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From the International Desk

Undergraduate Research in Scotland: An Enhancement-led Approach

Scottish higher education increasingly finds itself, as do sectors elsewhere, having to cope with the complexities of a globalized and uncertain world. This manifests itself in the speed of knowledge generation and transfer, as well as the speed of digital communication. The seemingly ubiquitous intensification of risk, in relation to environment, health, security, finance and technology has only been exacerbated by the onset of economic austerity. At the same time, the pressing scientific, social, and economic problems of our times—climate change, sustainability, security, international debt crises, public health, aging populations—require graduates with appropriate attributes to cope effectively and imaginatively in such environments.

Ideally, graduates are being prepared to view issues through more than one disciplinary lens, in order to bring these urgent issues more clearly into view. They also should be comfortable crossing epistemological, social, and ontological boundaries in pursuit of the solutions that policy-makers and employers desire. Barnett (2000a, 257) has characterized the “supercomplex” nature of this environment as follows:

A complex world is one in which we are assailed by more facts, data, evidence, tasks and arguments than we can easily handle within the frameworks in which we have our being. By contrast, a supercomplex world is one in which the very frameworks by which we orient ourselves to the world are themselves contested.

How graduates with such attributes might be developed, and how they can be encouraged to engage in such “re-invention” is a matter of pressing concern and timeliness for Scottish higher education. The National Survey of Student Engagement in the U.S. (Kuh 2008), probably the largest longitudinal study of student engagement in higher education, found that ten “high-impact activities” correlated with increased student engagement. One such activity was undergraduate participation in collaborative research. Barnett has commented further (2000b, 163) that “being engaged in research of a frame-developing kind and projecting those frames to wide publics is a strong ... condition of teaching that is aimed at bringing about supercomplexity in the minds of students.”

Further, Baxter Magolda’s longitudinal study over the last twenty-five years (2009) has identified a process of student development through inquiry that leads to “contextual knowing or self-authorship.” She argues, “Moving away from uncritical acceptance of knowledge to critically constructing one’s own perspective” is “more complex than learning a skill

set. It is a transformation of how we think—a change in our assumptions about the certainty, source and limits of knowledge” (2006, 50). As von Humboldt (1970) recognized some 200 years ago in a similar period of social, technological, and conceptual shift, such transformation in students through co-inquiry produces not just sound scholars, but also effective citizens with a critical moral perspective. It is also a reasonable assumption that the acquisition of such skills, attributes, and capacities will equip today’s students to perform many high-level employment roles.

Context and Culture

The fostering of an undergraduate research culture in Scotland can be viewed as part of a current distinctive policy climate. In recent years in the Scottish higher-education sector there has taken place one of the most concerted policy interventions yet witnessed explicitly designed to establish an approach to enhancing the quality of higher education across a whole university system. This has been characterized as a “push for a new Scottish policy culture” (Saunders 2009, 93) and certainly, politically and culturally, it arose at a significant juncture in recent Scottish history. The inception of this initiative, the Scottish Quality Enhancement Framework (QEF), took place in 2003, only four years after the establishment of the first Scottish government in nearly three hundred years. This bold move toward constructing a clear identity for the higher-education sector can be seen as part of the building of a broader and distinctive Scottish policy culture at that time. The impetus continues into the present as Scotland prepares for a major referendum in 2014 on possible national independence from the United Kingdom.

The Scottish higher-education sector is a close-knit community, but one that contains a high degree of institutional variation. This variability and diversity is present despite the limited size of the sector—nineteen higher-education institutions—with short lines of communication with each other and with government departments and agencies. There is a shared culture and a sense of community that foster both competition and collaboration, and a shared identity that can often give rise to a sense of solidarity.

