Assessing Sustainability in University curricula: Case Studies from the University of Leeds and the Georgia Institute of Technology

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Abstract As more universities become interested in, and engaged with, sustainability, there has been a growing need to assess how their curricula addresses sustainable development and its myriad of issues. This book chapter presents an update of the Sustainability Tool for Assessing UNiversities' Curricula Holistically (STAUNCH®), and its application in two universities: (1) the School of Civil and Environmental Engineering at the Georgia Institute of Technology (Georgia Tech); and (2) the Bachelor and Master degrees from the Faculty of Business and the Faculty of Environment at the University of Leeds. The update includes the influence of the number of students enrolled in courses and the relative weight in credits of the courses in respect of the degrees. In addition, the tool provides graphs with information about which sustainability criteria are being most and least addressed. The curricula assessment can aid in better understanding the current status of a university's courses and degrees and identifying how they could be changed to become more sustainability-oriented. While the curricula assessment at Georgia Tech and the University of Leeds show different approaches for curricula contribution to sustainability, the results indicate that STAUNCH® can be instrumental in identifying courses that more adequately cover the breadth and depth of sustainability issues and exhibit higher contributions to sustainability. Overall, STAUNCH® can provide a systematic method for evaluating the strengths and weaknesses of a curriculum for the purpose of devising curriculum reform strategies to promote student sustainability learning. This can then help universities in making societies more sustainable.

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Introduction

As the number of higher education institutions (HEIs) engaging with sustainability grows (see Boks and Diehl 2006; Lozano 2006a, 2010; Wemmenhove and de Groot 2001), there has been an increasing interest in how they embed the principles of sustainability into their systems, including: education, research, operations, outreach, and assessment and reporting (Cortese 2003; Lozano 2006a), as well as collaborating with other universities; fostering transdisciplinarity; making SD an integral part of the institutional framework; creating on-campus life experiences; and 'Educating-the-Educators' (Lozano et al. 2013).

Universities' institutional progress toward sustainability has generally been focused on campus management, reporting degrees, and research initiatives (Lozano 2010; Lozano and Peattie 2011). By comparison, progress on the incorporation of SD into the curriculum has been slower, more limited, and piecemeal (Capdevila et al. 2002; Lozano and Watson 2013; Lozano and Young 2013; Thomas 2004; Velazquez et al. 2005). In spite of the recognized need to incorporate SD into curricula (Barth and Rieckmann 2012; Shriberg 2002b), and some efforts to explore its adoption into courses, schools, and universities, this has been little and slow (Boks and Diehl 2006; Capdevila et al. 2002; Thomas 2004; Velazquez et al. 2005). Limited research has been done on attempting to explain the incorporation of SD into university curricula (Capdevila et al. 2002; Thomas 2004; Velazquez et al. 2005). Some of the research on sustainability in universities' curricula include: Lozano's (2010) article, which explores the dynamics of the adoption and diffusion of SD in curricula by analyzing the results from the curricula audit of over 5,800 course descriptions at Cardiff University in Wales; and Ceulemans and De Prins (2010) paper, which offer a teacher's manual and method for the integration of SD into curricula, based on experiences in Hogeschool-Universiteit Brussels. Additionally, a number of authors have analyzed degrees and courses related to sustainability (see Glavic et al. 2009; Lourdel et al. 2005; Lozano 2010; Lozano and Peattie 2009, 2011; Lozano and Watson 2013; Lozano and Young 2013; Segalàs et al. 2010).

In general, four main approaches can be found for incorporating SD into higher education curricula, as proposed by Lozano (2010):

1. Some coverage of particular environmental and/or social issues and material in an existing course (Thomas 2004);
2. A specific SD course added to the curriculum (Abdul-Wahab et al. 2003; Thomas 2004; von Blottnitz 2006);

3. SD intertwined as a concept within pre-existing disciplinary-oriented courses, with the relevant SD component issues matched to the nature of each specific course (Abdul-Wahab et al. 2003; Boks and Diehl 2006; Peet et al. 2004);
4. SD offered as a specialization within the framework of particular faculties or schools (Kamp 2006).

