Tema d'anàlisi:

University and the 2030 Agenda for Sustainable Development: processes and prospects

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Abstract

Higher Education has been widely recognised as a principal agent for addressing the current sustainability challenge that society is facing, because of its key mission of knowledge generation and transfer through research and teaching. Several are the contributions that have sought to model and define the key features necessary for creating more sustainable universities. This article presents a review of current practices and initiatives worldwide towards achieving the 2030 Agenda for Sustainable Development at universities. It includes an analysis of existing models of sustainable universities, environmental and sustainable practices, the Education for Sustainable Development (ESD) rationale and pedagogy, and curriculum development and innovation towards embedding ESD within Higher Education. Based on this review of the literature and key initiatives and milestones in ESD, key implications and pathways for future research and practice of ESD in Higher Education are outlined.

Keywords: Agenda 2030, Education for Sustainable Development, university, higher education, organisational change, curriculum, student learning

1. Introduction

In the year 2000, driven by the need for a more sustainable development in society, leaders of the United Nations member states signed an agreement to endorse the Millennium Development Goals (MDGs: UN, 2000), eight objectives related to human development to be met by the year 2015. This agreement generated worldwide mobilisation on an unprecedented scale. According to the final report (UN, 2015), by the end of the MDG period, millions of lives had been saved and living conditions had been improved for countless individuals thanks to this initiative. However, several major issues persist, from gender inequality to poverty and hunger, to climate change, environmental degradation, and major armed conflicts. In view of this, in 2015 the United Nations passed the 2030 Agenda in the hope of prolonging the impact of the MDGs. The Agenda is comprised of 17 Sustainable Development Goals (UN, 2015), integrated in such a way that they combine the three dimensions of sustainability: economic, social and environmental.

The United Nations Decade of Education for Sustainable Development 2005-2014 (DESD) was announced through a resolution that addressed the need to adopt a global perspective when facing environmental issues. The resolution also called for education to be more accessible, and to be redirected so as to promote lifestyles that better society and promote a more sustainable future

(UNESCO, 2005). The UNDESD acted as a catalyst to the processes of integrating the principles of education for sustainable development (ESD) into all levels of education, where ESD is based on processes of collaboration, systems thinking, innovation, and active and participatory learning (Tilbury, 2011).

The 2030 Agenda for Sustainable Development results from the need to integrate the principles of DESD with the aim of planning specific sustainable initiatives that, by aiding the acquisition of certain skills, would allow individuals to reflect on their actions and their social, cultural, economic, and environmental impact at the local and global scale (Cebrián & Junyent, 2015; UNESCO, 2017).

In this context, Higher Education (HE) has been recognised as a principal agent for addressing the current sustainability challenge that society is facing, because of its key mission of knowledge generation and transfer through research and teaching (UNESCO, 2005). Sustainability in HE calls for interdisciplinary and innovative practice to promote sustainability in all its activities (Cebrián, 2018). The curriculum, pedagogy, structure, organisation and ethos are shaping dimensions of education; therefore, embedding sustainability implies a cultural change rather than an add-on to existing curricula and structures. ESD can foster a sustainable social transformation, through the clarification and reassessment of values; it should be creative, innovative and constructive, culturally appropriate and action-orientated (Sterling, 2004).

Several are the contributions that have sought to model and define the key features necessary for creating more sustainable universities (Cebrián, 2018; Sterling et al., 2013; Velazquez et al., 2006). This article presents a review of existing initiatives towards achieving the 2030 Agenda for Sustainable Development at universities. First, the main areas of development, the modelling of sustainable universities and promoting environmental and sustainable practices, are outlined. Second, the ESD rationale is presented, including ESD teaching and learning strategies, student learning outcomes and sustainability literacy. Third, the main trends in curriculum development in ESD and key projects that have contributed to generating holistic curriculum change are summarised. Finally, in the last section, the implications and pathways for future research and practice of ESD within HE are highlighted.

