

CAPSTONE COURSES – AN OVERVIEW

Extracts from a report by

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Structure of report

This report begins by defining a capstone course and its purpose. We then look at examples of capstone courses and associated teaching methods in order to present readers with options for implementation. This is followed by a section addressing strengths and weaknesses of capstone courses, critiques, challenges and recommendations.

What is a capstone course?

First, what is a capstone? Literally, capstones are a set of slabs on the top of a wall or building. The laying of capstones often indicates the ceremonial completion of a building. Thus, the capstone shows that a significant body of work is reaching completion. Metaphorically, a capstone is a crowning achievement.

In education, then, a capstone course is a course offered towards the end of a programme of study, either undergraduate or postgraduate. In the USA, where the term “capstone course” originated, “senior seminar” and “capstone course” both refer to a culminating learning experience, with no appreciable difference between the two terms. A capstone course is most often intended to be the final course in a major, building on previous coursework in a cumulative and integrative fashion and covering the breadth of the discipline. It may be a practicum (Zeichmeister & Rich, 1994), address a contentious issue (Ault & Multhaup, 2003) or focus on professional development (Zeichmeister & Reich, 1994). Some institutions encourage their students to submit their major projects in the capstone course for presentation at conferences to obtain external validation of the quality of their work (Marchese & Lorenzet, 2010). A capstone course is also a suitable vehicle for introducing interdisciplinarity (Hamilton, McFarland & Mirchandani, 2000).

Henscheid’s (2000) monograph¹ on senior seminars and capstone courses offered at 549 institutions of higher learning in the USA categorises capstone courses into five general types. In order of frequency of occurrence they are:

1. *Discipline- and department-based.* These summarise learning within an academic major and make connections between academic learning and the professional world. Assessment in these courses is usually by means of a major project and a presentation on that project.
2. *Interdisciplinary.* These synthesize General Education, academic major classes and co-curricular activities. They address broad topics and often also involve philosophical issues. Here again assessment is mainly by means of major projects and presentations.

¹ Henscheid’s monograph provides a comprehensive review of capstone courses in the USA, covering, among others, course goals, types of credit, length of course, instructional practice, evaluation and assessment. She also provides examples of the different types of capstone courses.

3. *Transition courses.* These are intended to prepare students for the world of work, postgraduate study or post-student life. Topics may include job searching, life transitions and relationships. Assessment is usually by means of a portfolio.
4. *Career-planning courses.* These are pre-professional courses, covering such things as current trends and job-seeking procedures. Assessment may require a portfolio, project or presentation.
5. *Other.* Courses in this last category often span curricular and co-curricular work and address broad institutional goals. They differ from the interdisciplinary capstones in that they do not usually have a General Education component.

Two of the five types of courses, then, are to prepare students to leave the university, while the other three are focused more on academic work. Most capstone courses fall into the “discipline-based” category.

As might be expected, the type of course offered reflects the academic ethos of the university. Small, private, highly selective universities tend to offer interdisciplinary courses, institutions focusing on career-oriented programmes have capstone courses with work-related components and the majority, mainstream, universities relate the capstone specifically to work done in the major, sometimes with a preparation for postgraduate study.

Why a capstone?

Is a capstone necessary? What purpose is served by the inclusion of a capstone? The reason for offering a capstone course is generally implied by the nature of that course.

Based on the fact that the majority of universities offer discipline-based capstones – and this is true of South African as well as American universities --, it seems that the most common reason for offering a capstone course is to *consolidate and integrate disciplinary knowledge* gained during the undergraduate years. For example, the Sociology Task Force of the American Sociological Association and the Association of American Colleges recommended that a Sociology major should include one or more capstone courses aimed at integrating the “diverse elements of the coursework into a coherent and mature conception of sociology as an approach to inquiry and to life” (cited in Durel, 1993, p. 223). Carlson and Peterson (1993) suggest that a capstone course “should give students a sense of coherence...in a discipline and should deepen their appreciation of the discipline as an approach to specific problems” (p.239). South African universities frequently mention the purpose of integration when describing their capstone courses. Rhodes University’s (2002) academic policy, for example, specifically defines a capstone as being integrative and cumulative. Related to this kind of capstone are courses that seek to prepare students for postgraduate work.