Current curricula in higher education emphasize disciplinary specialization and reductionist thinking (Cortese 2003; Lozano 2010). As a result, many graduates are unbalanced, over-specialized, and mono-disciplinary graduates (Lozano 2010; Lozano and Watson 2013).

Within the incorporation process, three levels have been identified: (1) Major progress in embedding SD into undergraduate and post-graduate degrees; (2) Some limited progress; and (3) Relative difficulties in making credible and rigorous connections in courses and degrees, in spite of an interest in adopting the SD agenda (Thomas 2004).

A curricula assessment can offer university leaders a starting point for change, by providing a picture of where the courses and degrees are addressing sustainability issues, and where they could be improved (Lozano 2010; Lozano and Peattie 2009, 2011; Lozano and Young 2013). This could then be complemented with staff development projects (Barth and Rieckmann 2012; Shriberg 2002b) and curricular changes (Barth and Rieckmann 2012).

Many tools have been presented to assess the sustainable development initiatives of universities, including the Auditing Instrument for Sustainable Higher Education (Roorda 2001), the Graphical Assessment for Sustainability in Universities (GASU) tool (Lozano 2006b), and the Environmental Management System Self-Assessment (Shriberg 2002a). However, many of these assessments focus on the broader sustainability of a university's operations, while providing little or no insight into sustainability content of the curricula. However, the Sustainability Tool for Assessing Sustainability in UNiversities' Curricula Holistically (STAUNCH®) system is aimed at overcoming this shortcoming by assessing the extent to which a curriculum addresses the economic, environmental, social, and cross-cutting sustainability dimensions (Lozano 2010; Lozano and Peattie 2009, 2011).

This research presents and discusses the results from the STAUNCH® assessment of the B.Sc., in Environmental and B.Sc., in Civil Engineering from the School of Civil and Environmental Engineering at the Georgia Institute of Technology, as well as the Faculties of Business and Environment at the University of Leeds. This provides an illustration of the STAUNCH® assessment at two different curricular levels.

The Sustainability Tool for Assessing UNiversities' Curricula Holistically (STAUNCH®)

The STAUNCH® system was developed in 2007 with the aim of moving university curricula beyond the current emphasis on anecdotal evidence and non-comparable ad hoc reviews.[1] It was later updated in 2010 to consider the influence of the number of credits of each course (i.e., where a course has 20 credits it *may* have double the impact of a 10 credit one) and the number of students enrolled in the courses (see Lozano and Young 2013). In addition, the updated system features four new pie charts of criteria coverage for the economic, environmental, social, and cross-cutting themes, which can help to identify the coverage of SD criteria.

The STAUNCH® system relies on the explicit published course aims and outlines as a data source. This means that all the necessary information is (or should be) easily accessible, but it also means that the accuracy of the results depends on the accuracy/specifics of the published information. SD education delivered in the classroom but not reflected in the course documentation will not be captured.

The assessment is done on the course descriptors, or syllabi. It has two objectives: (1) to assess systematically how a university's curricula contributes to SD (i.e., the SD issues' coverage, depth, and breadth), by assessing its courses, degrees and schools; and (2) to facilitate consistent and comparable auditing efforts capable of handling a large quantity of data, and its application across multiple institutions.

STAUNCH® is based on two combined equilibria: first, cross-cutting theme issues (such as Holistic thinking, and SD statement, see Table 1), which are considered to be those that integrate economic, environmental, and social dimensions; and second, the SD contribution, which is calculated using formulae that look for the balance among the four dimensions, taking into consideration their strengths.

The analysis is three tiered, where the basic unit of analysis is the published course description: first, the analysis of course descriptions provides the results for the degrees; second, the degree results as the school's building blocks; and finally, the schools considered as the building blocks of the university.