The QEF is coordinated by the Quality Assurance Agency on behalf of the Scottish Funding Council and is designed to provide an integrated approach that emphasizes enhancement rather than solely assurance (the latter referring to judgments made against defined criteria to ensure the meeting of a standard). Quality enhancement (QE) is defined as “a commitment by colleges, universities and other relevant bodies to

continuously enhance the quality of provision that students enjoy.” Each institution is required to be evaluated every five years. (For a fuller explanation of the enhancement framework, see Land and Gordon 2013.) An important dimension of this complex and ambitious policy is a high degree of collaboration and partnership among stakeholders. Policy-makers aimed to achieve a sense of ownership and legitimization of the enhancement framework among all those with a vested interest. In particular, considerable emphasis has been placed on listening to the voices of students and encouraging their participation not just as consumers of a service but also, after appropriate training, as genuine partners in the review of quality.

There also has been a concerted attempt, at least in the early years of the initiative, to move away from an overly managerial and prescriptive audit approach—one sometimes characterized as “high fidelity”—to one that would be more consultative, pragmatic, and collegial, although perhaps less consistent or “low fidelity.” Grassroots participation was intended to replace top-down compliance, and judgments were designed to be less driven by metrics and rankings than derived from a more nuanced basis of evidence. Consensual rather than coercive decision making—carrots rather than sticks—has been stressed. This model implies a strong awareness of the need for realistic and feasible measures that have a reasonable hope of implementation in a varied but compact sector. The overriding factor in this equation is the need for mutual trust. As Saunders suggests (2009, 59), “This enabled a familiarity, an ownership and a legitimation that other forms of implementation strategy might find hard to emulate. We term this a theory of ‘consensual development.’”

Institutional Collaboration in Enhancement

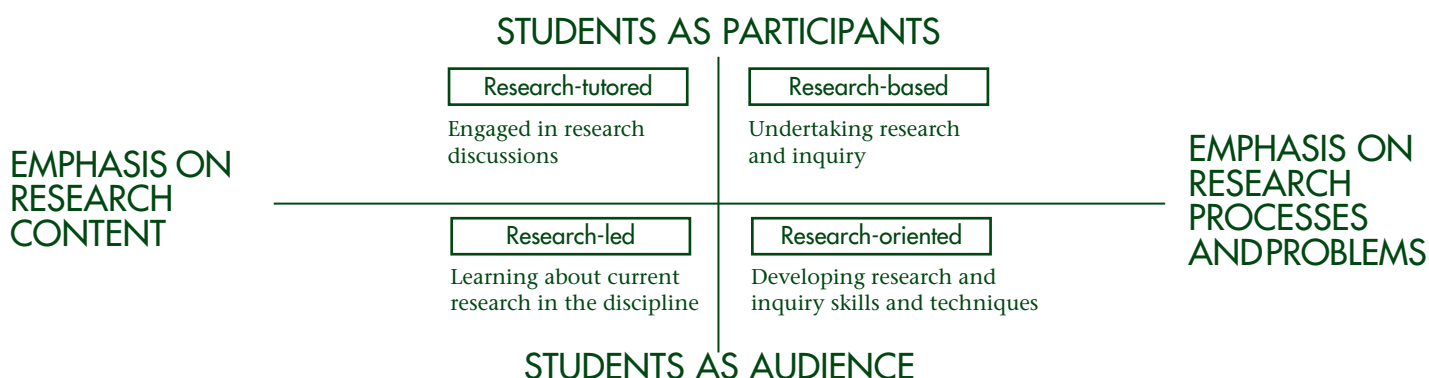
A further distinctive element of the Scottish framework is the periodic (roughly biennial) identification of an enhancement theme around which selected institutions gather to collaborate and share diverse solutions appropriate to their own institutional contexts. This work is coordinated by the Scottish

Higher Education Enhancement Committee (SHEEC). Since 2003 a burgeoning repository of resources—publications, presentations, reports, and case studies—has been made freely available on the committee’s website. Two recent enhancement themes, titled “Research-Teaching Linkages: Enhancing Graduate Attributes” and “Graduates for the 21st Century,” drew increased attention to the need for and value of undergraduate research.