The aims of consolidation and integration may be particularly relevant in the American higher education system, where there is far more leeway in the choice of courses making up a bachelor's degree than is the case in South Africa's more closely focused programmes. Nevertheless, in South Africa there is still merit in having a culminating course, especially where semesterisation and modularisation can result in shorter-term, more fragmented learning. However, even when there is a capstone course of this kind, it will cap not the whole university experience, but rather one specialised part of it, unless, of course, the degree itself is rather specialised, as is the case with engineering programmes.²

A rather distant second in terms of frequency of occurrence is the interdisciplinary course. At a university that places emphasis on developing broad as well as specialised knowledge and on co-curricular learning, it is to be expected that a capstone will continue this approach. Thirty years ago this was in fact how a senior seminar was defined. *The Handbook of Undergraduate Education* (1978) described a senior seminar as "designed to cap the general education experience by application of different student majors to a common problem" (cited in Henscheid, 2000, p.2). The focus in this case is on the *integration of all learning*, not just that of one major, with the intent that this learning be applied to real-world problems.

Regarding the concept of general education: Most American universities require their students to take a set of courses encompassing a broad range of topics, covering the arts and sciences and providing opportunities for students to develop requisite writing, research, mathematical and critical thinking skills. Because some general education classes also relate to a student's major, general education classes will comprise a quarter to a third of a student's undergraduate credits. Thus, a capstone course with a general education orientation will develop interdisciplinary and transdisciplinary thinking and also activities outside the university walls, as well, perhaps, as being related to the major. Such a course would serve as a preparation either for postgraduate work or for enlightened, engaged citizenship and employment outside the university. This kind of capstone would be in keeping with discussions at Stellenbosch regarding a signature learning experience, and would complete the signature learning process begun in the first year of study and continued in succeeding years.

The third purpose indicated by capstone courses is to *prepare students to leave the university*, in terms of awareness of employment possibilities, job-seeking skills and personal adjustment. Because Stellenbosch University has other mechanisms for addressing transition and career-planning needs, we shall concentrate more on discipline-specific and interdisciplinary capstones.

While the three broad purposes mentioned above summarise virtually all capstone courses in the USA, it may be useful to record the more detailed breakdown given by Cuseo (1998), who identifies ten purposes for capstone courses, as follows:

² South African engineering courses generally offer a capstone project.

- Promote the coherence and relevance of general education
- Promote integration and connections between general education and the academic major
- Foster integration and synthesis within the academic major
- Promote meaningful connections between the academic major and work (career) experiences
- Explicitly and intentionally develop important student skills, competencies, and perspectives that are tacitly or incidentally developed in the college curriculum (for example, leadership skills and character and values development)
- Enhance awareness of and support for the key personal adjustments encountered by seniors during their transition from college to post-college life
- Improve seniors' career preparation and pre-professional development, that is, facilitate their transition from the academic to the professional world
- Enhance seniors' preparation and prospects for postgraduate education
- Promote effective life planning and decision making with respect to practical issues likely to be encountered in adult life after college...
- Encourage a sense of unity and community among the senior class, which can serve as a foundation for later alumni networking and future alumni support of the college. (p.22)

Besides these directly academic purposes, a subsidiary function of capstone courses can be to provide data useful in making curriculum and administrative decisions. Sum and Light (2010) point out that capstones can serve as a source of information about the quality of instruction, programme effectiveness, and the extent to which institution-wide goals are met. Because a capstone course is in effect a summation of work done during the undergraduate years, departments can use capstone assessments to make “informed adjustments to pedagogy and programs, such as the addition of specific skills exercises and methods or theory courses, and compensate for any deficiencies they detect” (Sum & Light, p. 523). Indeed, Henscheid (2000) found that approximately half the accredited colleges and universities she surveyed used capstones as part of their institutional assessment. Because capstones efficiently and effectively measure student learning (Berheide, 2007) they become a method for performing programme evaluation. The primary goals of the Political Science capstone course Sum and Light describe include not only “exposing students to a holistic view of the discipline of political science and facilitating student reflection on experiences in the major with an eye toward future application of central themes and concepts (e.g., practices of good citizenship),” but also using the course “as a vehicle for programmatic and institutional assessment, elevating it as a goal equal to others in our department’s mission and reinforcing a departmental culture of assessment” (p. 524). Sum and Light suggest that the students’ part in the evaluation of the course increases their commitment to the course and that this commitment in turn makes for more effective evaluation. Johnson and Halabi (2011), on the other hand, warn against using a capstone simply “as a convenient setting for departmental or university-wide exit assessment” (p. 271). They remind their readers that a capstone should primarily enable synthesis and reflection and develop

competencies and that these academic purposes should not become secondary to administrative purposes.

