforts to incorporate SD into curricula have focused on curricula design and delivery [10,12,15] or on learning outcomes [19].

There has been increasing research on competences for sustainable development (e.g., [20,21]). Some peer-reviewed articles have proposed different pedagogical approaches to better deliver SD within courses (e.g., [22–24]); however, there has been limited research on the connection between how courses are delivered (pedagogical approaches) and how they may affect sustainability competences.

Pedagogy and competences generally have been studied separately, though there have been some exceptions: for example, the case-based approaches for sustainability science [25]; the effectiveness of different pedagogical approaches in engineering courses for improving student awareness of sustainability [26]; and the connections between pedagogical approaches, knowledge domains (declarative, procedural, effectiveness, and social knowledge), and four key competences (systems thinking, foresight, collaboration, and change-agent skills) in the context of primary and secondary education [27]. Despite these examples, there is still limited research linking these two elements of ESD. This paper is aimed at providing a framework to link SD pedagogy and competences and, in turn, provide better sustainability education to future professionals.

The paper is structured in the following way. Section 2 presents the methods used; Section 3 reviews ESD competences; Section 4 reviews pedagogical approaches that may be applied in ESD; Section 5 provides a novel framework linking these specific HESD pedagogical approaches to competences; and Section 6 provides a summary discussion and suggestions for applications and further research based on this framework.

2. Methods

Two methods were used to analyse the connections between SD competences and pedagogical approaches: hermeneutics and Grounded Theory. The analyses performed for this paper were done via an iterative process, reflecting on the authors' understandings and interpretations of sustainability pedagogical approaches and competences.

Hermeneutics is a method that is aimed at analysing, through interpretation, written texts [28–30]. Hermeneutics allows a researcher to understand and, ultimately, discriminate critically between blind and enabling prejudices [31]. Hermeneutical explorations have the possibility of developing valid interpretations by analysing understanding [32]. It should be noted that the analysis is bound to the experience of the interpreter [33]. An important characteristic of hermeneutics is the paradox of the hermeneutics circle, wherein the whole has to be understood from its individual elements and their connections with each other, yet it presupposes that to understand the individual elements the whole has to be understood [28,33–35].

Grounded Theory (GT) is a method that was developed as a response to the lack of effective tools for theory discovery [36], the concerns over the predominance of quantitative methods in social sciences, and the tendency to test existing grand theories [37]. It was designed to close the gap between theory and empirical research [36]. GT emphasises developing and building theory from data and observations [36–39]. GT helps the researcher detect if there are causal connections between variables and to generalise from a specific context [40].

This paper's analysis was based on the constant comparative analysis used in GT [36], which has four stages: (1) comparing incidents applicable to each category, i.e., classifying the data into meaningful categories that may be derived from the data, from the theoretical framework, or from the researchers' readings, life experiences, research, and scholarship; (2) integrating categories and their properties; (3) recognising the relationships between the categories and, if needed, developing new ones; and (4) writing the new or modified theory. The initial framework for analysis was based on: (1) competences for sustainability and (2) pedagogy for sustainability. The analyses were done, based upon the authors' interpretations of how pedagogical approaches and competences are related. The competences and pedagogical approaches were discussed by the five authors to result in a common understanding of their meaning in order to synthesise their key principles (as shown in Tables 1 and 2). The link between the competences and pedagogical approaches was developed in an iterative process, in which a first draft was proposed and discussed in four rounds to ensure that there was agreement on the levels and on the entire framework. The development of the framework is the equivalent of combining the 'integrating categories' and 'recognising relations' stages of GT.