Both of these themes recognized and subsequently advanced the notion that encouraging students to participate in inquiry-based or “research-minded” activity could deliver a range of benefits. These included increased student academic engagement, as well as enhanced capacity of individuals as rigorous scholars, proactive employees, and ethical and responsible citizens—attributes envisioned by policy-makers as necessary for the successful modern Scottish society and economy. A rich array of valuable scholarship has grown out of the work done in connection with the enhancement themes, which addresses institutional, disciplinary, and pedagogical practices. This work, which merits wider dissemination, includes nine discipline-related national studies of undergraduate research, as well as studies exploring various dimensions of undergraduate research. Jenkins’ (2009) overview of the research-teaching linkages theme is a valuable gateway into this literature.

A number of conceptual tools were employed in addressing the themes. For example, Gunn (2011) helpfully discussed the notion of “research-mindedness” as one analytical lens. Another tool was Healey’s (2005) model of potential research-teaching linkages (after Griffiths 2004), shown in Figure 1 below. In terms of the Healey model, a shift from the “research-led” tendency (lower left-hand corner of the diagram) to a “research-based” tendency (upper right-hand corner) was deemed necessary in order to effect an active culture of undergraduate research that would develop the desired attributes in graduates. All four approaches shown in the model were deemed important, but only the “research-based” approach was considered likely to lead to the capacities necessary for dealing with the “supercomplex” society described by Barnett.

Figure 1. Healey’s Model of Undergraduate Research and Inquiry



Source: Healey and Jenkins (2009, 7), based on Healey (2005, 70)

The enhancement work in Scotland identified a polarization in approaches to the development of undergraduate research. At one end of the spectrum the approach might be characterized as a “junior model of the practitioner,” with the emphasis placed on research outcomes, the acquisition of competence in research methods, and publication. Approaches that focus on research internships, undergraduate research publications, and undergraduates assisting faculty in their (faculty-led) research might fall into this category. The emphasis is on excellence and selectivity—engaging the best students who probably choose themselves to conduct research. It is an elite (and elitist) model in the positive sense of those terms. Activities in this narrative are often organized by an institution’s office of research.

The alternative approach is similar to what Jenkins and Healey (2009) have termed “mainstreaming.” This emphasizes the development of important student attributes gained from research within the undergraduate curriculum and tends to be inclusive of all students. This approach might be characterized as fostering “research-mindedness” or skills of inquiry. It is informed by notions of graduates’ ultimate employability and is concerned primarily with educational outcomes. Activities in this framework are often organized by an institution’s office of teaching and learning, and it was this approach that groups working on the enhancement themes were seeking to advance.

These sector-wide enhancement projects encouraged the adoption of a broad and inclusive interpretation of research, encompassing Boyer’s (1990) four types of scholarship (discovery, integration, application, and teaching). The projects embraced where appropriate:

- research formally evaluated and ranked by research councils, funding bodies, or government
- practice-led research
- consultancy-based research
- research of local economic significance,
- contributions to the work of associated research institutes or other universities
- various types of practice-based and applied research, including performances, creative works, industrial or professional “secondments” (the temporary transfer of a person from their normal duty to another assignment) and research internships
- inquiry-based or problem-based learning.

Qualities Sought in Graduates

The steering group studying research-teaching linkages, which included faculty and students, considered how to develop the desirable student attributes through the taught programs. It focused on how, at level of the institution and the academic program, links among research strategies, activities, outputs, and processes could support student learning and enable the

development of key research-oriented attributes in graduates. At the undergraduate level, such potential attributes included:

- critical understanding
- awareness of the provisional nature of knowledge
- awareness of how knowledge is created, advanced, and renewed
- ability for effective communication and dissemination of findings
- an ability to analyze problems and issues and to formulate, evaluate, and apply evidence-based solutions and arguments
- an ability to apply a systematic and critical assessment of complex problems and issues
- an ability to deploy appropriate techniques of analysis and inquiry
- familiarity with advanced techniques and skills
- inventiveness and creativity in formulating, evaluating, and applying evidence-based solutions and arguments
- effective project management of time, resources, operations, and information
- an understanding of the need for a high level of ethical, social, cultural, environmental, and professional conduct.