2. Modelling the sustainable university

2.1. Emerging models

An important field of research in the area of sustainability in HE has been the modelling of sustainable universities. Several research papers discuss and identify the key features of a university committed to sustainability in all its activities (Adomßent, Godemann, & Michelsen, 2007; Ferrer-Balas et al., 2008; Heck, 2005; Lukman & Galvic, 2007; Velazquez et al., 2006). All these models share the following similarities:

- Sustainability is seen as part of all the activities including education, research, outreach, community service, management and operational practices, and university leadership (institutional vision and mission, structure and action planning).
- Universities are conceived as complex systems where all university activities and their interdependencies need to be taken into consideration. All draw on ideas of systems theory to model the sustainable university.

Transformation of current institutional structures and the organisation is seen as necessary.

- Networking, partnerships, stakeholder and community engagement and outreach are regarded as pivotal in the development of more sustainable universities.

- Interdisciplinary and transdisciplinary collaboration is regarded as crucial.

- Models are presented as non-prescriptive tools with the aim of fostering discussion and promoting action, and new developments acknowledge the relevance of the cultural and social context.

- Monitoring, assessment and reporting are seen as necessary. Two suggest the use of the Plan–Do–Check–Act (PDCA) cycle as a tool to monitor and coordinate continuous improvement (Lukman & Galvic, 2007; Velazquez et al., 2006).

- These models are created on the basis of existing case studies of universities or use case studies and experiences of universities as pilots for validation.

It should be noted that one of the weaknesses of these models is that they have not been applied; therefore no empirical research exists on their application and outcomes. Velazquez and colleagues (2006) defined four implementation phases to achieve a sustainable university from strategic to operational action: development of a sustainable vision; development of a mission; creation of committees and policies, targets and objectives on sustainability; and development of initiatives and strategies in research, community outreach, campus and education. Velazquez and colleagues surveyed eighty universities and concluded with a discussion on the difficulty to embed sustainability holistically, as none of them accomplished all the implementation phases. Other papers have outlined the concrete strategies and actions taken by universities. These are descriptive case studies and accounts of the policies and implementation strategies in university activities including campus sustainability, research, academic development and education (Ferrer-Balas et al., 2008; Heck, 2005). For example Adomßent et al. (2007) outlined the development project 'Sustainable University – Sustainable Development in the Context of University Remits' at the University of Lüneburg (Germany) where they used transdisciplinary research methods and a transformative approach, stressing the importance of a systems approach that encompasses all the university activities at once. The Graz Model for Integrative Development (Mader, 2013) has established five principles and their different levels to assess the transformative capacity of sustainability initiatives and processes. The five transformative levels are: transformational leadership; transdisciplinary research; generative learning; decision influencing; and innovation network (Mader, 2013). Projects and initiatives such as this are particularly relevant because they explore the complexity of universities through systems thinking, and transdisciplinary and transformative approaches to research and learning, which are needed for creating sustainable universities (Sterling et al., 2013).

Assessment and monitoring are recognised as key in progressing the sustainability agenda; however these have proved more difficult to establish than expected (Sammalisto & Lindhqvist, 2008). Some authors have also noted the importance of forward-thinking (Adomßent et al., 2007) and the existing lack of envisioning by part of the university community of what a sustainable university actually is (Velazquez et al., 2006). As Temple (2012; p. 105) states, a university dealing with sustainability faces the 'classical example of supercomplexity in action'. This implies a participatory leadership, a shift in the decision-making processes whereby universities become learning organisations, which engage the different stakeholders involved in HE (students, educators, staff, researchers, managers and executive groups, benchmarking agencies, external bodies, local community, NGOs and businesses amongst others) in their decision-making and actions (Temple, 2012). Therefore, universities are struggling to progress equally in their activities. Empirical research is lacking on environmental management processes of universities and on the incorporation of sustainability into research and education.

Universities have signed international and national declarations and have publicly committed to work towards achieving sustainability in their campuses, research, outreach and curriculum (Wright, 2010). However sustainability in HE is a rather recent and emerging research area. Most of the research to date has focussed on: environmental management, carbon management plans and greening of university campus; descriptive case studies and examples of good practice of universities; embedding sustainability in specific courses; theoretical developments on teaching and learning approaches towards sustainability; and university and policy analysis (Cebrián, 2018; Cotton et al., 2009; Wright, 2010).