To summarise the purposes of a capstone course: The capstone should consolidate all work done during the undergraduate period, provide a broad view and prepare students to use their knowledge after graduation. The course may include practical work or research and address academic conventions and norms.

Examples of capstone courses

We turn now to examples of capstone courses, to see how the purposes previously discussed find expression at different institutions and in different disciplines. With hundreds of courses offered it is nigh impossible to provide a definitive sample. However, the courses described below do cover a variety of disciplines and provide some insight into various options, approaches and practices regarding capstone courses.³ Among those included here readers may find examples related to their own or another discipline that could be adapted to their particular course needs and goals.

Much of this section is an abridgement of university web pages and published course descriptions. Courses are grouped according to the five categories described under “What is a capstone course?” (p.4). Some analyses across several universities are also mentioned.

Discipline and department-based courses

Although the courses described below focus on a particular discipline, in many instances the work required is a mix of curricular and co-curricular activities, as is recommended for the Signature Learning Experience.

Computer programming, Hillsborough Community College

This is a project-based capstone, requiring students to design, develop, test and implement a sophisticated computer programme that requires substantial programming effort. Students work individually. There are no required class meetings; rather, the student meets individually with the lecturer to review each deliverable.

Information Systems (IS), University of the Witwatersrand

A capstone project is required of BCom and BSc(Applied Computing) students taking IS as a major. They work on a team-based project in which they analyse a real-world client’s business problem and design and develop a customized information system solution.

³ For a useful summary of types of capstone courses and assessment options, see Appendix A, which is an abridgement of a Skidmore College teaching development web page.

Information Systems, Virginia Tech

Abrahams and Singh (2010) emphasise the need for experiential learning in information systems (IS) education. They describe a capstone IS class where, instead of single-team, single-project engagements for an extant client, the students initiated a fully-fledged not-for-profit organisation, thus combining knowledge about entrepreneurship, e-commerce and information systems in the creation of their own organisation. Instead of having the class split into independent teams working on their own projects, the class was divided into five teams working together, each team having its own emphasis: marketing, finance and administration, publishing, web and sales. Each team had its own team leader and project manager and a class executive director oversaw the project as a whole. Teams were required to make both planning and results presentations. Along with these activities, students learned how to manage a web hosting account, edit web content, install a content management system, register a domain and create a new web hosting account.

Information Science, Stellenbosch University

The Department of Information Science offers an integrated third-year capstone module in professional practice and theory. The course requires the development of theoretical instruments for analyzing processes in a chosen organization and 14 consecutive days of practical experience in that organization.

Computer Science, New Jersey Institute of Technology

This is a team-oriented project course. Early in the semester, students choose one of a range of proposed projects, form teams, devise a plan for solving the project problem, and formally present their proposal to the class. Subsequently, each team implements its plan, periodically reporting to the class on the progress of their work and soliciting advice on problems in implementation. At the end of the semester, each team formally presents its results.

Computer Science, Northern Arizona University

The course requires that students complete a sponsor-approved software development project culminating in an oral presentation, product demonstration and formal report. A major objective of the course is to wean students from the structured academic environment and prepare them for the corporate teaming environment. There are very few class meetings; instead, student teams meet with a mentor once a week.

Digital Media, Georgetown

In Georgetown's capstone course in Digital Media Management, participants from the Management and Analytics tracks apply knowledge from previous courses as they complete a final project together. Team leaders and web analysts apply their skills in a simulated client scenario. Course participants collectively assign team responsibilities as they develop an

integrated marketing plan, conduct research, execute elements of the strategy, analyze results, and present their final project to a "client."

Computer Science and Engineering, Ohio State

According to the website for Ohio State University's Department of Computer Science and Engineering, the capstone courses offered are designed to prepare students for engineering practice via a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. The courses include additional activities to contribute to students' achievement of professional outcomes such as lifelong learning. All the capstones are organized around projects with a major design component, requiring student teams to explore various design alternatives while accounting for constraints such as performance (space and/or time), platform restrictions, and so forth, and requiring student teams also to account for maintainability issues such as accommodating changing requirements or functioning in a somewhat different environment.

Construction Management, Sacramento State University

This course is designed to bring together the multiple elements of the Construction Management program and to give the student a personal feel for the real-life aspects of managing a construction enterprise. The class is in seminar format. Students also work in teams on a term project, chosen by the team and agreed to by the instructor, which consists of the development and presentation of a strategic business plan for a construction organization (company, division, department or complex project). A portion of most classes is dedicated to reviewing the results of the students' outside research. The completed strategic plan is presented both orally and in writing. An outside panel of industry representatives may also hear the oral presentation.

