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The Entropy of Sustainability: Observed Tensions in Canadian Tertiary Innovations

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ABSTRACT

University innovations relevant to sustainability education do not always come labelled as such. Inspiration can potentially be drawn from a wide range of fields and initiatives. During a 2005 study tour of Canada, seven universities were visited to investigate such programs, focussing on those that comprise more than one subject and that are intended for an undergraduate audience. In this paper, an exploratory study is undertaken of the collected interviews, field notes and documents to identify some of the debates common to the wide range of cases. Core structure and content, equity of access, operational constraints, and organizational structures are discussed, each delineating characteristic tensions between homogeneity and diversity; collegiality and isolation; idealism and pragmatism; and, flexibility and rigidity.

RÉSUMÉ

Les innovations universitaires liées à l'éducation au développement durable ne sont pas systématiquement identifiées comme telles; elles s'inspirent d'une multitude de milieux et d'initiatives. Dans le cadre d'une tournée pancanadienne en 2005, sept universités ont été visitées pour examiner ces programmes, en particulier ceux portant sur plus d'une matière et conçus pour les étudiantes et étudiants de premier cycle. Dans cet article, une étude exploratoire des entretiens, des notes

d'observation et des documents recueillis est entreprise afin d'identifier quelques-uns des débats que ces nombreux cas ont en commun. La structure et le contenu de l'enseignement, l'équité d'accès, les contraintes opérationnelles et les structures institutionnelles sont quatre thèmes abordés. Chacun de ces thèmes met en lumière les tensions observées entre homogénéité et diversité, collégialité et isolement, idéalisme et pragmatisme, et flexibilité et intransigeance.

> The danger of falling back into monodisciplinarity is not imaginary; it is the way of least resistance, the 'entropy of science' (Zonneveld, 2000, p. 39)

Sustainability is an increasing concern in the higher education sector worldwide (Tilbury, Keogh, Leighton & Kent, 2005). Long term sustainability requires "put[ting] human and natural capital on an equal footing with economic capital, inform[ing] public debate and ensur[ing] integrated decision-making" (Environment Canada, 2004, p. 3). This high order social goal is promoted by the current United Nations Decade of Education for Sustainable Development (2005-2014), and literally thousands of policy documents worldwide (Connor & Dovers, 2004; Smyth, 1995). Consistent messages have featured since the 1977 Tbilisi Declaration (UN, 2005) on environmental education, despite the shift implied by changes in terminology from environmental to sustainability (Sherren, 2006a). Such policy thrusts are relatively easily absorbed into centralized and standardized public endeavours like primary and secondary education. Universities are largely autonomous, however, and internally decentralized via academic freedom and departmental fragmentation, making them uneven policy instruments (Dovers, 2005). The normative nature of education for sustainability (EFS) certainly challenges uniform adoption across higher education institutions. Within institutions, sustainability uptake is challenged by its conceptual breadth; the need to span not only disciplinary silos, but the very university walls, in addressing it (Moore, 2005); and, the way in which increased marketization creates pressure towards homogeneity in what is offered. All create entropy in universities around the challenge of sustainability.

The EFS literature targeting universities includes individual subject[1] cases (Alvarez & Roberts, 2006; Muijen, 2004; Wemmenhove & de Groot, 2001; among many), high level pedagogical philosophy (Bowers, 2001; Orr, 1992; Stables, 2001; for example), staff development (Holdsworth, Bekessy, Mnguni, Hayles & Thomas, 2006; Tilbury, Podger & Reid, 2004) and top-down policies (Bosselmann, 2001; Sharp, 2002) and audits (Bekessy & Burgman, 2001). Canadian scholars and universities are prominent among all of these (Beringer, 2006; Jickling, 2001; Moore, Pagani, Quayle, Robinson, Sawada, Spiegelman & Van Wynsberghe, 2005; Wright, 2004). This paper is concerned rather with the aggregate experience of students and staff in innovative settings. Students

take many subjects in their academic programs, and groups of staff members design those experiences. For this paper, relevant innovations above the level of individual subject are explored with those people involved in bringing them about. How were the innovations husbanded into existence? What elements of the disciplinary, structural, administrative or collegial life of the university act as barriers? How do pressures from without, such as the student market and government funding, affect outcomes? Finally, to what key factors can their successful (or otherwise) implementation be ascribed?

Given the diffuse nature of sustainability, an important issue to this paper is how to identify relevant pedagogical innovations. I take the position that this definition should not be limited to those that explicitly make reference to the concept. In fact, some of the key elements of sustainability education are as commonly found outside of environmental faculties as within (Sherren, 2006a; see also Sherren 2008). For example, liberal models of education encourage the acquisition of a rich context for decision-making and critical thinking skills. Cosmopolitanism is a concept of world citizenship and empathy to the other – the oft-neglected intragenerational equity – that is informed by the humanities. Civics helps students to actively participate in improving society, and is engendered by authentic, outreaching curriculum including the social sciences. Interdisciplinarity helps students to bridge conceptual divides, and requires intentional integration, not just content diversity. The Boyer Commission's (1998) list of recommendations to improve undergraduate education in America's research universities includes many ideas sympathetic with EFS, including inquiry-based first year studies, research-based learning, removing barriers to interdisciplinarity. and culminating degree programs with capstone experiences. Potential sources of inspiration can be found across the university campus.