STAUNCH® follows three steps:

1. *Data collection*. STAUNCH® relies on using explicit published course information, including aims, outlines, and descriptions as data sources;
2. *Data input and grading against the selected criteria*. When all the available data has been collected it is entered and graded against the issues presented in Table 2, according to the following strength criteria:

[1] For a more detailed explanation of the STAUNCH® system refer to Lozano (2010), Lozano and Peattie (2009, 2011).

Table 1 STAUNCH® 2010 curricula contribution to sustainable development assessment criteria

Economic	Environmental	Social
• GNP/Productivity/ Profitability • Resource use/exhaustion (materials, energy, water) • Finances • Production/consumption patterns • Developmental economics • Markets/commerce/trade • Accountability	• Policy/Administration • Products and services: transport, ecoproducts and services, LCA • Pollution/Accumulation of toxic waste/ Effluents • Biodiversity • Resource efficiency/eco-efficiency/ cleaner production • Climate change: Global warming/ Emissions/Acid rain/Ozone depletion • Resources use: depletion and conservation of materials, energy, water • Desertification, deforestation, land use: erosion, soil depletion • Alternatives: energy, technologies	• Demography/ Population • Employment/ Unemployment • Poverty • Bribery/ corruption • Equity/Justice • Health • Politics • Education and training • Diversity and social cohesion • Culture and religion • Labor/Human rights • Peace and security • Work/life balance
Cross-cutting themes • People as part of nature/Limits to growth • Systems thinking/application • Responsibility • Governance • Holistic thinking • Long term thinking • Communication/Reporting • SD statement • Disciplinarity • Ethics/Philosophy • Transparency		

Source (Lozano and Young 2013)

- ***Blank*** *"Ignored"* (effectively a score of zero): indicating that a particular issue is not mentioned;
- *1 "Mentioned"*: the issue is mentioned, but no explanation is given about how it is addressed;
- *2 "Described"*: the issue is mentioned and there is a brief description of how it is addressed;
- *3 "Discussed"*: there is a comprehensive and extensive explanation of how the issue is addressed;

3. Analysis of degrees, schools, and the university's contribution to SD. STAUNCH® offers two types of reports for each part of the university (typically a School or Faculty): a summary report, and a detailed report; and four

Table 2 SD Contribution and qualitative levels

Hypothetical degree	Contribution	Level
U0001	0.00	None
U1001	0.01–0.67	Very low
U2001	0.67–1.29	Low
U3001	1.30–1.99	Medium
U4001	2.00–3.50	High
U5001	>3.50	Very high

graphs: (1) A map of contribution versus percentage of courses; (2) A chart representing the relative contribution to each SD dimension (economic, environmental, social, and cross-cutting themes); (3) A relative frequency chart of criteria strength; and (4) A map of contribution versus weighted average strength.

Two of the key points in the analysis reports are: (1) the level of contribution, indicating the 'breadth' and 'depth' of coverage of sustainability issues (the higher the contribution's value the better the balance among economic, environmental, social, and cross-cutting dimensions); and (2) the percentage of courses contributing to SD, given by the number of courses that relate to SD, divided by the total number of courses in each degree. Table 2 provides an illustration of this, as well as the qualitative level.

The STAUNCH® system is aimed at helping universities assess the depth and breadth of their SD-related curricula in a holistic and systematic way to produce standardized and comparable results. STAUNCH®'s results provide a 'snapshot' of how SD is currently being addressed within a university. Its reports detail the percentage of courses currently addressing SD, their balance among the conventional dimensions of SD (economic, environmental, and social), as well as those themes that cut across them. This information offers the possibility to detect whether SD is integrated across the curricula or is being broken down into individual issues to be addressed as a portfolio throughout the curricula. The reports can also serve to question current degrees, discuss how they could better contribute to SD, and help the institution better align with the Decade of Education for Sustainable Development (DESD) (UNESCO 2005).