An important emphasis for this steering group was provided by recent Australian work. Krause’s (2007) “knowledge transfer conceptual framework” warns against the dangers of polarization between research and teaching. She argues the need to acknowledge emerging conceptions of knowledge transfer, notions of “public scholarship,” and “third stream” activities” (i.e., revenue-raising activities undertaken by academics over and above their first two stream activities of teaching and research. These could take the form of collaborations with commercial companies, such as providing professional development programs, one-off consultancies, or knowledge transfer partnerships (KTPs) in which research posts would be funded as a joint enterprise between private companies and universities). This is in keeping with the influential work by Gibbons et al. (1994) on changing modes of research, including a contemporary shift to publicly commissioned, team-based, applied, and shorter duration “mode 2” research, e.g., a university working with a local engineering firm to test the durability of a new material. In contrast, the concept of “public scholarship” has received less debate in the UK. Krause refers to public scholarship as occurring when universities engage “in reciprocally beneficial ways with communities at [the] local, national and international level.” It is more commonly discussed in the United States, where it has grown out of “service learning” and is related to Boyer’s (1996) concept of “the scholarship of engagement.”

In terms of defining attributes desired in graduates, the steering group readily acknowledged that the language used to describe student development is fraught with inconsistencies in terms of use and meanings. Indeed, terms such as attributes, skills, competencies, and abilities are often used interchangeably. A fellow Australian, Barrie (2004, 262), defines desirable attributes as being “the skills, knowledge and abilities of university graduates, *beyond disciplinary content knowledge*, which are applicable to a range of contexts.” A significant amount of research has been undertaken, predominantly in Australia, to look at how institutions can use the concept of graduates’ attributes to be more transparent and explicit about how students can expect to develop throughout their higher education. An important dimension of defining needed attributes, which arguably is less obvious when talking about skills, is the extent to which the definition enables inclusion of values and behaviors, as well as technical abilities. Interpreting graduate attributes in this way enriches the debate and begins to capture the transformational elements of the higher-education experience. This, in turn, raises more fundamental questions about the role of a university education in today’s society.

Vignettes of Undergraduate Research

Comprehensive information on all the Scottish enhancement themes can be obtained from a dedicated website at: <http://www.enhancementthemes.ac.uk/resources/publications>. A full account of the variety of undergraduate research in Scottish universities is available from Land and Gordon (2008a, 2008b). The following is a brief selection of vignettes from their work (2008b) showing the range of student research.

University of Strathclyde Mechanical Engineering: First-Year Design Through Problem-Based Learning

Students are aware that they will undertake a “mechanical dissection” of a car before enrolling at university; the exercise is highlighted in the degree prospectus and “open days” (when students have the opportunity to visit a university and find out more about the subjects they are interested in before they apply). At the beginning of the students’ first year, the structure of this class is explained so that students know when during the year they will be working on the car dissection. It is also emphasized that the tasks they must undertake are related to the development of research skills for use later in their course. Students are divided into groups and each group spends a couple of hours selecting a part of the car (for example, the front or rear suspension, or a part of the braking system) and removing that part. The following day each group meets with two lecturers to discuss the physical principles behind the component’s function and then selects a couple of parts for further examination. These parts are examined under a microscope to ascertain the materials and processes involved in their manufacture. The students then (in the style of problem-based learning) research the functions, physics, manufacture, and design of the components and produce a poster explaining these characteristics.

They present their draft poster to two staff members who discuss the content with them and inform the students of any further work necessary to bring the poster to an acceptable standard. The students then have to produce a brief PowerPoint presentation covering the same material as the poster for a conference plenary session at which two students chosen at random from each group describe their component to the rest of the cohort. After their presentation, each group has to field a couple of questions from one of the other groups of students. In preparing the poster and presentation, students will need to explain topics not covered elsewhere in their first-year course.