Some caveats inevitably apply in such a survey piece. First, this paper provides an outsider's perspective on the experiences common to a range of relevant innovations, based on a wide sample of supporting evidence. Such a wide scope necessarily sacrifices analytical depth to acquire breadth in cases. Second, due to the breadth of cases investigated, this paper can only give an overview of each, enough to serve as a starting point for many seeking insight. Third, the analysis has been undertaken in an exploratory fashion rather than deductively. Some of the information conveyed is admittedly of the tacit variety, but the value of this knowledge is rarely recognized by those who hold it, or by those who do not. Publishing such a research paper serves to put it on the record.

RESEARCH DESIGN

A case study approach is a logical choice for studying change in institutions, but it also presents some challenges (Corcoran, Walker & Wals, 2004). Single-case studies can be difficult to generalize to new settings (Fien, 2002). At the same time, multiple case studies require a sensible sampling system, and – even then – the unique setting of each institutional environment makes perfect replication a null concept. Individual features of interest *can* be replicated,

such as categories of innovation (see Wild River, 2006, for an example). The relevant innovations investigated here were identified based on past work by Sherren (2006a), and included instances of the following:

1. attempts to unify cross-cutting sustainability environmental or sustainability activities using an "umbrella" style organizational superstructure;
2. interdisciplinary environmental or sustainability programs; or,
3. aggregated curriculum designs featuring cosmopolitanism, civics, liberal education, and/or disciplinary integration.

Individual instances of such features were found through web queries, informal inquiries, and targeted research techniques. The seven campuses chosen provided replication in each feature (see Table 1), stratified across each of three regions (western, central and eastern Canada) and a wide range of institutional characteristics like student body size, research activity, and course profile:[2]

- The University of British Columbia (UBC) and Simon Fraser University (SFU) in Vancouver, British Columbia (BC), and the new inter-institutional Great Northern Way Campus (GNWC), linking these with the BC Institute of Technology and the Emily Carr Institute of Art + Design;
- Ryerson University and York University in Toronto, Ontario (ON); and,
- The University of New Brunswick (UNB) and St. Thomas University (STU) in Fredericton, and Mount Allison University (MTA) in Sackville, New Brunswick (NB).

I visited each of the above universities during a study tour of Canada in September and October of 2005. To gain an overview of each program, an average of two interviews was conducted per feature case (range: 1-3), with about three people per institution (1-7) overall. Respondents came from a wide range of disciplinary traditions, from microbiology to theology. Only three were female, and all bar one were native English speakers. The 21 formal interviews that resulted (one interviewee had worked at two of the universities) were open-ended and lasted 47 minutes on average.[3] Questions focussed on the academic, operational, marketing, and structural issues associated with the creation and maintenance of the program in question, and its perceived trajectory. The success or failure of each program was not externally benchmarked, so any such judgements discussed below reports uncritically the opinion of the interviewees, based on their personal interpretations of student demand, pedagogical outcome, staff satisfaction, and administrative burden. I took field notes during three classes in session and in a handful of less formal discussions, and documents were also collected, such as course catalogues, planning documents, and academic literature discussing some of the specific innovations of interest. All of these data are synthesized in the ensuing discussion.

This rich data set was analyzed inductively – seeking to identify the narrative threads that make the diverse cases generalisable to other settings – and iteratively. For the sake of brevity, and in consideration of the breadth of themes and cases to be covered, the material presented here will remain at the level of

Table 1. Research design, showing replication of relevant features across case study institutions (see Sherren 2006b tables and appendices for more details).

	British Columbia		Ontario		New Brunswick		
	UBC	SFU/ GNWC	Ryerson	York	UNB	STU	MTA
Interdisciplinary undergraduate environmental curriculum	Interfaculty Program in Sustainability Science (and GRS, below)			B. Environmental Studiess	Environmental Studies major/ minor		BA (Environmental Studies)
Integrated teaching structures	Integrated Science final year grad. program (& Science/ Arts 1)	Undergrad. Semester in Dialogue at Harbourfront Campus of SFU	'Ideas that changed the world' sequence in BA (Arts and Contemporary Studies)			Aquinas Program: 'Truth in Society'	
Liberal education/ novel foundation years	Science 1 and Arts 1 block offerings		Common first years in BA/BSc, and tripartite model from polytech.		Renaissance College BPhil (Interdisciplinary Leadership Studies)		
Cosmopolitanism, civics and outreach in curriculum	BSc Global Resource Systems (GRS), including study abroad and charity work	Inter-institutional 'Learning City' applied sustainability subjects at GNWC	BA (Politics & Governance)		Same as above, features local and international work placements		
Umbrella research structure	Institute for Resource, Environment and Sustain-ability (IRES)	Centre for Interactive Research on Sustainability (CIRS) at GNWC		Institute for Research & Innovation in Sustainability (IRIS)	Environment and Sustainable Development Research Centre (ESDRC)		

broad narrative rather than individual discourse. As a result, a minimum of interview data is presented. Included quotes acknowledge the sources of particularly cunning language, rather than accumulated evidence. Unless stated otherwise, conclusions are derived from this research, rather than other sources.