The STAUNCH® system has been used by a number of universities, such as Cardiff University (see Lozano 2010; Lozano and Peattie 2009, 2011), University of Leeds (Lozano and Young 2013), Monterrey Tech, Worcester University, Georgia Institute of Technology and 11 Welsh universities through funding from the Higher Education Funding Council for Wales (HEFCW).

Case Studies

Two case studies are presented to show the systemic approach of STAUNCH®: two undergraduate degrees from the Georgia Institute of Technology (Georgia Tech) and two faculties from the University of Leeds. The courses were analyzed

by this article's first author, who has analyzed over 10,000 courses from Cardiff University, Monterrey Tech, Georgia Tech, and the University of Leeds. Only some results and graphs are presented for each case study to serve as an illustration of the results that STAUNCH® provides.

Georgia Tech Curricula Contribution to Sustainability

Georgia Tech is one of the premier public research universities in the USA. Georgia Tech is home to six academic colleges: Architecture, Management, Liberal Arts, Computing, Engineering, and Sciences (GIT 2011).

Georgia Tech is committed to training engineers to engage in sustainable development. Based on this, CEE implemented a Civil Engineering Systems course to teach students about sustainability using a systems approach, where students learn about the economic, environmental, and social dimensions of sustainability during the semester and then apply principles by conducting a sustainability analysis of an existing infrastructure system. While CEE at Georgia Tech has made considerable efforts to incorporate sustainability principles into the curricula, a formal assessment was needed to determine the effectiveness of these efforts.

Forty-four courses offered by the School of CEE were analyzed with STAUNCH®. The analysis revealed that the curricula have strengths of 1.35 with contributions to sustainability education of 1.28. Both metrics are classified as "medium" (see Fig. 1). In addition, 12.8, 64.1, 2.3, and 20.8 % of sustainability

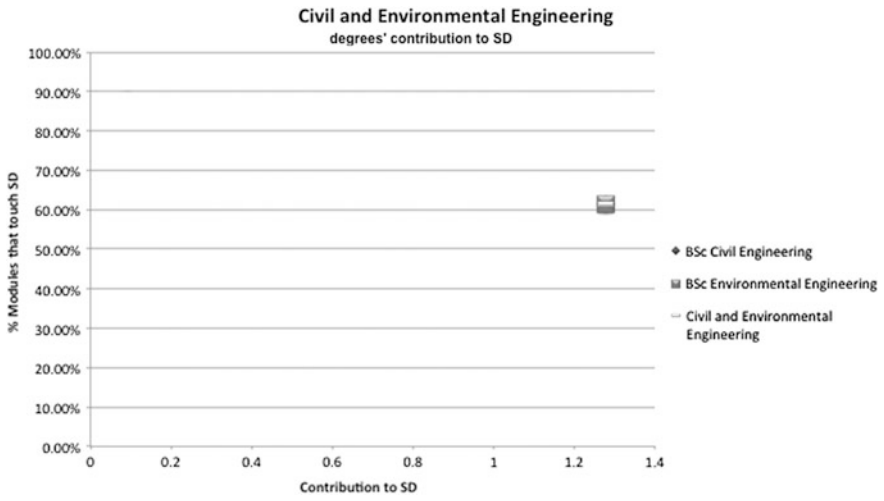

Fig. 1 Civil and Environmental engineering contribution to SD versus percentage of modules related to SD