The overall aim in developing this class was to show the students how the rather theoretical academic work they cover in their lectures is relevant to the practical challenges of engineering. The tasks associated with producing the poster and presentation also build skills in team work, research, and communication and, further, encourage independent learning. The students have said this exercise “is probably the only thing that everyone spends the whole first year waiting for,” that it “expands on so many skills,” and that it “allows you to see how an engineer would think.”

University of Aberdeen School of Divinity, History and Philosophy: Temporary Ordination in Second Life

This initiative is seeking to build a simple “virtual monastery,” loosely modelled on a small Soto Zen monastery, with appropriate clothing and avatars so that students in the Encountering Buddhism course can experience the challenges and responsibilities of being members of a religious order dependent on patrons for food, clothing, and other resources. (The monastery is developed using the online virtual world SecondLife software, <http://www.secondlife.com>.) The outcome is a research-informed teaching environment for second-year and fourth-year students that uses role-playing to convey the ritualization, ethical constraints, internal cohesion, and social separateness of Buddhist monastic life. This allows them to understand the ritualization of everyday life that is a part of monastic behaviour; experience the challenges and constraints of being dependent, as a mendicant community, on the charity of the surrounding community; and understand the distinction between the ethics of personal commitment—as taught in popular books on Buddhism or in discussions on religious and monastic experience—and the ethics of a vow of behavior.

University of the Highlands and Islands Marine Science: Fieldwork Aboard Vessels

One example of good undergraduate research practice with a small group of students is found within the honors program in marine science. Each year a maximum of 15 students embark on a four-year program at the Dunstaffnage Marine Laboratory, where they have unprecedented access to research vessels, a wide range of shore and coastal habitats, and state-of-the-art laboratories. The labs support work in fields includ-

ing physical oceanography, marine biology, marine resource exploitation, and sedimentary bio-geochemistry. During all four years, students undertake fieldwork aboard the vessels and work in the specialized laboratories.

Modules are led by experts in the disciplinary fields, so the students are exposed to the latest conceptual and technological developments. A wide range of pedagogical activities are tied directly to students' acquisition and development of higher-level research skills. These include, for example, technical-report writing beginning in the first year; training in experimental design in the second year; reviewing of academic papers and writing abstracts in the third year; writing research proposals and undertaking research projects in the third and fourth years; and deconstructing the certainty of science and communicating science in the fourth year. Although not a systematic approach to embedding research-teaching linkages at the core of the curriculum, this occurs because of the nature of the students' environment at the laboratory.

Conclusion: A Future Agenda

A number of issues arise from the foregoing discussion of undergraduate research practice in Scotland. A particular implication of the mainstreaming approach discussed above is the need for appropriate faculty development. Such an approach for all students in undergraduate curricula requires a degree of scaffolding for students. Faculty require an awareness of curriculum design and are obliged to negotiate a learning threshold that places emphasis on student activity and student learning, as opposed to faculty research expertise.

An interesting future research agenda also arises from such undergraduate research. How do undergraduates perceive their own development and academic identity through their experience with research and co-inquiry? How does this narrative relate to shifts in a student's disciplinary understanding and identity, as well as developments in their practical capacities and perceptions of whether the experience has increased their employability? Given the interdisciplinary nature of many of the intractable issues facing societies in the 21st century, what learning gains have students experienced from intercultural encounters and border crossings? What are the identifiable factors in the design of research-based curricula and co-curricula that are most likely to optimize student engagement? Scottish higher education institutions continue to explore such issues. One hopes that similar issues might also emerge in the papers at future CUR conferences and issues of the *CUR Quarterly*.

The Scottish research-teaching linkages work offers much that may be of value to institutions in the United States at departmental, institutional, national, discipline, and accreditation-agency levels. It offers a practical framing tool (Land and Gordon 2008a, 68-72) and an audit tool (*ibid* 72-73) to analyze current practice, as well as the resources already mentioned above, all freely available online.

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CALL FOR ABSTRACTS

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