The following caveats should be highlighted due to the nature of hermeneutics and interpretation. Due to limitations on the size of a journal paper, the competences and pedagogical approaches are presented in a concise form, although each of them were studied extensively, based upon the relevant literature. Other important caveats included threats to reliability and validity [38]. In this paper, reliability was mainly affected by observer error and bias, based upon the nature of the interpretation and hermeneutics, which are based on the standpoints, experiences, values, and understanding of the researchers [41]; these were framed by holistic approaches, systems thinking, and life-cycle thinking as crucial bases for understanding the meaning and application of sustainability pedagogical approaches and competences. Five researchers with varied experience and backgrounds in natural and social sciences and several decades of combined teaching experience in different countries discussed the competences, the pedagogical approaches, and their inter-linkages, which was aimed at providing a generic framework. Despite this, the framework, based on interpretation, may not be fully applicable in all cases, e.g., for different regional or national contexts. The validity of this research was influenced by the context in which the pedagogical approaches and competences have been used (mainly in a Western context in the past two decades) and was evaluated within the context of Higher Education for Sustainable Development. The conclusions are, therefore, bound by this context and might not be applicable to other regional or temporal contexts. The discussion of the pedagogical approaches and competences was valid at the time the paper was written, which may limit its generalisability and conclusions in the future, depending on academic and world developments.

3. Competences for SD in Higher Education

Competences are a way of describing desired educational outcomes [42–46]. They include cognitive, functional, ethical, and personal dimensions [47] and link complex knowledge, skills, and attitudes [48]. Competence-based education focuses on the ability of students to develop important knowledge, values, aptitudes, and attitudes necessary to address complex issues they will encounter in their future personal lives and professional careers [21]. Competence-based education is opposite to repetition [49–51] or indoctrination [20], since the outcome of these are the inculcation of rote habits and the acquisition of skills.

During the last ten years, there has been a growing body of literature addressing and discussing the definition and use of competences for SD. Lists of competences relating to education for sustainable

development and their use have been proposed by several authors in recent years. Barth et al. [20] described the development of key competences for SD in higher education and focused on their implications in formal and informal learning settings. Brundiers et al. [18] discussed how real-world learning opportunities contribute to the acquisition of key SD competencies. Hanning et al. [52] provided a comparison between SD competences obtained by engineers and industry needs.

Wiek et al. [48] compiled a list of key competences for SD and collaged them into the following groups: Systems-thinking; Anticipatory; Normative; Strategic; and Interpersonal competences.

Rieckmann [53] proposed the following twelve competences: Systemic thinking and handling of complexity; Anticipatory thinking; Critical thinking; Acting fairly and ecologically; Cooperation in (heterogeneous) groups; Participation; Empathy and change of perspective; Interdisciplinary work; Communication and use of media; Planning and realising innovative projects; Evaluation; and Ambiguity and frustration tolerance. This categorisation is aimed at providing a more comprehensive set than the previous ones.

Lambrechts et al. [21] compared the lists of competences developed by de Haan [54] and Roorda [55] and proposed the following ones: Responsibility (values, ethics, reflection); Emotional intelligence (transcultural understanding, empathy, solidarity, compassion); System orientation (inter-disciplinarity); Future orientation; Personal involvement (self-motivation, motivating others, learning); and Ability to take action (participatory skills).

Four sets of discussions took place between the authors of the paper on the SD competences and their classifications. The discussions resulted in a synthesis of twelve competences, presented in Table 1: Systems thinking; Interdisciplinary work; Anticipatory thinking; Justice, responsibility, and ethics; Critical thinking and analysis; Interpersonal relations and collaboration; Empathy and change of perspective; Communication and use of media; Strategic action; Personal involvement; Assessment and evaluation; and Tolerance for ambiguity and uncertainty.

Table 1. A Synthesis of Education for Sustainable Development (ESD) Competences.

