From the International Desk

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Integrating Undergraduate Research into the Curriculum: International Perspectives on Capstone and Final-year Projects

*All undergraduate programs should "Culminate with a capstone experience. The final semester(s) should focus on a major project and utilize to the fullest the research and communication skills learned in the previous semesters" (*Boyer Commission *1998, 27).*

*"Re-imagining capstone projects has implications for students, faculty, departments and institutions, but greater diversity could enhance its relevance to students and employers, better aligning the student experience with the academic interests and future career demands of the 21st century graduate" (*Hill *et al. 2011, 331).*

These two quotes summarize my argument: Capstone projects are a key way of integrating research into undergraduate programs, but it is time to rethink their role and give students more choice in how they conduct them and how their work is assessed and disseminated. The other articles in this issue focus on capstone courses and undergraduate research *within* the United States, but here I take an international perspective by presenting examples from outside the USA. It draws particularly on two projects published by the UK Higher Education Academy (Healey et al. 2013; 2013) and includes mini-case studies of capstone research and inquiry projects from Australia, the Netherlands, New Zealand, and the United Kingdom. More than 100 case studies were collected as part of these projects. (For additional information see, http://insight.glos.ac.uk/tli/activities/ntf/creativehops/pages/default.aspx; and http://www.heacademy.ac.uk/college-based-he/research-based-curricula. For an updated set of case studies, see: http://www.mickhealey.co.uk/resources.)

The Nature of Capstone and Final-year Projects

The term "capstone project" is commonly used in North America and Australasia for a project in the last year or semester of students' degree programs that provides opportunities for them to synthesize and apply the knowledge and experiences gained from their entire undergraduate experience. The goal is to help them use the project to transition into the workplace or further study, and many capstones involve a significant amount of research and inquiry.

Similarly in many other parts of the world, final-year research projects also often characterize degree programs, although the term "capstone" is not commonly used. In the U.K., for example, "dissertations" are seen as the "gold standard" of the undergraduate degree and commonly consist of an 8,000- to 12,000-word report on a piece of research done by an individual student seeking an honors degree. In mainland Europe they talk about "the bachelor final project/".

Beyond the benefits to individual students, institutions and government agencies are paying more attention to such final-year projects, because they are seen as providing an important indicator of how well particular degree programs are achieving desired student-learning outcomes. In the U.K. there is a growing interest in assessing program-level outcomes, rather than just individual teaching modules or courses (PASS 2012). In Sweden, the quality of the final-year project is being used to assure the quality of degrees (Swedish National Agency for Higher Education 2011). In the U.S., as accountability pressures grow, capstone projects are increasingly seen as an important way to assess the learning experience of students in their majors (Jones et al. 2012). In Australia, capstone projects are becoming more important with the increased emphasis on accountability within the Australian Qualifications Framework and the resulting need to identify whether desired program outcomes are being achieved (Matthews and Hodgson 2012), as well as to set threshold achievement standards across the disciplines (Lee 2013). Capstone projects also occur at the end of some one-year and two-year programs in the U.K.

Purposes and Characteristics

According to Marshall (2009), final-year inquiry projects have a variety of purposes, including:

- promoting skills and employability
- diversifying assessment
- empowering learners
- motivating students
- promoting links between teaching and research
- identifying potential research students.

Drawing particularly but not exclusively on U.K. experience, our project team identified 10 characteristics of final-year projects and dissertations within bachelor's degrees

Table 1. Characteristics of a Final-year Project or Dissertation. It should:

1.	Be an extended piece of work
2.	Be research or inquiry-based
3.	Be relevant to a discipline or take an interdisciplinary approach
4.	Be underpinned by a range of relevant sources
5.	Be set in an academic context and show recognition of the evolving nature of knowledge
6.	Incorporate elements of critical thinking, challenge, and evaluation
7.	Be clear about what it is contributing to knowledge
8.	Have a clearly defined and justified methodology
9.	Build up to its conclusions and, where appropriate, have an element of reflective commentary, including recommendations
10.	Communicate the research outcomes appropriately and effectively

Source: Healey et al. (2013, 28-29)

(Table 1). Of course, not every project or dissertation will exhibit *all* of the characteristics. Some of them are generally applicable, while others are more relevant to particular disciplines; some are aspirational rather than being strict requirements. And not all final-year projects for associate degrees (called "foundation" degrees in the U.K.) can be expected to meet all of the characteristics outlined. Nevertheless, the list may prove useful to educators, based on their specific discipline, institution, and educational goals, as they help students plan capstone and final-year projects.