DISCUSSION

Many stories can be told with the same qualitative data set. The one that emerges here describes the alternatives and tensions related to decision points common to each feature:

- For interdisciplinary environmental degree programs, how will core curriculum be structured, and what will it hold?
- For labour-intensive, aggregate curricular models, how will student numbers be limited, and how can administrative routines designed for traditional offerings be subverted?
- For cross-campus networking structures around sustainability, can any governance model work to provide value to research *and* contribute to undergraduate offerings?

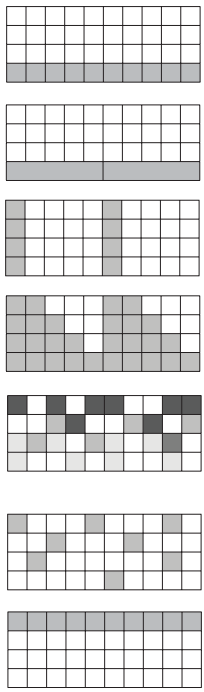
What is perhaps surprising is the fact that the choices made in each instance, as discussed in detail below, caused very little friction amongst the creators. Success was common, too; only one initiative was felt by its innovators to have failed. This success often relied on deep commitment and vigilance on the part of individual academics who persist in sometimes hostile settings. Despite the centralising forces inherent in administrative systems designed for the majority, and the opportunity costs of working against them, a clear message emerged that the effort required to implement atypical teaching and departmental models is worth it for students, staff, universities, and the larger educational sector.

Core curriculum structure and content

One key decision in any educational program design is how to embed core and optional course requirements, but this is particularly the case with interdisciplinary programs. The amount of freedom that is included in degree programs speaks to the cohesiveness of a field (i.e. whether there is an established canon (see Sherren, 2007)), and the degree of theoretical rigour that practitioners are perceived to require upon completion. Sustainability attempts to balance concepts of social justice, environmental citizenship, cultural diversity, and economic viability (Hawkes, 2001), with a scientifically informed view of the natural world. Translating to the academy, this "diffuse" (Whitley, 1984) field of sustainability appears to be about everything and nothing all at once. Such a vague connotation is at odds with the idea of core knowledge. This section explores various choices of structure and content found in Canadian cases, for a range of courses, along with their pros and cons.

Core structure. Seven archetypes for handling core content in degree programs were encountered in the universities visited, but they do not appear to

have been described previously (Figure 1). They are often found in combination, such as a foundation year with chequerboard course requirements in later years. Some represent extreme, pure cases at the ends of a spectrum. So-called "cafeteria" degrees, for example, usually have a few core subjects, and "rigid" ones free up a handful of elective spots. I do not assert that any of the approaches is inherently better or worse than the others, but that choices are careful compromises under competing interests. These models are presented to show the range of options that exist in program design processes. The debates at play in each choice are discussed below, drawing on the examples annotating Figure 1.



Foundation year – parallel
New Ryerson programs in Arts and Contemporary Studies (ACS), Politics and Governance and Science

Foundation year – block
UBC Science 1 and Arts 1 (as well as their 'coordinated' alternatives);
STU 'Aquinas' program (although it is optional)

Longitudinal
UBC Global Resource Systems (GRS) core;
Ryerson 'Ideas that changed the world' subject series for ACS

Rigid
UBC B.Sc. (Natural Resources Conservation);
Old Ryerson programs (before common foundation developed)

Chequerboard (high prerequisites)
MTA Environmental Studies major option in B.Arts;
UNB Environmental Studies minor and secondary major for any degree

Cafeteria (low prerequisites)
Ryerson B. Arts and Contemporary Studies;
York B. Environmental Studies;

Capstone
SFU 'Undergraduate Semester in Dialogue';
UBC 'Integrated Science' grad program, and Forestry 4th year field course

Figure 1: Core curriculum structural types, supported by examples encountered in case work.

One common core structure is the *foundation year* (or years), during which students are inculcated to an appropriate level of knowledge in a number of the essential fields – the canon – of their chosen area of study. Units are usually one or (more rarely now) two semesters in length, or cover the same material in more intensive modules. Subjects following the core in such a degree program can assume a particular background in their students, a fact increasingly rare as students leave high school with fewer common competencies. Foundation years

are often diplomatically designed to expose students to the various options that exist for more detailed study within their program, such as majors or specializations. Such a practice benefits departments too, by equalising the likely distribution of declared majors across options, and imposing a cost (perhaps another year's study) to transfer to other ones. If foundation years are so intended, however, conflict can arise where potential paths outnumber introductory spaces. There are other kinds of foundational content that encourage well-roundedness and civic agency, as described by Newton's (2000; see also Sherren 2008) "effective citizen" model, but these are sadly often limited to liberal universities or those with a religious emphasis. It was noted by one interviewee that lengthy, common groundwork can also be evidence of a paternalistic attitude by "building in the institutional capacity [for students] to remain uncertain for as long as possible" (C113[4]).