Competences	Principles and Summary	Based on
Systems thinking	• Analysis of complex systems across different scales and domains of inquiry • Comprehension, empirical verification, and articulation of a system's key components, structure, and dynamics • Attention to systemic features such as feedback, inertia, stocks and flows, and cascading effects • Understanding of complex systems phenomena, including unintended consequences, path dependency, systemic inertia, and intentionality • Understanding of connectivity and cause-effect relationships • Application of modelling (qualitative or quantitative)	[21,27,48,53,56–59]
Interdisciplinary work	• Appreciation, evaluation, contextualisation, and use of knowledge and methods of different disciplines • Ability to work on complex problems in interdisciplinary contexts	[21,53,60]
Anticipatory thinking	• Envisioning, analysis, and evaluation of possible futures, including scenarios with multi-generational timescales • Application of precautionary principle • Prediction of reactions • Dealing with risks and changes	[21,27,48,53,59]
Justice, responsibility, and ethics	• Application of concepts of ethics, justice, social and ecological integrity, and equity • Description, negotiation, and reconciliation of principles, values, aims, and goals for sustainability • Responsibility for one's actions • Ethics and sustainability of personal and professional behaviour	[21,48,53,59,60]

Table 1. *Cont.*

Competences	Principles and Summary	Based on
Critical thinking and analysis	• Ability to challenge norms, practices, and opinions • Reflection on one's own values, perceptions, and actions • Understanding of external perspectives	[53]
Interpersonal relations and collaboration	• Participatory and collaborative approaches to solving problems or conducting research • Skills and understandings in communication, deliberation, negotiation, empathizing, leadership, and collaboration • Ability to deal with conflicts • Learning from other perspectives • Participation in community processes	[27,48,59,60]
Empathy and change of perspective	• Ability to identify own and external perspectives • Understanding and sympathy for the needs, perspectives, and actions of others • Ability to deal with internal and external value orientation • Compassion, empathy, and solidarity with others across differences • Accepting and embracing of a diversity of opinions, experiences, or perspectives • Transcultural understanding	[21,53,59]
Communication and use of media	• Ability to communicate effectively in intercultural contexts • Ability to use appropriate information and communication technologies • Critical consideration and evaluation of media	[53]
Strategic action	• Ability to design and implement interventions, transitions, and transformations for sustainability • Active and responsible engagement in sustainability activities • Development and application of ideas and strategies • Planning and executing projects • Ability to reflect on, and deal with, possible risks • Organisation, leading, and controlling processes, projects, interventions, and transitions • Identification of scopes of creativity and participation • Taking responsibility for motivating others	[21,27,48,53,59]
Personal involvement	• Participation in creating sustainability initiatives • Willingness and ability to take action • Willingness to learn and innovate • Self-motivation • Initiation of own learning	[21]
Assessment and evaluation	• Develop assessment and evaluation standards and guidelines • Independent evaluations with respect to conflicts of interest and goals, uncertain knowledge, and contradictions	[53]
Tolerance for ambiguity and uncertainty	• Coping with conflicts, competing goals and interests, contradictions, and setbacks	[53]

4. Pedagogical Approaches for SD in Higher Education

The UN Decade of Education for Sustainable Development framework stresses the need for high quality education for SD, requiring a multi-method approach, via the use and combination of different pedagogical approaches [61]. ESD highlights the need for alternative and student-activating methods for teaching and learning [25,62–64]. This is aimed at challenging students to participate actively, think critically, and reflect [65]. A switch to alternative methods of teaching can provide a better education for SD [66–68].

Pedagogy is defined as "the art or science of teaching" [17]. The choice of a pedagogical approach depends on the target (pedagogical and educational goals) and the specifics of the situation (regarding students, teachers, or the learning environment) in which they will be used [69]. The variation in pedagogical approaches offered is also important: given the diversity of students (e.g., gender or cultural background) within a program, it is desirable and necessary that various approaches be used [61,64,70]. A diversity of approaches allows students to employ and develop different learning processes, making them grow as learners and enhancing their skills and capacities to learn and think [64]. Nonetheless, alternative pedagogical approaches to traditional lectures have not yet been not widely utilized in higher education to convey sustainability content [23,67].

Some articles on SD integration in higher education have touched upon relevant pedagogical approaches and offer interesting examples from case studies in HEIs (e.g., [22,24,25,62,70]). Despite these, there have been comparatively fewer studies on SD pedagogical approaches than on competences. In the recent ESD literature, there have been some attempts to collect and analyse relevant SD pedagogical approaches (with the exceptions of [26,71,72]); however, a systematic approach to the development and use of SD pedagogical approaches is not often found.