2.2. The change process towards embedding sustainability

Most of the papers reporting on the sustainable university are lessons learned but the studies often lack a coherent and clear theoretical and methodological basis (Corcoran et al., 2004). These whole university models often refer back to the experiences and learning gained through sustainability strategies, initiatives and policies, but the in-depth study of the processes of change has been overlooked (Moore, 2005). It has been difficult to move from theory to action (Cotton et al., 2009). These papers tend to speculate on the barriers and possible opportunities and recommendations. Academic culture, academic freedom, disciplinary working environments or lack of interdisciplinarity have been referred to as existing barriers to sustainability by several authors (Cebrián, 2018; Ferrer-Balas et al., 2008). Some other barriers identified are: misconceptions on sustainability; time and resources; and lack of funding. The main drivers are identified as: networking and connecting; coordinative and cooperative agencies or projects; funding; professional development; transdisciplinary research and teaching; participatory projects and evaluation; and leadership and commitment from senior managers (Ferrer-Balas et al., 2008; Filho, 2011). With the current economic crises and HE change situation, the allocation of funding and resources has become more of a challenge (Brown, 2010). While institutional commitment and leadership, allocation of resources for innovative projects, leadership and staff professional development amongst others are needed for holistic university transformation towards embedding sustainability (Ryan, 2011).

In a conducted comparative study on the process of integrating sustainability amongst different universities, Barth (2013) has identified three distinctive patterns of implementation: student-led initiatives (bottom-up); sustainability as environmental management of the estates and operations; and sustainability as an institutional approach (top-down). Bottom-up and top-down approaches are needed to foster organisational learning and change on sustainability in HE, with the critical leadership role that the 'middle' (faculty and staff) of the organisation can offer in achieving sustainable practices across all the university activities and operations (Brinkhurst et al., 2011). According to Lozano (2011) it is worth looking at Rogers' innovation theory (Rogers, 1995) when thinking about incorporating and institutionalising sustainability within HE. Diffusion of innovations theory (Rogers, 1995) focuses on understanding change processes and the introduction of new ideas and practices in social organisations. Rogers (1995) views four stages of the innovation process: invention, diffusion (or communication), time and consequences. In his view, information and networks within the organisation and leaders play a key role in the adoption of any innovation or change. An adoption lifecycle is likely to happen in any innovation, which starts with innovators to then engage early adopters, to early and late majority, and finally to involve laggards (Rogers, 1995). This is in line with the four phases of sustainability adoption: grass roots enthusiasts - bottom-up approach; early adopters - beginning as an organisation; getting really serious - important organisational and operational changes; and full commitment - sustainability integrated in the core business of universities.

Effective organisational communication is key for the success of new ideas such as sustainability in universities. Little research has been published so far on the communication of the sustainability message in universities (Djordjevic & Cotton, 2011). Therefore having a clear institutional message and vision is critical towards sustainability being institutionalised and part of the organisational culture. Champion universities have their own sustainability offices and senior managers and have created their own institutional unique approaches. However, they all share a holistic understanding of sustainability

and a whole institution approach (Ryan, 2011). Some examples are: the 4C Model at the University of Plymouth, which involves curriculum, campus, community and institutional culture; the Promising Futures Sustainability Strategy at the University of Gloucestershire, the goal of which is to 'embed sustainability in the DNA' of the university; and Ecoversity project at the University of Bradford, which is a culture change programme focussing on formal, informal and physical curricula.

Furthermore, emergent areas of research on sustainability in HE are those of staff professional development, organisational learning and change processes, and leadership, which have been overlooked so far (Cebrián, 2018; Thomas, 2004). There exists a lack of lessons learned and the application of these derived from successful organisational change projects in HE (Ryan, 2011). However it should be acknowledged the work that different networks and partnerships have done to establish the change processes required to embed sustainability. In this area the Peoples' Sustainability Treaty on Higher Education (Peoples' Sustainability Treaties, 2012) has also provided essential transformation steps towards integrating sustainability into HE: transforming current paradigms and university structures; new vision and purpose; communication platforms; development of indicators; using participatory processes, funding and rewarding; partnerships; professional development; and coordinated efforts and effective leadership for sustainability amongst others.