A subset of the foundation year approach are those offered in integrated or *block mode*, where students enrol in a set of common subjects that are then taught organically rather than in parallel. Lecturers in such block programs combine their material to communicate disciplinary interconnections, and often only one final grade is given, such as in UBC's Science 1 and Arts 1 programs (Benbasat & Gass, 2002). Despite obvious benefits of such demonstrated holism, there are many challenges to such an educational model. Designing and delivering such programs involves heavy collaboration on the part of academics more accustomed to working alone. Such labour-intensive offerings also challenge departmental workload and funding formulae. One interviewee reported "departmental imperialism" (E219) as a barrier, relating colleagues' concerns that students of such blocks may not recognise disciplinary elements if taught "Aristotle instead of sociology" (E219) in first year. Students may also experience discomfort when they encounter the rest of their degree program, likely structured more modularly, or express concern about how such a non-traditional offering and grading system will affect later opportunities like university transfer. Economies of scale create sector-wide pressure for modularity and subject reuse, rather than integration via such blocks. The intensive pedagogical methods employed tend to restrict class sizes and diversity of student circumstances, too; traditional foundation years are thus run in parallel for the majority of students. Compromise programs, like those at UBC, link parallel subjects, each individually graded, with an integration seminar (see Benbasat & Gass, 2002).

Core content can also serve as a common thread, undertaken *longitudinally* throughout a degree program. The examples annotating this structure in Figure 1 all feature one or two team-taught subjects per year that bring together students who are otherwise focusing on different themes within cross-cutting courses. In the Global Resource Systems program at UBC, students choose a region (including a relevant language) and a resource to study, and spend time on overseas work terms related to that focus. It has a particularly ambitious longitudinal program that unites students from all years of a program – on campus and on exchange – in common discussions and other activities.

Compulsory content can also be identified for completion anytime in the degree program or major. In such *chequerboard* programs, students may also be pursuing other majors, minors or certificates, whose requirements will be similarly dispersed, and university-wide core may also be stipulated such as English or writing requirements. In this model, choice increases as the course progresses, but flexibility may decrease; prerequisites may become more stringent. The onus is on students to map their own progression through prerequisites, or to take responsibility for their own transition where they have had requirements waived. In more liberal institutions, a distinction is made between putting academics in silos, and putting students in them. Cross-cutting majors in liberal institutions draw on subjects from across the campus, rather than keeping all students within their home department. There is a risk that students may not choose to major in a field that appears to have few subject offerings dedicated to it (i.e., a few courses starting with ENV). Other than giving subjects multiple codes, there is little that can be done about this. Internal accounting structures can support such a liberal model by taking pressure off maximising declared majors in a department as long as its subjects are adequately enrolled (Scott, 2004, gives another example).

Rigid programs are typical of highly technical or applied fields with formal accreditation, but this model can limit transferrability between programs and encourage attrition. Such programs are rarely offered part time or by distance education, as the sequencing is considered critical. Their inflexibility is evidence of cohesive, traditional disciplines with wide consensus on desired practitioner characteristics. Students in such programs are often kept within one faculty for all their work, but increasingly exert pressure for more choice.

The opposite of this is the *cafeteria*-style degree that seems increasingly common as student fees rise. Some programs of this type offer creative, cross-cutting specializations, but under a generic degree name where the declared area does not appear on the certificate. In some cases these sequences act simply as guidance for students, or a marketing hook, rather than as firm course rules or stipulations; students can still graduate having taken a very different series of subjects. Some students have found that the lack of detailed designation is a barrier to employment or further study (e.g. proving mastery of teachable subjects for later qualifications in education). These flexible programs feature subjects with few prerequisites, although students may be encouraged to take subjects within a particular faculty. Academic staff administering such programs report that the onus on them for individualized advice can be quite trying.

The final option is the capstone practice of putting all the core content at the end of the degree, rather than the beginning. Majors or programs that start requirements in later years often receive inflow from internal or external student transfers. Core that comes at the end often assumes a diversity of foundations, and thus tends to be either introductory or integrative in nature. While disciplinary depth may be sacrificed, the rich variety of student perspectives and experience present in the capstone classroom is its own reward. Senior seminars

in more liberal programs serve a similar purpose. Capstones do exist in rigid programs, too, but they require a common background in order to maintain the "quality of debate and discourse" (W108). More typically, it is flexible programs that can spare the elective space for capstone graduation programs.

Each of the seven core options discussed above makes assumptions about its student market, and serves a specific purpose in educating an undergraduate. Used in combination, these core options allow a powerful amount of degree customization without leaving the novice student unsupported in her/his progression. The generous degree space of North American undergraduate degrees keeps academics from having to choose only one option (except in the case of rigid programs). Students have time to get an introduction to a broad field, get some disciplinary expertise, and practice integration. With their remaining electives, undergraduates can opt into a thematic or problem-based graduation program, explore a hobby interest, study abroad, take an internship, or apprentice at research. Each such program is autonomous, and can be managed locally (i.e., by faculty, school, or interdisciplinary research group), with transparency and communication between them necessary to minimize duplication, fill gaps and eliminate impossible prerequisite arrangements. With such a mosaic of opportunities, students can develop their interests progressively, neither making big decisions too soon nor being left without guidance. At the same time, course coordinators do not have to offer and support custom-designed programs, something they are increasingly under pressure to do.