In their teacher's manual for SD integration in higher education, Ceulemans and De Prins [70] presented a range of student-activating methods that can be applied to address sustainability related issues in the classroom such as videos, brainstorming, case studies, demonstrations, forms of dialogue, team work, jigsaw, assignments, problem-oriented education, oral presentations, project learning, small discussion groups, voting, and questions.

Lambrechts et al. [21] identified three main characteristics of teaching and learning methods for achieving SD competences: interactive and participative methods, including the Socratic method, group discussion, role play, group or personal diaries, brainstorming, and peer assessment; action oriented methods, including learning through internships, solving real community problems, and outdoor education; and research methods, including bibliographic research, problem analysis, value clarification, case studies, and concept mapping.

Cotton and Winter [71] proposed the following pedagogical approaches: role-plays and simulations; group discussions; stimulus activities (watching a video or looking at photos, poems, or newspaper extracts to initiate reflection or discussion); debates; critical incidents (students are given an example and asked what they would do, what they could do, and what they should do); case studies; reflexive accounts; personal development planning; critical reading and writing; problem-based learning; fieldwork; and modelling good practice.

Other potentially useful pedagogical approaches that have been proposed but not yet fully tested in a sustainability context include action learning [72]; backcasting [26,60,73]; collaborative learning [18,60,72,74]; gamification [75–77]; online discussion forums [78]; and serious games and systems simulations [79,80].

Table 2 presents twelve pedagogical approaches selected from those that have well-cited references in ESD literature or are known to be broadly used. These pedagogical approaches are non-exclusive, with some overlap in techniques among them and a clear potential to use two or more of these educational strategies synergistically. A breadth of pedagogical approaches, from philosophical perspectives on SD instruction (e.g., eco-justice and community), were included in specific teaching and learning activities (e.g., mind and concept maps). The pedagogical approaches have been separated into:

- **Universal**: broadly applicable pedagogies that have been used in many disciplines and contexts (case studies, interdisciplinary team teaching, lecturing, mind and concept maps, and project and/or problem-based learning);
- **Community and social justice**: pedagogies developed specifically for use in addressing social justice and community-building (community service learning, jigsaw/interlinked teams, participatory action research); and

- **Environmental Education**: pedagogies emerging from environmental sciences and envron education practices (eco-justice and community, place-based environmental education, supply chain/Life Cycle Analysis, and traditional ecological knowledge).

Table 2. A Synthesis of ESD pedagogical approaches.

Classification	Pedagogical Approach	Summary
Universal	Case studies	In case studies, qualitatively rich descriptions of settings, problems, and controversies in sustainable development challenge students to interact with the inherent complexity and uncertainty found in global, regional, and/or local contexts [25,26]. Case studies invite students to consider real-world examples and examine issues from a diversity of stakeholder perspectives [25,26]. Case studies can provide a detailed example of opportunities for students to engage in research with complex human-environment systems [81].
	Inter-disciplinary team teaching	Team-taught courses allow for the possibility of having specialists in different fields help students explore interdisciplinary and transdisciplinary topics from two or more distinctive disciplinary perspectives. There are challenges to interdisciplinary team teaching (in terms of course listing, instructor compensation, and the like) that are unique to the regulations and norms of the educational institution. Instructors may have difficulty coming to an agreement about the content and direction of the course and could often benefit from some guidance in team processes [82].
	Lecturing	Structured lecturing may be viewed as a good way to introduce subject material and concepts [26]. A skilled lecturer with deep subject knowledge can serve as a role model to students as novice academics, demonstrating the fusion of excitement, discovery, and mastery that creates expertise [83]. Lecturing remains a standard approach to instruction in higher education institutions, so much so that many professional instructors are identified as 'Lecturers', and many new instructors rely heavily on such didactic approaches because they believe this to be the expected norm in higher education [84]. However, lecturing may not be the most effective approach to student learning [85,86].
	Mind and concept maps	Mind maps, cognitive maps and argument maps are all approaches for graphically representing relationships between ideas [87]. Mind maps are a non-linear outline of a major concept or theme, with related concepts radiating out from a central key idea; they may include short phrases or pictures to represent separate points and use colour, size, connecting line style, and placement to communicate other relationships [88]. Mind maps improve student retention of factual information, provided that students retain motivation to use them as a study tool [89]. Cognitive maps have been used as a way to compare the efficacy of different pedagogical approaches in engineering courses; the results indicated better understandings of sustainability in courses in which more community-oriented and constructive-learning pedagogical approaches were employed [26].
	Project- or Problem-based learning	Project-based learning and problem-based learning are broadly overlapping approaches to education, emphasizing the value of working on complex, real-world problems for students to develop knowledge, skills, and competences, particularly when the problems/projects represent interdisciplinary sustainability challenges [26,90]. Students typically work in self-directed, collaborative groups (sometimes between institutions and even on multiple continents), and may engage stakeholders in community, organizational, or business partnerships to address problems through inquiry under conditions similar to professional consultation [18,90]. Problem-based learning may also overlap with case studies as another form of inquiry-based learning [91,92].