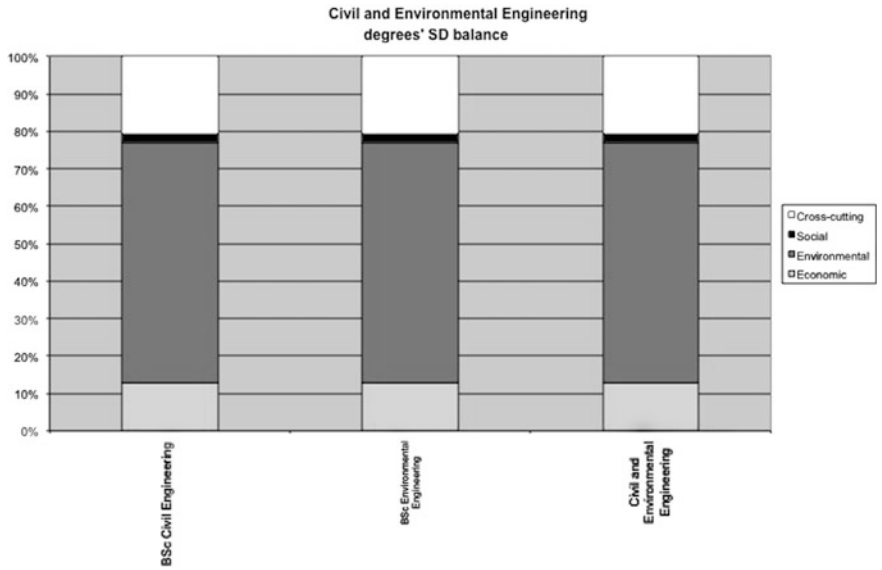

Fig. 2 Civil and Environmental engineering SD balance

content is related to the economic, environmental, social, and cross-cutting dimensions, respectively (see Fig. 2).

Although CEE has made substantial efforts to incorporate sustainability into the curricula, additional strives are needed to complete the integration. While the environmental dimension of sustainability is extensively covered (see Fig. 3 for the issues covered), the other three dimensions coverage could be improved. The STAUNCH® results also suggest that some issues are being neglected in the current curricula, including markets/commerce/trade, resource efficiency/eco-efficiency/cleaner production, and diversity/social cohesion. Identifying courses that could address these currently over-looked issues could also improve the curricular contribution to sustainability.

University of Leeds Curricula Contribution to Sustainability

The University of Leeds was founded in 1904, but its origins go back to the nineteenth century with the founding of the Leeds School of Medicine in 1831 and then the Yorkshire College of Science in 1874 (Leeds 2012b). The University of Leeds is an independent corporation established by Royal Charter (Leeds 2012a).

The university of Leeds has 33,223 students from 145 countries (29,429 full time students, 3,794 part time students), of which: 24,983 are undergraduates and

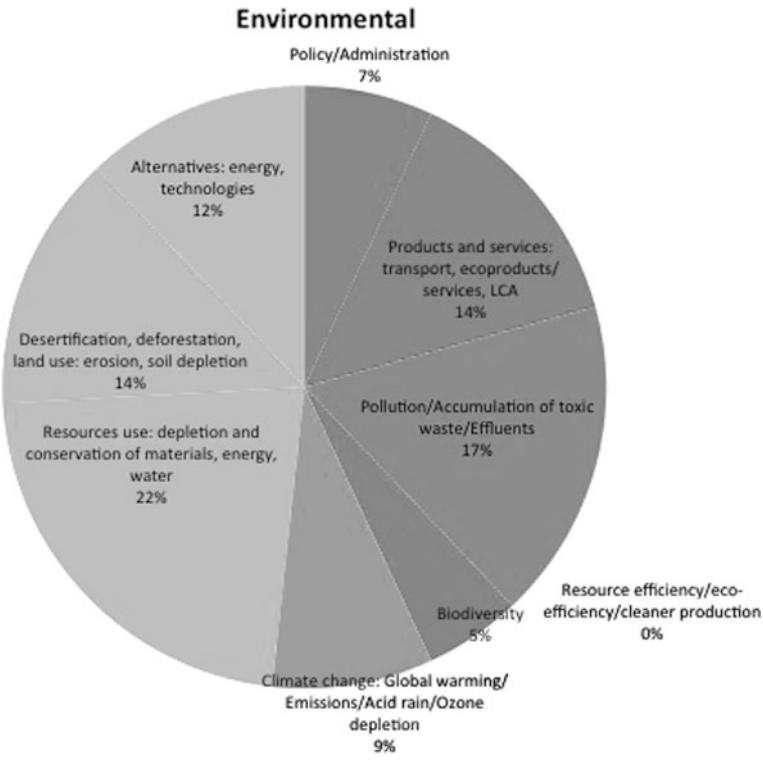

Fig. 3 Civil and Environmental engineering contribution to the environmental dimension

8,240 are postgraduates. Over 2,000 students volunteer for local community projects. The university has 7,543 staff from 99 different nationalities (Leeds 2012a).