Core content. Deciding the disciplines to be included in core content is often a more contentious process than deciding how it should be structured (Sherren, 2007). Outcomes often demonstrate departmental determinism. Sustainability is a diffuse field with no formal accreditation processes, and little consensus on what theory produces a good practitioner. Teaching such a topic with rigour requires time and clear intentions (Collier, 2000), difficult with sustainability understood differently across the academy (Reid & Petocz, 2006). The content of existing environmental programs have been audited in Australia (Baxter, Hockings, Carter & Beeton, 1999; Cosgrove & Thomas, 1996; Sherren, 2005; 2006a) and the United States (Blockstein, 2003), and some preliminary core competencies have been developed outside of fraught planning environments (Second Nature, n.d.; Sherren, 2007; Focht & Vincent, 2004). Such discussions are all too easily affected by non-academic concerns, like the internal accounting processes that assign credit for subject or student load. Similarly, the educational experiences and value systems of staff members affect what is possible (Lattuca & Stark, 1994).

Environment and sustainability are most popular in Canada as graduate, rather than undergraduate, pursuits. There are twice as many graduate students in that field as undergraduates, when viewed as a percentage of all completions (2.9% and 1.5% respectively). In fact, almost a third (30.3%) of students in "agriculture, natural resources and conservation" who graduated from Canadian universities in 2003 were at the graduate level, the highest of any category (av-

erage 17.6%) (Statistics Canada, 2005). Although no undergraduate programs in sustainability were readily found, four environmental programs were sampled that each purported to educate for sustainability according to marketing materials (Figure 2). The environmental education and sustainability education literature has not differed significantly in scope, so although we do not know how well these four represent the larger phenomenon, they provide an interesting perspective into the undertaking. The chosen programs were all established in the last 15 years and are reasonably small. They are also all delivered from different faculties, demonstrating the unclear home of environmental studies within universities (Sherren, 2006a).

Table 2. Interdisciplinary environmental programs sampled, including indices of diversity.

Home	Program	Group Responsible	Type	Core structure	Yearly intake
UBC	BSc (Global Resource Systems)	New Faculty of Food and Land Systems (was Agriculture)	Degree	Parallel foundation with longitudinal	50-100
York	B. Environmental Studies	Faculty of Environmental Studies	Degree	Cafeteria	50-100
MTA	Environmental Studies major for BA students	Faculty of Social Science	Major	Chequerboard	<10
UNB	Campus-wide, Environmental Studies minor	Environment and Sustainable Development Research Centre (ESDRC) umbrella group	Minor	Chequerboard	<10

Each program differs slightly in the fields it requires in core curriculum, as shown in Figure 2. Aggregated, the programs emphasize applied rather than pure sciences, and the human realm comes distant second. The high ranking of "Language and Culture" comes largely from compulsory first-year composition subjects. This lack in the core may be traceable to the fact that upper-year social sciences and humanities subjects lack prerequisites compared with those in science: students' future subject choices in social sciences and humanities are thus not limited by making early subjects optional. Only the UNB minor includes the kind of policy content that a recent survey of sustainability experts recommended (Sherren, 2007), and none had the philosophy or ethics content they called for.[5]

Student choice was supported in all four programs, with varying levels of personal responsibility assumed by students and faculty. Course coordinators each voiced support for breadth and interdisciplinary studies. The integration of disparate fields was either engineered in the programs by the use of longitudinal or capstone core, or it was assumed to emerge from being taught by staff who are themselves interdisciplinary scholars. Each course development process dealt with the usual debates around disciplinary depth and rigour that come