In Turnaround Leadership for Higher Education Fullan and Scott (2009) draw out effective change management for universities. This can be extrapolated to sustainability and any university change process, creating resilient organisations that are able to act and try out innovative solutions. In this work also identified a series of levers for building more change-capable universities. In 2012, building on from that work and for the case of sustainability in HE, Scott et al. (2012; pp. 3-4) conducted a study which reported on ten key steps identified by current ESD leaders that universities could take to embed sustainability holistically:

1. Acknowledge the distinctive challenges and complexity of ESD leadership.
2. Sharpen the focus and understanding of ESD across the HE system.
3. Context counts: ensure organisational integration and system alignment to support ESD and its leaders.
4. Track and improve ESD program quality more systematically.
5. Put in place the right incentives.
6. Engage the disengaged and the institution's senior leadership.
7. Apply the key lessons on successful change management in HE.
8. Focus on the change leadership capabilities.
9. Review ESD leadership position descriptions, selection processes and succession strategies.
10. Apply the most productive approaches to leadership learning to the professional development of ESD leaders.

To create successful change processes in HE, both Fullan and Scott (2009) and Scott et al. (2012) assign a key role to the training and development of leadership capabilities, contextualisation, participatory processes and engagement, and implementing, monitoring and benchmarking systems. Several projects have shown the potential in generating organisational learning and in HE becoming a leader and innovator to advance sustainability (Albrecht et al., 2007; Beringer & Adomßent, 2008). These projects

have proved to be successful, however they are often fragmented and happen in the margins of the organisation (Sharp, 2002).

2.3. Environmental management

Much of the progress achieved on sustainability in HE has been on the environmental management of the estates and operations, with the purpose of reducing the carbon footprint and bringing economic savings to the organisation (Sammalisto & Lindhqvist, 2008). Evidence of these achievements can be found in various universities' websites. Practically all universities have their own environmental managers of their estates, and their own strategies, policies and plans in this area (Sterling et al., 2013). Many universities have implemented Environmental Management Systems (EMS) and ISO 14.1001 (Lozano, 2011). These provide a systematic structure to manage and improve the environmental performance of the organisation.

Carbon management has been another growing area of development over the last years because universities have been targeted by external agencies to reduce their carbon emissions. The actual carbon emissions and the transport, climate change and carbon reduction strategies and action plans of universities are reported in their websites and in several papers in the literature (Atherton & Giurco, 2011; Button, 2009; Cleaves et al., 2009). Universities can play an important role as stakeholders in decision-making and in assisting regional and national policy developments to meet the climate change challenge (Coffman, 2009).

Corporate social responsibility and procurement practices are other areas of development in universities that are seeking to become more sustainable in their activities. A review of the information available on the websites and the annual reports of the top 10 leading universities in the world concluded that all showed a commitment to, and practices on social responsibility (Nejati et al., 2011).

Papers reporting environmental and sustainability initiatives have drawn on organisational learning theory (Albrecht et al., 2007; Gudz, 2004; Sharp, 2002). Sustainability projects can encourage organisational learning to take place (Albrecht et al., 2007). However projects to date have tended to be small-scale, led by enthusiasts and believers of sustainability without transforming and impacting on the current organisational structures and thinking (Sharp, 2002; Thomas, 2004). Universities aiming to embed sustainability need to rethink their existing organisational learning processes and become genuine learning organisations. Therefore organisational learning theory can inform the transition of universities to more sustainable organisations that encounter complexity and integration of its activities to create a shared vision and action (Gudz, 2004) leading to a cultural and structural change towards sustainability.

2.4. Monitoring, benchmarking and assessment tools

Monitoring and assessment tools have been regarded as levers and important features of organisational change processes in sustainability (Ryan, 2011; Thomas, 2004). For this reason the development of monitoring, benchmarking and assessment tools has become an important area of research, however few universities have reported to date their sustainability performance (Lozano, 2011; Shriberg, 2002). Some of the tools that have been developed are: Auditing Instrument for Sustainability in Higher Education (AISHE) (Roorda, 2001); Graphical Assessment of Sustainability in Universities (GASU) tool

(Lozano, 2006); The Sustainability Tracking, Assessment & Rating System (STARS) (AASHE)a; Sustainability Assessment Questionnaire (SAQ) (ULSF)b; and the Sustainability Tool for Auditing University Curricula in Higher Education (STAUNCH) (Glover, Peters, & Haslett, 2011). STAUNCH was developed by the Cardiff University's Centre for Business Relationships Accountability, Sustainability and Society (BRASS) and is a software package focussed on the curriculum, auditing the sustainability content of HE curriculum. A review of eleven cross-institutional tools was conducted by Shriberg (2002) who concluded that they were contributing to effectiveness, support, operationalisation, communication, and improvements on sustainability. However, because of their limited application, in the early stages of implementation, development and validity, the focus was on the process rather than on the impacts.