The university has committed to spending £157 million by 2016 on new buildings and refurbishment to create an environment in which to pursue excellence in research and teaching. It has won a number of environmental awards, including a 'Highly Commended' in the 2011 Green Gown Awards for Promoting Positive Behaviour in relation to its UTravel Active transport project (Leeds 2012a).

Part of the university's efforts toward sustainability is the curricula assessment project for the Faculties of Business and Environment (including the Institute for Transport Studies, School of Earth and Environment, and School of Geography), including all bachelor and postgraduate degrees for the academic year 2009–2010.

From the Faculty of Business, 698 courses were analyzed for 14 bachelor degrees and 16 post-graduate degrees. From the Faculty of Environment, 2,063 courses were analyzed, from 15 bachelor degrees and 56 post-graduate degrees. Typically, an undergraduate student in the University of Leeds has to gain 360 credits, 120 per year, while a taught postgraduate has to achieve 180 credits.

Table 3 Summary of the university of Leeds faculties' results

	Percentage				Percentage of courses contributing to SD (%)	Contribution	Strength	Percentage students exposed (%)
	Economic (%)	Environment (%)	Social (%)	Cross-cutting (%)				
Faculty of business	78	2	19	1	63	0.98	1.31	63
Faculty of environment	15	54	7	24	62	1.75	1.25	66

During the assessment, the following assumption was made: Dissertations, and similar projects, were not graded because of their usual variability in topics and results.

Table 3 presents the summary of the results from both faculties. As it can be observed, they each have a similar number, and percentage, of students exposed to SD. However, the contribution to SD from the Faculty of Environment is considerably higher (1.75 vs. 0.98), while the strength of both faculties is fairly similar (1.31 and 1.25, respectively). Also, the Faculty of Environment has a better balance among the four dimensions, than the Faculty of Business.

Figure 4 provides an example of the criteria coverage of the environmental dimension from the Faculty of Business, where it can be seen that the criteria with the highest coverage is 'Products and services', while the one not addressed is 'Desertification, deforestation, and land use'.

Discussions

The STAUNCH® system is aimed at helping universities assess the depth and breadth of their SD-related curricula in a holistic and systematic way to produce standardized and comparable results. STAUNCH®'s results provide a 'snapshot'