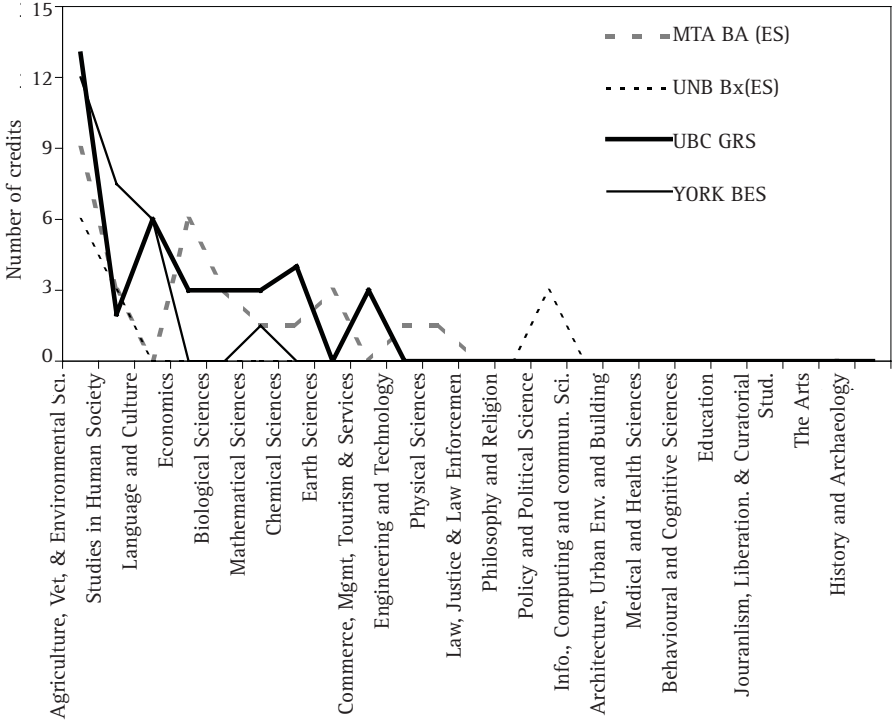


Figure 2: **Core curricula of case environmental programs (source: university course materials as of September/October 2005; three credits is one-fifth of a typical semester's load).**

with interdisciplinarity (Lattuca & Stark, 1994). Understanding the choices made in structuring each course may lie in the organizational context and history of each path-dependent institution (Connor & Dovers, 2004). Many courses evolve and self-organize from faculty interests rather than being designed, per se (Harvey, Forster & Bourman, 2002).

Using area studies (e.g. American Studies, Asian Studies) as an example, Canning (2005) identifies two types of interdisciplinary programs that speak to sustainability: those run by multidisciplinary departments and those that are a partnership between disciplinary departments. These fundamentally different approaches produce very different student experiences, but – as with core structure – each has strengths and weaknesses. York is an example of the former, and MTA and UBC are examples of the latter. Multidisciplinary departments are better able to engineer an integrated experience for their students, because they are often in control of all the key subjects, whereas programs that emerge from the offerings of many departments are vulnerable to local funding priorities, and staff changes. Without some longitudinal or capstone core, students of the latter will largely be left alone to integrate what they have learned. Additionally, multidisciplinary departments will reward their students for their breadth

and ability to integrate. Those same students, if taught similar content by various disciplinary departments, would be evaluated in comparison with specialist majors in those fields, and perhaps found wanting, especially in upper years (Canning, 2005).

These fundamental types of interdisciplinary program also value disciplines differently. Multidisciplinary units value the capacity to integrate knowledge, and consequently draw little – if at all – from discipline-based departments, specify few prerequisites (to avoid specialization) and demonstrate a core curriculum with little reference to traditional fields (Cairns, 2004). Of the four programs studied, the only full course with no foundational core or majors in traditional disciplines was offered from the York Faculty of Environmental Studies, which has no structural subunits, disciplinary or otherwise. Students can pursue a major external to the faculty if they wish to specialize. The UNB minor was similar, and is not offered from a faculty at all. This means either that environmental studies are felt to be about breadth alone, or that organizational structures impose themselves normatively on educational design.

Programs that are partnership offerings value the tools and knowledge residing in disciplines, and thus rely heavily on that expertise in core curricula. The studied programs at MTA and UBC are run from faculties with relatively traditional departments that value disciplines and use prerequisites to encourage a building of foundational expertise in addition to breadth. Although the organizational structure at the liberal arts MTA is more porous than at UBC, in that students are freer to take subjects from across the campus, it clearly supports a canon in the environment other than interdisciplinarity itself. Neither of these approaches is inherently better or worse, but designers should be aware of the options and their repercussions.

Program selectivity

Student numbers must usually be limited in innovative teaching programs to control costs, workloads and retain the engaging nature of the pedagogical methods involved. The means chosen to winnow numbers belies the philosophy of the creator(s) in terms of education as transformation. The cases that illustrate this section may not be seen by their originators as contributing to environment or sustainability, but meet at least some of the criteria established earlier. They also each limit their intake to between 20 to 45 students. Those cases that fill enrolment lists first-come, first-served include the following:

- The Learning City service and action learning subjects now available at the inter-institutional Great Northern Way Campus,
- The STU Aquinas Program, which is a team-taught, thematic block program utilising collaborative inquiry approaches.

Those cases selecting their intake based on grades, or more ephemeral qualities such as well-roundedness, or performance in an interview, include:

- The SFU Undergraduate Semester in Dialogue, a capstone, thematic, block offering with a collaborative learning ethic; and,

- The Bachelor of Philosophy in Interdisciplinary Leadership Studies at UNB's Renaissance College, a rigid yet liberal program developed with funding by a private foundation (Rehorick & Taylor 2001; Renaissance College Council 2005).

Challenging the traditional model of higher education in these cases has unarguably resulted in increased costs. They cross disciplines, encourage communities of learners, and engage with the real world both to critique and improve it. Each one involves team teaching and intense immersion for students and staff. Traditionally aged students are typical participants. Some of the few mature-aged students who have undertaken the STU Aquinas Program, for instance, have been resistant to the creative pedagogical approach and its time demands, possibly as a result of other major life commitments they may be balancing with their education. Traditional modes of study are usually available in parallel for such cohorts, and students are encouraged to self-select within the diversity of offerings available.