The rethinking going on concerning such projects is occurring in an era in which the number of students in higher education has expanded, students are coming from a wider range of backgrounds and are studying in a wider range of higher-education institutions, and the challenges facing 21st century society are increasingly complex and call for interdisciplinary analysis. In addition, with the recent growth of interest in MOOCs (massive open online courses), it is arguable that capstone projects give colleges the opportunity to demonstrate the value of faculty supervision and guidance in providing high-quality, student-centered learning—something not easily deliverable by MOOCs. This may be an argument for final-year projects to become an even more significant feature of the curriculum.

Designing Transformative Experiences

As noted above, preparing students to move into work or further study is an underlying rationale for creating final-year projects and capstone courses in many countries (e.g., Lee 2006; Schermer and Gray 2012; Sill *et al.* 2009). Indeed, many students testify to the transformational effect on their learning of conducting end-of-course projects (Derounian 2011). Many students are transitioning from higher education into the world of work, and the final-year project can help them to deal with more complex and uncertain problems (Barnett 2004; Brew 2006).

For example, at the University of Gloucestershire in the final semester of the second year of the foundation (or associate) degree in Community Engagement and Governance, students have to address a "wicked community problem." That is one that is difficult to solve because of incomplete, contradictory, and changing requirements and hence resistant to resolution (Rittel and Webber 1973).

Brief Case Study 1: Community Engagement at the University of Gloucestershire, U.K.

Students in the Community Engagement and Governance program are part-time, mature, distance learners who are mainly studying online and are scattered across Wales and England. The final, problem-solving project in the program (accounting for 30 percent of the final grade) is worked on in pairs. Each student identifies a current "wicked" community problem for the other to address, researching and explaining why he or she considers it "wicked." Each student then makes recommendations for dealing with the problem he or she was assigned and also comments on the partner's recommendations for solving the issue the partner was assigned. Both individuals reflect on the assignment and what they learned through the process, each producing a report of up to 2,400 words.

Compelling evidence exists that end-of-course projects have a beneficial impact on student learning. Research has found that they provide an important indication of students' intellectual development (Baxter-Magolda 2009), and the projects have been recognized as an activity that has a high impact on student learning (Kuh 2008). A study of two service-learning capstone projects in New Zealand, using the Australasian Survey of Student Engagement, found that student engagement was enhanced by the projects, and that the gain was largest among the previously least-engaged students (O'Steen *et al.* 2010).

Diversifying the Form and Assessment of Capstone and Final-year Projects

Despite the transformative experience that many traditional end-of-course projects provide, they do not suit the needs or aspirations of all students. This is particularly true of students taking vocational and professional courses who may not see the relevance of the traditional research-focused, single-author projects common in academic courses, particularly in the U.K. and several Commonwealth and European countries. Indeed, as the number and diversity of students in higher education have risen, a similar diversity of approaches to designing and assessing capstone projects is needed. Moreover, where possible, students should be given a choice as to the form these take.

While recognizing the strengths of traditional capstone and final-year projects, more forward-looking experiences can help equip students to thrive in an uncertain, super-complex world (Barnett 2000). The Australian National University tackles this need directly in a capstone course entitled Unraveling Complexity open to students across the university.

Brief Case Study 2: Unravelling Complexity at Australian National University (ANU)

The final-year capstone course involves seven students from each of the seven colleges/faculties examining different disciplinary ways to unravel complexity. It is one of a suite of courses sponsored by the vice-chancellor in which university researchers from different disciplines share leading research ideas and discoveries with students. Students are selected on the basis of academic excellence and their interest in and commitment to working in policy areas. The course features a weekly two-hour panel of different high-profile researchers speaking to the class on how their disciplines deal with complexity. Each panel typically consists of a range of speakers taking different perspectives on an issue, for example, global financial crises, the collapse of empires, contemporary "failing" states, pandemics, engineering and network failures, and the moral and legal dimensions of these issues.

Pairs of students then facilitate a tutorial discussion with about 16 of their classmates on the particular week's topic. As the course unfolds, students are encouraged to apply methods and insights from different disciplines to each week's example of modern complexity. Reflective and interdisciplinary thinking is encouraged through having students assemble a learning portfolio, which is the major element on which students are assessed in the course. Students commented that the course structure reflects likely work scenarios they may soon be involved in—working in interdisciplinary teams on complex problems whose solutions require a diverse range of tools and perspectives.