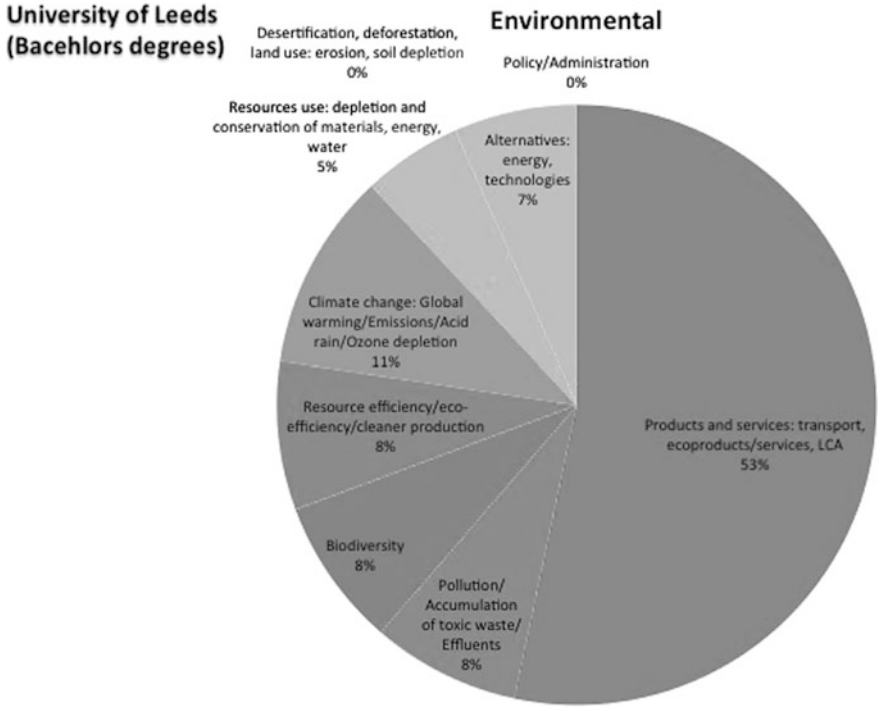

Fig. 4 Results from STAUNCH® criteria coverage of the environmental dimension for the faculty of business

of how SD is currently being addressed within a university (Lozano 2010; Lozano and Peattie 2009, 2011; Lozano and Young 2013).

The STAUNCH® assessment of the curricula for Georgia Tech and the University of Leeds shows a wide range of approaches to sustainability in the curricula, even within the same institution. This concurs with Fien's (2002) and Matten and Moon (2004), who indicate that sustainability has not yet permeated throughout the different disciplines and curricula. The STAUNCH® results offer the possibility to detect whether SD is integrated across the curricula or is being broken down into individual issues to be addressed as a portfolio throughout the curricula. The reports can also serve to question current degrees, discuss how they could better contribute to SD, and help the institution better align with the DESD (Lozano 2010; Lozano and Peattie 2009, 2011; Lozano and Young 2013).

Sustainability needs to be better intertwined within existing modules (see Abdul-Wahab et al. 2003; Boks and Diehl 2006; Peet et al. 2004) to improve the contribution of curricula to sustainability. This could help universities move toward a more balanced, synergistic, transdisciplinary, and holistic academic system, thus helping graduates better contribute to making societies more sustainable (Lozano 2010).

While incorporating sustainability concepts, it is important for educators and directors of teaching and learning (see Lozano 2010; Lozano and Peattie 2011) to consider both the contribution (i.e., balance and depth) for the four sustainability dimensions, as well as the coverage strength. Over- or under-emphasizing any one dimension in their undergraduate education may lead graduates to do the same in their careers (refer to Davidson et al. 2007; Mihelcic et al. 2003).

Conclusions

There has been an increasing interest in assessing and incorporating sustainability into curricula at all levels, as well as examining how students may gain an understanding of the impacts of their decisions and actions on the environment and society. However, questions still remain on the scope, extent, and impact of what is being taught, and the validity and reliability of curricula assessments. This paper shows the results from the curricula assessments of the B.Sc., degrees in Civil and Environmental Engineering at Georgia Tech and the Faculties of Business and Environment at the University of Leeds using the STAUNCH® 2010.

As previously indicated (Lozano 2010; Lozano and Peattie 2011), the results from the curricula assessments can help to stimulate discussions with directors of learning and teaching on how to better incorporate sustainability into the curricula. Curricular assessment can present university leaders with a starting point for change by providing a picture of where the courses and degrees are addressing sustainability issues, and where they could be improved (e.g., degrees where less than 50 % of students enrolled are exposed to sustainability issues).

We need courses and degrees that deliver an education that considers its full implication to sustainability, and we need more and better-educated graduates, who understand and implement holistic and transdisciplinary approaches to address the four dimensions of sustainability (economic, environmental, social, and time) and their inter-relations.

Curricula assessment should also be complemented with research on pedagogy approaches and their efficacy in delivering sustainability education, and 'educating the educators' degrees (see Barth and Rieckmann 2012; Huisingh and Mebratu 2000; Lozano et al. 2009), as well as assessments of campus operations, research, and outreach.

A challenge that remains is how to assess the contribution and impact that curricula and university life may have on students' personal and future professional lives, and ultimately on helping make societies more sustainable.

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