A transformative ethic is stronger among unselective programs which take students on a first-come, first-served basis. A non-competitive entry shows a desire to convert and/or transform, fostering an informed and active citizenry, rather than taking the converted to new heights. The STU Aquinas Program's inventors had a "commitment. . . to making [it] not elitist and not triage. . . to have the same students we have all the time but give them this opportunity" (E219). Choosing students based on academic standing or other less measurable qualities may be seen as "silk purse recruiting and manufacturing" (E219) by some. However, a carefully engineered class composition can nurture creative, critical, and cross-disciplinary leaders for a sustainable future. There were no mentions of concerns higher up about inequitable opportunities being offered, nor amongst direct participants, but the peers (not interviewed) running traditional subjects in parallel that carry the bulk of the students may have very different stories.

Organizational structures

As already discussed, sustainability has no clear home in the academy, so many universities form superstructures to help people collaborate on research across disciplinary silos. Although universities in Canada receive their provincial government funding only for teaching (Donald, 2006), there is a real disjoint between research and teaching when it comes to time, organization, and rewards. While the training of research students is often firmly within the interests of such umbrella organizations, undergraduate teaching is another world entirely. Undergraduate students can clearly benefit from the expertise and research in such organizations, so why the disconnection? Is it a message that undergraduate students should not be engaging in interdisciplinarity? Three such organizations were visited to investigate these questions:

- The Institute for Resource, Environment and Society (IRES) at UBC, in the Faculty of Graduate Studies;

- The Institute for Research and Innovation in Sustainability (IRIS) at York, led from the Schulich School of Business but funded by the Research and Innovation budget; and,
- The Environment and Sustainable Development Research Centre (ESDRC) at UNB, housed in the Faculty of Forestry and Environmental Management but funded outside.

Of the environmental programs discussed earlier, only the UBC ESDRC's minor in Environmental Studies was offered from outside a faculty.[6] The ESDRC is largely funded by the 1994 (NB) Premier's Round Table on Environment and Economy – outside the academy – and uses short-term grants to help its members to establish coursework to fill perceived gaps in UNB's offerings. Interviewees at ESDRC found that teaching outside of a traditional faculty structure was a major disincentive: "[I]t's like the tragedy of the commons. If [a course] doesn't belong to somebody, it doesn't belong to anybody." (E117). This dependence on goodwill and short-term funding is a recipe for burn-out, even amongst passionate environmental educators.

The other two umbrella groups studied were somewhat virtual, comprised largely of academics that have permanent appointments elsewhere in the university. Many of the members teach undergraduates under the latter role, and the students they attract contribute to funding those formal departments. Research-based funding sources further limit the mandate of such informal groups, but helps them to avoid the diffuse obligations of academic departments. The institutional, disciplinary, and sectoral context already involves a challenging set of overlapping allegiances, incentives, and barriers to individual staff activities. Governance of such umbrella groups is loosely collegial, optional, and non-restrictive: the key to their success lies in value-adding for members rather than increasing obligations, although none of those studied felt adequately resourced to do so. Such umbrella structures may provide a one-stop location for research on sustainability for those outside, but risk intellectual turf wars inside.

Administrative issues

Innovative curriculum structures are often unexpectedly hampered by the tools and structures that are intended to assist in their administration. If too many new things are proposed at one time, the administrative ones can trip up the process as easily as the pedagogic ones. The lesson that came out of some of the cases previously discussed is to make innovations administratively invisible whenever possible. Rather than being idealistic, conceding the administrative elements can help to save the educational. Hurdles around student credit, workload calculations, and resources are advisedly minimized wherever possible, particularly in the initial, proof of concept stages of innovation. Digital environments can form useful bridges between ideal pedagogic design and more standard structures.

Student credit is usually delivered in regularly sized chunks, and this homogeneity in the size of subjects facilitates opportunities like multi-mode delivery

and exchange programs. Full-year subjects are decreasing in number for the same reasons. Block offerings like the STU Aquinas Program and the SFU Undergraduate Semester in Dialogue use a number of standard credit units instead of one big one, and simply arrange to have the enrolments between them linked, even though the delivery is fully integrated. The innovative Learning City subject used open course numbers earmarked for independent study when it was in pilot mode at UBC. A successful offering later supported a submission to Senate for a dedicated code. The recent move of Learning City to the inter-institutional Great Northern Way Campus presents a new challenge. Students enrol in up to four institutions to be taught collectively by instructors from up to four institutions; where does the credit accrue? Such concerns call for a new kind of governance that was still under development at the time of this research.

Faculty member workload accounting is often decentralized and thus difficult in innovative structures. In the only program studied that did not make it past the proposal stage, the planned UBC Interfaculty Program in Sustainability Studies (Spiegelman, Van Wynsberghe & Moore, n.d.), recruiting and accounting hurdles proved insurmountable as a result of working outside of a faculty. Where the block programs and team teaching approaches *have* worked, as in UBC's Global Resource Systems, the STU Aquinas Program, the SFU Undergraduate Semester in Dialogue and others, participating faculty members have been given credit for all the time they spend in the classroom, not just their share as if it involved a tag-team form of joint subject delivery. Graduate co-supervision across faculties, such as that within the Resource Management and Environmental Studies masters program at UBC/IRES, should also be appropriately credited. More extreme cases, such as Environmental Science at UBC, depend on the sense of duty of committed teaching faculty, whose additional hours are essentially volunteered. If such a faculty member leaves, or burns out from effort, the program disappears. Funds for teaching assistants and a ready supply of postgraduate students can offset this burden, but all too often, innovative teaching programs depend on short-term teaching and learning grants. Without a guarantee of ongoing resources, academics can sensibly find that the effort of developing new programs incurs an opportunity cost by hampering their productivity in areas more highly valued.