Giving students a choice of alternative forms of final-year projects and dissertations is important to ensure that the needs of all final-year students are met, regardless of background, discipline, institution, or life goals. A product-design project at Nottingham Trent University (below) provides a good example of giving students a choice concerning the form of their final-year projects. Similarly, biosciences students at the University of Durham have a choice of three different kinds of final-year projects, and at the University of Leeds, bioscience students have a choice of nine. All projects count as a dissertation and are assessed using similar criteria.

Brief Case Study 3: Alternative Options for a Product-design Project at Nottingham Trent University, U.K.

Assessment is based on a learning contract negotiated and agreed upon by the student and his or her tutors. This contract stipulates the content of work, enabling students to complete one of the following options:

- Option 1: a 10,000-word dissertation and a poster that summarizes the student's work;
- Option 2: a 5,000-word conference paper with a supporting presentation delivered to peers and tutors;
- Option 3: a conceptual project with a 5,000-word critical justification. As well as a written report, students are required to produce illustrations or simulations.

Prior to students undertaking their chosen assignment, there is an intensive three-week period in which students complete the learning contract. The contract identifies what option the student will complete, what he or she hopes to learn, and how that learning will be demonstrated. The course involves students using a wide range of primary and secondary research skills.

Variants from the form of traditional projects are already quite common in some subject areas and countries. Some approaches use group rather than individual projects, and some are linked to employment or community-based learning opportunities. For example, in the final-year marketing project at Letterkenny Institute of Technology in Ireland, students work in groups to address a research problem identified by a

local business. In the first part of the course, students design a research proposal, and in the second, they revise it in the light of feedback and carry out the research.

Problem- or inquiry-based learning in community and workplace settings has proven to be "an effective approach to teaching as real-life, problem-based learning provides opportunities for students to find academic activities meaningful and worthwhile" (Lee et al. 2010, 563). For example, the geography department at the University of Canterbury, New Zealand, has been running an inquiry-based course in service learning for several years in which students undertake projects for community organizations.

Brief Case Study 4: A Capstone Service-learning Project in Geography at the University of Canterbury, New Zealand

This final-year course enrolls between 40 and 60 students working in groups of five or six. Topics are formulated in conjunction with community groups. The key to its successful operation is the negotiation of roles and responsibilities among students, community partners, and university academic staff (the latter acting as advisors, not supervisors). The course runs for a semester (12 weeks) with minimal formal contact time, although it begins with a residential weekend away from campus so all parties can meet each other. During the weekend students engage in research-methods workshops.

The course ends with a public presentation of class findings. Assessment is 60 percent based on the work of the student's group and 40 percent based on the individual student's work. That work is a short essay at the beginning of the course assessing previously published work relevant to the topic, and a reflective essay at the mid-point of the course. Grades for the group's work (a 5,000-word written report and the conference presentation) are moderated with input from each group member, including the staff advisor. Beginning in 2011, the format proved readily adaptable for research into the earthquake response and recovery following the Christchurch earthquake disasters between 2010 and 2012.

In developing different forms of end-of-course projects, it is essential to use the assessment process to ensure that academic standards are maintained and that there is comparability of amount of work and academic rigor among the different forms. When options are offered, the clarity of the learning outcomes, assessment criteria, and detailed course guides are key to ensuring standards.

Preparing Students Effectively

Critical to success in capstone and final-year projects is appropriate preparation of students in previous parts of their academic programs. The University of Sunderland has explicitly stated that its focus for the undergraduate degree has changed to become more research-focused, with a strong build-up in students' work prior to beginning their dissertations or final-year projects.

Brief Case Study 5: Implementing an Active Research Curriculum at the University of Sunderland, U.K.

The university revised its institutional teaching and quality-assurance processes in 2010 to deliver an undergraduate curriculum that promotes progressive development of graduates' research abilities through increased student engagement in inquiry. In the final year, all programs ensure that students experience a suitable activity that not only allows them to integrate their knowledge and understanding of their discipline and professional area, but that also prepares them for employment and citizenship.

Implementation of this broad framework is at the faculty level. In the business school, for example, programs are being redesigned to offer a common first-year set of courses. The curriculum includes an 80-credit "super module" in which students will work in multidisciplinary teams to research and design a business start-up and a 20-credit module on contemporary debates. In the latter module experts from the various disciplines of business and management will lead discussions on topical and controversial issues in their subject areas to raise students' awareness of the uncertainty, subjectivity, and dynamic nature of knowledge. This research-active curriculum is also now being developed in community colleges linked to the university.