Table 2. *Cont.*

Classification	Pedagogical Approach	Summary
Community and social justice	Community Service Learning	In community service learning, students engage in activities intended to directly benefit other people, where the activities are integrated with learning activities in an intentional and integrative way that benefits both the community organization and the educational institution [93]. The settings, experiences, levels of engagement, and learning potential can vary widely from mere participation in some typical volunteer work with limited problem solving and community interaction to prolonged collaboration on a complex project. Community service learning has the potential to transform student worldviews [72]. Service learning contributes to improvements in students' responses to uncertainty, reflexivity on their own learning, and awareness of multidimensionality in considering social problems [94].
	Jigsaw/Interlinked Teams	The jigsaw model of instruction is a cooperative peer-learning method developed to help reduce racial tension in recently desegregated classrooms [95]. Students are assigned to develop expertise on different sub-topics. Then students with expertise in each sub-topic are assembled to create a new 'jigsaw' learning team. In the jigsaw team, each student will be the only expert in each topic and is expected to teach that topic to her jigsaw teammates and learn the other topics from these jigsaw teammates to construct a complete picture of the entire topic. A broader, interlinked team approach has every student assigned to two small teams for parallel projects or research topics, developing expertise in each team that is shared with the other team [96]. The standard jigsaw approach to cooperative learning improved students' confidence, interest, and affective engagement self-reports in physics, while yielding little difference in exam achievement; students performed better in their assigned area of expertise but worse in areas in which they relied on peer instruction than did students in traditional instructional conditions [97].
	Participatory Action Research	The application of participatory action research in educational settings comes from a tradition of transformative critical inquiry and emancipatory pedagogical approaches [98,99]. Participatory action research is similar to action learning in its communitarian philosophical approach and cyclic, reflexive nature but emphasizes the collaborative nature of the research and the production of knowledge by all participants, especially those non-academic community members who would be considered 'research subjects' in more mainstream research approaches [100]. Participation through action can be a powerful method for improving at-risk student persistence in higher education [101].
Environmental education	Eco-justice and community	Eco-justice and community involves a deep transformation of mindset on the part of the instructor and students, shifting from mechanistic and industrial metaphors to metaphors rooted in living ecology and biological systems [102]. This philosophical transformation necessarily includes a significant emphasis on the diversity, relationships, autopoiesis (self-creation), and non-linearities that are characteristic of complex adaptive systems. This pedagogy has three main topical foci for critical consideration: (1) Environmental racism and class discrimination; (2) Recovery of the non-commodified aspects of community; and (3) Responsibility to future generations.
	Place-based environmental education	Place-based environmental education can be described as an "approach to teaching and learning that provides people with experience and knowledge to care for our environments" [72]. It seeks to connect scientific understanding and emotional attachment with a specific geography under investigation, cultivating a richer sense of place in students [103]. It generally focuses on outdoor experiential learning and the specificity of locality and bioregion and is typically multidisciplinary [104].