Administrative and operational resources can also become a stumbling block, but the internet can be useful to overcome some of them. A few of the innovators interviewed found that a permanent space allocation was important to developing a community of learners. Students in the SFU Undergraduate Semester in Dialogue found having the same room available for lectures, and for casual interaction outside of that time, to be extremely valuable. Such dedicated space is a luxury on most campuses. The UBC Global Resource Systems core programs need breakout spaces suitable for facilitating problem-based small group work and the lack of available rooms is what limits their enrolment size. The STU Aquinas Program no longer has a dedicated room two days a week as when the program was first launched. Some of the interaction that once hap-

pened face-to-face has moved to an asynchronous forum environment. Anonymity in such a setting can be less confronting for students, but teaching staff report some loss of engagement.

Some innovations using online environments can also challenge administrative processes. UBC's Global Resource Systems students participate in a cross-cultural subject throughout their degree that involves the interaction of students from all years, including those who are on site and those on exchanges world-wide. Four sections of each of the three years of subject numbers used thus have to share one forum, which neither Registrars nor the software are easily able to handle. Such longitudinal or integrating subjects also challenge timetabling systems for class time and examinations.

CONCLUSIONS

This paper identifies a range of tensions encountered during a study tour of Canadian universities in search of novel structures for sustainability. The cases included network organizational design and innovative and integrative curricula. The interviews and collected documents about each program's genesis reveal decisions characteristic to each feature of interest that are relevant for other settings.

In interdisciplinary, undergraduate environmental coursework, core structure, and content varies. In the former, a spectrum exists between flexibility and rigidity, shared foundations and collective capstones. Sustainability education is unlikely ever to garner the peer consensus for rigid programs; instead, a diversity of options – each carefully designed and transparently managed – can provide choice and support in equal measure. Students can self-select within these for a customised yet rigorous program, or be chosen. For example, some innovative courses studied aggregated a series of fields with outreach activities, but these intense offerings all required limited intake numbers. Two took all comers, in order of enrolment, seeing transformation as key; two were more selective, aiming to train leaders.

Core content for sustainability remains unclear, and subject to departmental determinism. The two different kinds of program investigated came from two different organisational structures. The two offered from multidisiplinary departments or centres focussed on integration, policy and action, and their programs are largely disconnected from disciplinary offerings elsewhere in the university. Comparatively, the two programs offered as partnerships between disciplinary departments contain much fundamental disciplinary content, but are less able to intentionally integrate them.

These options are echoed in the umbrella network structures studied. A theoretical tension exists between loose collegiums and rigid quasi-departments. Each governance arrangement studied balanced cohesiveness with fragmentation, risking either isolation or internal competition. Neither of them is easily able to directly engage with undergraduates: loose structures do not because staff who are members do so via their departmental homes; rigid structures do not because they have none, and are also typically funded for research only.

Finally, increasing oversight and utilitarian pressures for efficiency means that administrative support systems can act as barriers to innovative models. A tug-of-war between idealistic pedagogical innovators and pragmatic administrators is predictable but inadvisable. Invisibility is wiser, especially in planning or proposal stages, with the more challenging elements moved into virtual online environments where possible.

In the same way that black holes can only be detected by their effects on other celestial bodies, viewed together, these tensions demonstrate a centralizing force in academe. As noted by Campbell (1969), academic boundaries discourage activity at their edges. This pressure prefers uniformity, while sustainability calls for diversity, inside universities and out. Working against such entropic forces involve vigilance that can clearly be exhausting for many faculty members, but the enthusiasm in evidence suggests the effort is a worthwhile investment.

NOTES

1. In this paper, "subject" is used to refer to the individual units of degree programs, which vary in credit size but have an identifying code. Degrees are also synonymously known as "courses" and "programs."
2. This research was undertaken to provide a comparative perspective on curricular and structural innovation with the Australian higher education sector, but an international comparison is not attempted here for the sake of brevity (see instead Sherren 2006b).
3. Interviews were recorded using a laptop computer and Roemer Software's *Hi-Q*. The 16.3 hours of content was transcribed using Microsoft *Word* and NCH Swift Sound's *Express Scribe* and organized with the help of QSR's *NVivo* qualitative analysis software.
4. Interviewees have been given codes rather than names. The codes are comprised of 3 sections: 1) The region, W for west, C for central and E for east, 2) university number within the region, and 3) unique interview number (two digits).
5. Interestingly, philosophy and policy are two of the major foci of the UNB Bachelor of Philosophy in Interdisciplinary Leadership at Renaissance College.
6. At the time of the interviews, the UBC ESDRC also offered an MPhil in Policy Studies (Sustainable Development).

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