3. ESD processes and practices

3.1. ESD pedagogical strategies

A considerable amount of the literature on sustainability in HE has focussed on pedagogical aspects related to sustainability (Cotton et al., 2009). ESD is concerned with the 'what' and the 'how', therefore it is about innovation in pedagogy (Ryan & Cotton, 2013). The integration of sustainability within HE implies shifts in current pedagogical strategies moving from: transmissive learning to discovery learning; teacher-centred to student-centred approaches; and theoretical learning to practice-oriented learning that links both theory and practice (Sterling, 2004). It involves active and experiential learning, interdisciplinary approaches to phenomena and the link with the local community and stakeholders as part of the students' learning experience. Existing teaching and learning approaches for sustainability in HE are based on educators as role models and learners, experiential learning and holistic thinking (Lozano et al., 2017).

The literature suggests a number of teaching and learning approaches to sustainability. Tilbury (2007) highlights learning based change approaches such as participative inquiry, action learning and action research. Participative inquiry is based on collective research and learning on relevant sustainability issues within the local community to encourage questioning and new action. Action learning is about reflecting on a real problem to develop a plan and implement it, to then evaluate it to learn for future action and from the process and experiences. Action research is a cyclical research process that links action (change) and research (understanding) through planning, acting, observing and reflecting, and promotes innovation.

Transformative sustainability learning has been widely discussed in the literature as a suitable pedagogy in ESD (Moore, 2005; Sipos, Battisti, & Grimm, 2008). It is about the cognitive, psychomotor and affective domains of learning (Sipos et al., 2008). It seeks to engage students in challenging existing worldviews, beliefs, feelings, values and assumptions based on past experiences. Based on a process of critical reflection, decisions are taken collectively about new ways of understanding. Four main elements in transformative learning are identified: individual experience, critical reflection, dialogue and a holistic orientation (Mezirow, 2009).

Providing real world learning opportunities through the use of student-centred approaches such as problem based learning and experiential and active and participatory learning, referring to self-reflection, self-directed inquiry, learning-by-doing, engagement with real life problems and issues, and learning collaboratively within communities are required (Thomas, 2009; Moore, 2005). Problem-based learning is a teaching and learning strategy that develops the capacity to apply knowledge to real world

[a] For more information on STARS please visit: https://stars.aashe.org

[b] For more information on SAQ please see: http://www.ulsf.org/programs_saq.html

problems and situations, and to search and critically appraise different sources of information in order to solve real problems. For these reasons it is also envisioned as a suitable pedagogy for ESD (Lozano et al., 2017; Thomas, 2009). It is action orientated and reflection on the process is key. It promotes conceptual knowledge and problem-solving skills. Students acquire knowledge and learn the difficulties in implementing or generating solutions to sustainability challenges, and are thus able to understand the broad picture and the connection between different aspects such as environmental, social, cultural and political. It promotes the ability to learn how to learn, to develop teamwork skills, and to develop professional skills.

3.2. Learning outcomes, competencies and sustainability literacy

Emergent research in the field of sustainability in HE has explored the learning outcomes and competencies that educational programmes need to seek to develop in students for them to become change agents towards sustainability (Cebrián & Junyent, 2015; Sipos et al., 2008; Wiek et al., 2011). However, it is not possible to describe a mandatory set of competencies for sustainability because of the different definitions and conceptions of the terms sustainability and competence in educational settings (Mochizuki & Fadeeva, 2010).

Different authors have put efforts on defining sustainability competencies' frameworks. For example, De Haan (2010) introduces the elements of the sustainability competence or Gestaltungskompetenz. In his view it expresses the abilities and competencies of students in contexts of sustainability and can be defined as the ability to shape future scenarios by active participation in modelling and transforming society towards sustainable practices (Barth et al., 2007). Rieckmann (2012) conducted a Delphi study in which sustainability key competencies were defined by experts from Europe and Latin American, where systemic thinking, anticipartory and critical thinking emerged as the most relevant ones. Moreover, in a recently conducted literature review and framework proposal (Lozano et al., 2017) a set of twelve sustainability competencies have been identified: 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.