Table 2. *Cont.*

Classification	Pedagogical Approach	Summary
	Supply chain/Life Cycle Analysis	Supply Chain Analysis or Life Cycle Assessment activities challenge students to consider sustainability through the lens of a specific product or commodity, understanding its economic, social, and environmental backgrounds, contexts, and effects. While Life Cycle Assessment generally applies to detailed technical evaluations of impacts conducted by professionals under international guidelines [105,106], simplified versions can be a valuable learning experience for students [107]. This requires accessing and interpreting data from a variety of disciplinary sources. Students often research familiar items, allowing for a clear sense of real-world relevance and personal implications [107,108].
	Traditional ecological knowledge	Traditional ecological knowledge provides opportunities for students to consider the ways that socio-ecological systems are integrated in specific cultures. Long-term knowledge of complex local ecosystems is a powerful tool for conserving biodiversity, often providing valuable deep-time information that is inaccessible in the shorter timeframes of western scientific research projects [109,110]. By highlighting indigenous knowledge systems and values, instructors and students can also help to sustain threatened cultural diversity and heritage [111,112]. This can be especially beneficial for students from indigenous communities, who may feel alienated or unrepresented by colonial approaches to knowledge about their local bio-region [111]. It benefits non-indigenous students by opening the possibility to encounter and understand other cultures and worldviews [110].

5. A Framework Connecting SD Pedagogical Approaches to Competences

There have been limited attempts to link competences and pedagogical approaches. Sipos et al. [72] provided an overview of some established pedagogical approaches relating to the topic, combined with their intended learning outcomes, in their research on learning outcomes for transformative sustainable learning. Sprain and Timpson [25], connected some SD pedagogical approaches and competences, for instance, connecting a sustainability puzzle to systems-thinking competence, iceberg cases to anticipatory competence, and 'issue' cases to normative competence.

As indicated in the methods section, the principles of each SD competence and pedagogical approach were analysed in an iterative interpretative approach using hermeneutics and the constant comparative analysis of GT. This section refers to stages two, three, and four of GT.

Each competence was connected to its corresponding pedagogical approaches, initially by the first authors, and then discussed four times with the other authors to agree upon whether the pedagogical approach would likely address the competence, may address it, or would not address it. Figure 1 presents the results of this process, and matches the competences from Table 1 (rows) to the pedagogical approaches described in Table 2 (columns). A green cell represents a pedagogical approach that usually contributes to the competence, whilst a yellow cell represents a pedagogical approach that is likely to contribute to the competence. The following paragraphs discuss the connections between pedagogical approaches and competence(s).

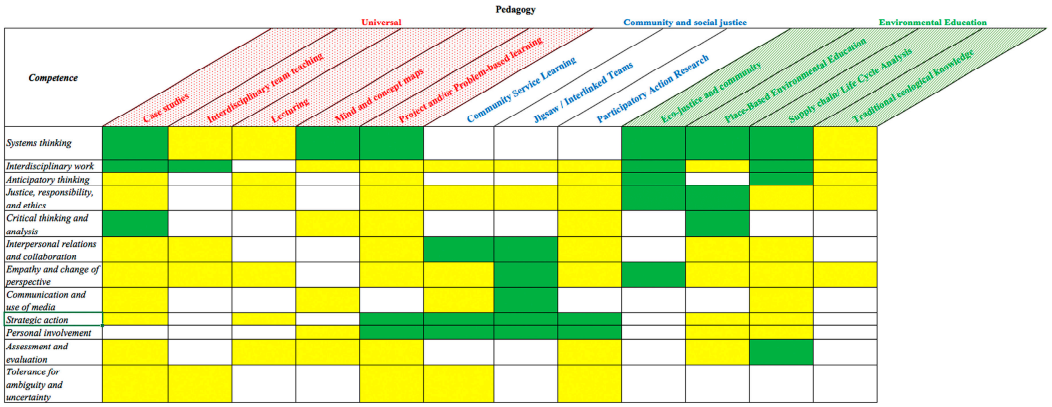

Figure 1. Framework connecting sustainable development pedagogical approaches to competences. The green cells indicate a high likelihood of addressing the competence, the yellow cells indicate that the approach may address it, and the white cells indicate that the approach does not address the competence.