Besides specific research skills, students need to develop and practice the generic capabilities that they will also need for successful capstone and final-year projects. Those capabilities include report writing, skill in verbal and visual presentations, creativity, critical thinking, and independent decision-making. One particular skill being increasingly emphasized as student numbers increase is the ability to work as part of a team. The University of Utrecht has a particularly useful way of helping students to gain authentic team-research experience in the third year without their having to

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be involved in actual laboratory work, which comes later. A team of students investigates a topic and methodology and together writes a proposal for graduate-level research.

Brief Case Study 6: Bridging the Gap Between Textbooks and Scientific Research in Cell Biology at the University of Utrecht, Netherlands

A third-year course for cell-biology majors focuses on writing and defending a research proposal as an open-ended, authentic assignment—meaning that it models much of the actual research experience of cell biologists, but not the actual laboratory tasks. It includes having student teams write a proposal for PhD-level research. The course builds on the textbook-oriented knowledge and controlled laboratory experiences that students acquired in the first two years of their degree programs. The 15-week course, which enrolls about 24 students, has three components:

1. A general research topic is defined by staff, and students read selected research papers with a focus on the research methodology used and the research questions posed.

2. Students are divided into four groups of six and out of class formulate a research question and methodologies that could be used to explore it. They also visit relevant research laboratories, contact experts, and discuss their proposals in class with fellow students and staff.

3. Student teams present their final proposals to a jury of four staff members.

Following this course, students produce an extended senior research thesis. Work on this usually occurs during the summer semester before their senior year and often extends into their summer vacation period.

Celebrating and Disseminating

Celebrating and disseminating the outcomes of capstone and final-year projects is an important part of the research process and provides public recognition of the student as a producer of knowledge and a scholar (Neary and Hagyard 2010; Hodge 2011). Research presentations provide the opportunity to invite potential employers and potential future students, as well as students' peers, friends, and relatives to see or hear the students' work. It is common to hold end-of-year shows in art and design courses and in the performing arts, but the principle is transferable to other subjects, although the format may differ and include undergraduate research conferences and the preparation of papers for publication in undergraduate research journals (Healey and Jenkins 2009; Walkington and Jenkins 2008).

The Boyer Commission (1998, 24) emphasized the importance of communication and dissemination:

> Every university graduate should understand that no idea is fully formed until it can be communicated, and that the organization required for writing and speaking is part of the thought process that enables one to understand material fully. Dissemination of results is an essential and integral part of the research process, which means that training in research cannot be considered complete without training in effective communication.

Going public with the students' work is one of the simplest ways to raise the standard of the work produced, because when they know their peers, friends, family, academics, professionals, and community members may see their work, they are more likely to put in the effort to produce their best work.

One example of a conference is at Newcastle College in the U.K., which in 2013 held its first annual conference to celebrate the work of second-year and final-year students and to encourage younger students to enroll in higher education. An example of an undergraduate research journal is *Geoverse,* which gives students an opportunity to publish their own work in an academic journal and demonstrates how students may collaborate to gain publishing experience (Walkington et al. 2013).

Brief Case Study 7:* Geoverse*—A National Journal for Undergraduate Research in Geography at Oxford Brookes and Three Other Universities, U.K.

Geoverse is a national undergraduate research journal in geography that involves four institutions. The geography departments at Oxford Brookes University (the lead institution); Queen Mary, University of London; the University of Gloucestershire; and the University of Reading comprise the editorial board of the journal. *Geoverse* publishes undergraduate-led original research based on theoretically considered and empirically based investigations. The aim is to motivate and reward students for innovative research practice, and to help them through the review process prior to publication. Papers are reviewed by a panel of postgraduate students.

Students at Oxford Brookes undertake a compulsory second-year course called Geography in the Field, which involves

a field trip and work in groups to collect data. An optional final-year course allows students to write their research as a paper with supervisory support from a tutor. Colleagues at the University of Reading have replaced an examination with writing a journal article for *Geoverse*. The University of Gloucestershire has developed an assignment in which students write a collaborative journal article. At Queen Mary University of London, students take an expedition to Iceland and are given the opportunity to produce a research paper for *Geoverse* upon their return based on the research they have undertaken.

Conclusion

Capstone and final-year projects are a key way of integrating undergraduate research into the curriculum in many different countries. While retaining, or in some cases introducing, capstone and final-year projects is important, it is time to think about all the forms such projects might take. At whatever level of undergraduate study they occur, the projects should be a transformative experience for students. This is a challenge, given the wide variety of postsecondary students' backgrounds and motivations, but the goal is more likely to be achieved if students are given a choice about the form and assessment of their capstone and final-year project.

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