In terms of learning outcomes, Sipos et al. (2008) developed the transformative sustainability learning (TSL) framework and conducted three case studies on courses related to sustainability and citizenship. They concluded that courses that were engaging students in a cognitive, psychomotor and affective sphere enhanced TSL (Sipos et al., 2008). Wiek and colleagues (2011) conducted a literature review on existing studies and frameworks on individual sustainability competencies and developed an integrative framework on key sustainability research and problem solving competencies, namely 'systems-thinking competence, anticipatory competence, normative competence, strategic competence, and interpersonal competence' (p. 205). More recent studies have contributed to the operationalisation of existing individual sustainability competencies' frameworks. For example, Ploum et al. (2018) reviewed and updated existing frameworks and validated the construct of sustainability competencies with 402 would-be sustainability entrepreneurs, arriving to a six competencies model. Also, Lambrechts and Van Petegem (2016) outline the role of research competencies in acquiring sustainability competencies, concluding with the need creating two conditions: the definition of research competencies within the context of sustainability; and the development of ESD values, attitudes and ethical perspectives in research. Other studies published in the area have conceptualised sustainability or ESD competencies' frameworks for specific subject areas, such as: engineering, pre-service and in-service teachers, and educators at all levels of education (Cebrián & Junyent, 2015; UNECE, 2012).

Other research has also looked at the inclusion of sustainability competencies in the programme descriptors of undergraduate degrees (Lambrechts et al., 2013). Thus the relevance of developing key

competencies on sustainability has been acknowledged by international agencies such as UNESCO (2005; 2017) and UNECE (2012). UNESCO has recently published a set of learning objectives for each of the 17 Sustainable Development Goals of the 2030 Agenda for Sustainable Development (UNESCO, 2017). Moreover, UNECE commissioned a group of ESD experts to develop a framework on ESD competencies for educators (UNECE, 2012). The UNECE framework is based on Delors' four pillars of education (Delors, 1996) and established 4 domains or competencies for educators: knowledge, interpersonal competency, ethics and values, and practical skills.

However, as this is a relatively new and emerging area of research, little evidence exists on the development, outcomes and impact that courses introducing students to these competencies have (Lozano et al., 2017). Further empirical research is needed on the development and implementation of assessment tools for sustainability competencies. There is still further research to be conducted to implement innovative and transformative teaching and learning approaches and transformative institutional strategies that lead to sustainability competencies (Barth & Rieckmann, 2016; Sterling et al., 2017). Therefore, as stated by Wiek et al. (2016) the research agenda in the following years needs to focus on operationalising sustainability competencies, framing the different levels of competence, and measuring and evaluating students' competencies development.

4. Curriculum development strategies

4.1. Sustainability embedded at an strategic level

There is no single curriculum model defining embedding sustainability in HE. Each institution is culturally and socially different, therefore each institution develops its own curriculum development programmes, plans and actions to embed sustainability (Cebrián, 2018; Sterling, 2004). A report on holistic curriculum change (Ryan, 2011) reviewed the international practices of twenty universities that had conducted some kind of holistic curriculum change initiatives, and performed an in-depth study of three leading universities that have been acknowledged worldwide for being examples of good practice in bringing about institutional curriculum change and practice for sustainability. The most committed universities have embedded sustainability in their strategic plans and teaching and learning strategies (Gudz, 2004). Ryan (2011) found from the review of the twenty universities that 75% had included the ESD agenda into its strategic documentation and plans, and 65% in curriculum change in the teaching and learning strategies. However, the fact of having sustainability embedded at a policy and strategic level does not necessarily translate into real practice, implementation across different faculties and departments, and engagement of the wider university community (Bekessy et al., 2007).

4.2. Different approaches to embedding sustainability within the curriculum

A number of publications have reported case studies on embedding sustainability within different disciplines such as: marketing and business; geography and environmental sciences; nursing; engineering; architecture; teacher education; social work; and humanities (Sterling et al., 2013; Roberts & Roberts, 2007). Likewise specific modules or sand-alone courses on sustainability related topics are being developed by a number of universities (Hegarty et al., 2011). The design and delivery of modules on sustainability can be seen as a starting point for embedding ESD. Other universities have set up interdisciplinary modules focussed on current global challenges, including sustainability (McCoshan & Martin, 2012). Others are offering Minors on Sustainability, such as the University of Michigan, the Penn State University, the University of Florida, and the University of Southampton.