Case studies, project and/or problem-based learning, community service learning, jigsaw/interlinked teams, participatory action research, eco-justice and community, place-based environmental education, and supply chain/life cycle analysis have a good coverage of the competences, while the other approaches have a lesser coverage of them. Some pedagogical approaches are broader in their coverage, but their potential contribution to the competences is limited, e.g., lecturing and traditional ecological knowledge. Some cover fewer competences, but they do it in a deeper way such as eco-justice and community, jigsaw/interlinked teams, supply chain/life cycle analysis, community service learning, and place-based environmental education.

Some competences are potentially better covered by the pedagogical approaches such as systems thinking, interdisciplinary work, empathy and change of perspective, strategic action, justice, responsibility and ethics, personal involvement, interpersonal relations and collaboration, and anticipatory thinking. However, some of the competences have more pedagogical approaches with a high likelihood of coverage (despite fewer pedagogical approaches that may address them) such as systems thinking, personal involvement, strategic action, critical thinking and analysis, and interdisciplinary work.

No single pedagogy alone reliably covers all competences, although appropriately planned case studies or problem/project-based-learning options have the potential to do so, and pedagogy for eco-justice and community could be combined with community service learning, jigsaw/interlocked teams, participatory action research, or problem/project-based-learning to more reliably do so. A combination of pedagogy for eco-justice and community plus case studies and jigsaw/interlocked teams will reliably cover ten SD competences and may effectively cover all twelve of the SD competences considered. Case studies and problem/project-based pedagogical approaches are associated with the broadest range of SD competences, and jigsaw/interlocked teams and pedagogy for eco-justice and community reliably cover the greatest number of different competences, so including any one of these instructional approaches would be a good way to bring SD competence development into virtually any course. Lecturing and interdisciplinary team teaching have the lowest breadth of possible coverage; lecturing in and of itself will not reliably provide learning experiences for any of the SD competences, although it can be a major component of other pedagogical approaches like case studies or pedagogy for eco-justice and community.

6. Conclusions

There is an urgent need to move from researching and developing SD integration objectives or aims to their actual integration in university curricula. Therefore, educators should address the

'delivery stage' of SD integration and focus specifically on relevant pedagogical approaches that enable the acquisition of competences for SD. There has been increasing research on competences for sustainable development. Some peer-reviewed articles have proposed different pedagogical approaches to better deliver SD in the courses; however, pedagogical approaches and competences have, generally, been studied separately.

This paper analyses competences and pedagogical approaches, using hermeneutics and the constant comparative analysis of GT to match these in a proposed framework based on twelve competences and twelve pedagogical approaches. The proposed framework connects the course aims to delivery in ESD by highlighting the connections between pedagogical approaches and competences. The framework is aimed at helping educators in creating and updating their courses to provide a more complete, holistic, and systemic sustainability education to future leaders, decision makers, educators, and change agents.

To better develop the mind-set and actions of future generations, we must provide students with the 'full monty' (i.e., a complete set) of sustainability competences.

Further research should focus on testing the validity of the framework in different contexts such as disciplines (e.g., engineering, business, or theology), the sizes of HEI, or geographical locations. The influence of each of the pedagogical approaches on the competences should also be assessed and empirically tested through an international survey to provide more clarity to the framework and the efficacy of each approach. Other pedagogical approaches have great potential for developing SD competences. Gamification and serious games hold promise for improving student engagement in learning. Further work on pedagogies for SD, particularly in linking them to SD competences is solicited. The framework should also be analysed in the contexts of primary, secondary, and further education.

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