Different levels and approaches to embedding sustainability within the curriculum have been identified as (Rusinko, 2010; Thomas, 2004):

- Including some content and material on sustainability issues in existing courses of a programme.
- Offering separate courses within a programme that deal with sustainability issues, offering minors, discipline specific or interdisciplinary compulsory or optional courses available to any students.
- Creating new discipline-specific or cross-disciplinary programmes on sustainability related topics.
- Integrating sustainability issues into all courses, having embedded the sustainability discussions throughout the programme and developing an understanding from the subject area context and the study programme.

The latest has been developed in areas that are leading to sustainability such as environmental sciences and geography, or by offering specialised undergraduate or postgraduate degrees on sustainability (Thomas, 2004). Many authors agree that an integrative approach is the best way to embed sustainability (Cebrián, 2018; Sterling, 2004) but this still tends to be limited to discipline specific courses typically in environmental sciences, geography and business and not necessarily linking research, campus and education (McMillin & Dyball, 2009). The field of research on the strategies, applications, results and best practices of incorporating sustainability into the HE curriculum is in its early stages (Sammalisto & Lindhqvist, 2008). No university exists that has embedded sustainability within its whole curriculum and in all the subject areas (Ryan, 2011). Some research has tried to conceptualise the elements that a curriculum orientated towards sustainability might have. A framework for greening the HE curriculum was developed through a participatory action research project involving eleven HEIs from Europe and Latin America (Junyent & Geli, 2008). Several characteristics for a curriculum towards sustainability were defined, such as flexibility, contextualisation, complexity, methodological adaptation and space for reflection and democratic participation. I believe that, with some imagination and originality, sustainability can be embedded in any subject area, but academic staff members need support and to be willing to engage in and try out innovative teaching and learning methodologies.

To achieve real impact on student learning experiences change is needed at subject level (Ryan & Cotton, 2013). However this must happen in conjunction with innovative experiences that link the formal curriculum to research, estates and operations, local community and external stakeholders (Hopkinson, Hughes & Layer, 2008). Initiatives as such provide students with opportunities to learn and work on real sustainability issues within the university or the community, and have the potential to push the boundaries of subject area knowledge and comfort zone, building interdisciplinary and transdisciplinary collaborations and empowering students to become change agents.

4.3. Universities as living laboratories

The idea of campuses as living laboratories for the community, staff and students is gaining momentum as a suitable strategy towards embedding sustainability in the curriculum and culture of universities and linking the operations, education and research (McMillin & Dyball, 2009). According to McMillin and Dyball (2009, p. 58):

"The campus is the most readily available laboratory for hands-on projects, and acts as a shadow curriculum for the students to apply to the campus what they learn in the classroom by engaging students in the operational aspects of the university, a powerful learning experience emerges".

Some papers have reported the experiences of universities in implementing courses and the idea of the living laboratory within their campuses (Beringer & Adomßent, 2008; Hopkinson et al., 2008). A case

study of the impact of the course 'Campus and Sustainability' at the University of Michigan concluded that little research has systematically looked at the outcomes so far (Shriberg & Harris, 2012). However the development of living laboratories is in its infancy, hence they still have the potential for improving the environmental performance of the university, enhancing students' experiences on real interdisciplinary sustainability issues, establishing links with the community, and contributing to the application and generation of knowledge and research.

4.4. Social learning and the hidden curriculum

Emerging initiates in the field have focussed on promoting sustainability learning through informal and social learning. This corresponds to what is known as the hidden curriculum, which is about the activities and practices of the organisation that transfer sustainability values (Winter & Cotton, 2012). Most of the universities committed to sustainability offer informal learning opportunities to students and staff to engage in sustainability. Many of these initiatives are volunteering activities, proving opportunities to engage in campus-based or community-based projects, in some cases leading sustainability modelling of the institution or community (Ryan, 2011). For example, Mulà (2011) studied social learning processes towards sustainability in HE in her doctoral thesis and highlighted the importance of providing staff with social learning opportunities to build sustainability awareness and action. Initiatives part of the informal curriculum are plausible across the globe (Global University Network for Innovation, 2012).

A growing number of partnerships and outreach activities with the local community have contributed to capacity-building and the improvement of regional development (Fadeeva & Mochizuki, 2010). The rethink of university and community interaction is a current trend due to its importance in building sustainability practices, where the university and community become partners towards building local sustainability, and students become active change agents that can actually learn and practice sustainability in action (Winter & Cotton, 2012). Furthermore engaging the local community and different stakeholders in university business is critical to embed sustainability. However a gap seems to exist in linking curriculum development with social learning in HE (Müller-Christ et al., 2014). The impact of informal and social learning towards building sustainable universities has been overlooked (Mulà, 2011). Another example of building informal and social learning for sustainability within the university is the United Nations University Regional Centres of Expertise (UNU RCEs); this focuses on university-community partnerships. A number of initiatives can also be found in campus climate change and environmental student-led projects (Helferty & Clarke, 2009). Student-led projects and work is another important area to foster social learning towards sustainability.

5. Implications and pathways for future research and practice

Key elements of modelling sustainable universities, educational processes towards embedding sustainability and curriculum development strategies have been reviewed. Based on the review of literature and key initiatives and milestones in ESD in HE, the following points summarise the implications and pathways for future research and practice:

Significant improvements have been made in environmental management of the estates and operations, however curriculum development and the integration of sustainability across the curriculum is still in its infancy and little research exists on its implementation and outcomes.

A whole organisational system approach linking and coordinating the operations, education, research and outreach is necessary to foster a sustainable university. Systemic transformation is required. Modelling, assessment and monitoring tools are being developed but there is still little application. There is a lack of real progress and structural change where current educational structures and practices need to be challenged.

Universities need to work on the implementation side and develop effective mechanisms to mainstream good practice and transfer lessons learnt that clearly present theoretical and methodological frameworks. There is no systematic implementation and evaluation so far, and it is often reduced to enthusiasts conducting small-scale research or projects.

Leadership and staff professional development are key for organisational learning and change and have been overlooked. A new type of leadership that is transformative and integrative is essential.

There is evidence that environmental and sustainability projects drive organisational learning. Universities need to become learning organisations to embed sustainability within their structures and culture.

Living laboratories build the case for linking campus operations, research, students' experience and the community.

Considerable literature on ESD pedagogy exists, however little are the studies focusing on staff perceptions or the challenges and opportunities faced by academics when incorporating ESD principles in their teaching practice.

Figure 1 summarises with keywords the factors that have been pointed out throughout this review and are envisioned as key elements and processes in fostering a student learning experience and holistic curriculum in HE towards sustainability.

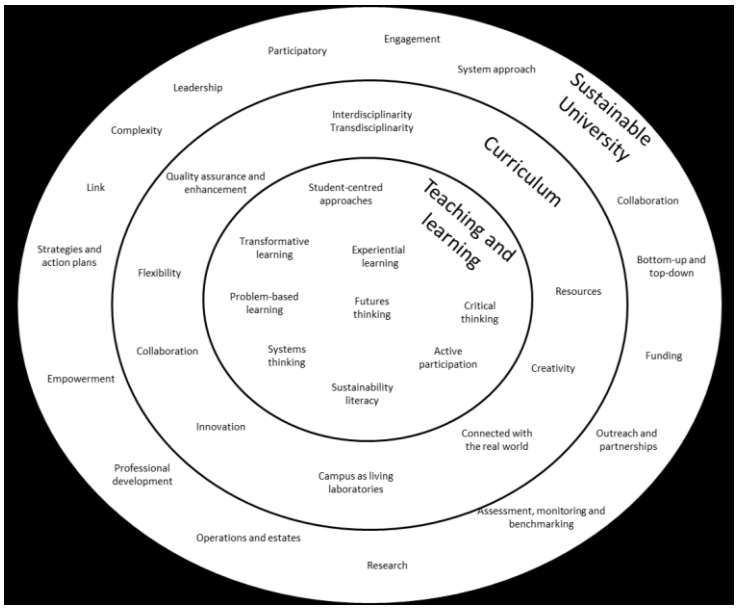

Figure 1 Key factors influencing student learning experience towards sustainability

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