Chemistry, York College

The York College Chemistry capstone (Harrison, 1994) centres on discovery-based research and discussion, supported by mini-lectures, with the aim of teaching

- journal familiarity, abstracting and experimental design
- literature searching
- writing technical papers and proposals
- technical speaking

Students are required to present a written research proposal and make an oral presentation regarding the proposal. The final essay exam is on philosophically-oriented readings about how science and mathematics are conducted.

Physics, University of Tennessee – Knoxville

This course aims to make students aware of world issues regarding energy and to prepare them for careers connected to energy use, supply, and policy. The emphasis of the course is on the technical underpinnings of energy choices for the future. The course is in line with university initiatives in sustainability and makes use of an existing working relationship with a nearby national laboratory. Guest lecturers from the university and the laboratory are called upon when relevant. Students also visit the laboratory's energy-research facilities. However, the course appears to be mostly centred on readings rather than experiential learning. It addresses the technical underpinnings of various energy options and also includes some discussion of the history, policy and economics of energy use, in addition to the environmental impact of various energy forms. A key consideration is climate change and the associated build-up of carbon dioxide in the atmosphere.

Black Studies, University of Missouri

This Black Studies capstone seminar is designed to have students integrate general and specialized knowledge within the three Black Studies tracks (History, Society, Culture) with a focus on the enslavement and emancipation of Africans in the diaspora. The practice of slavery in selected countries in the West Indies is compared with slavery in the United States. The course makes extensive use of published and unpublished primary sources as a way to rethink, revise and reconceptualise the role and significance of black women in American history. The final grade is based on class participation/presentations along with either an original capstone research paper using primary sources, or a historiographical review essay. In either case, papers must have a comparative dimension and be approved by the instructor.

Communication, University of Kentucky

The major objective of this course is for students to integrate their previous work through the writing of a senior thesis, which takes the form of either an extensive literature review or a critical paper. The students complete a number of assignments that function as formative assessment towards the final paper. They are also required to present a short capstone speech related to the final paper.

Marketing, California State Polytechnic University

Metcalf (2010) describes a project-based capstone Marketing course specifically designed to provide Marketing students with an international community service learning experience. It is multidisciplinary and emphasises collaborative learning. This approach was adopted in response to a study on business school effectiveness revealing that employers found graduates to be lacking in broader work-related competencies. The new focus was on strengthening marketing-

related competencies learned in earlier courses and on developing broader work-related competencies such as cross-functional thinking, teamwork, communication and cross-cultural sensitivity. The course engages multiple teams across colleges in the university, such as marketing, graphic design, public relations, art, photography, accounting, management, international business, communication and social science. It is oriented primarily towards business- and market-related skills, secondarily towards personal insight, and thirdly towards understanding social issues. Students from various schools apply for roles in a multidisciplinary team. Because they have varying levels of competence both in areas outside their disciplines and in work-related skills, such as project management, teamwork, peer leadership, self-presentation, and communication, each student is required to identify personal learning goals and learning resources, to monitor progress toward goals, and to perform self-assessment in conjunction with lecturer assessment.

Metcalf's (2010) article is well worth reading in its entirety for its description of an authentic transdisciplinary learning experience.

Nursing, Lubbock Christian University

Boswell and Long (2011) approach a capstone as a way of demonstrating and documenting a student's acquisition and synthesis of knowledge and of other designated programme outcomes. Lubbock's capstone course includes discussion board entries, practica and, finally, presentations that require self-examination of how the student has addressed each of the programme objectives. These presentations are attended by all faculty members and are rated in terms of students' achievement of programme outcomes. They are also seen as a celebration of the learning experience.

Boswell and Long (2011) comment on the value of this approach as a way of developing self-reflection and self-assessment. They also report that students show great excitement at being able to showcase their personal and professional development and how they have attained designated goals and objectives.

Nursing, Walsh University

The Walsh University Nursing capstone is required in the last semester before graduation, when all other course requirements have been met. It centres on the development of a professional portfolio that highlights the student's past and present academic and work achievements, summarises issues that relate to current nursing practice, and includes a projection of long- and short-term professional goals. In addition, the portfolio contains a current resume and philosophy of nursing. This portfolio contributes 70% of the final mark. The other 30% is made up of one presentation each on community activity, political issue investigation and professional image promotion.

Nutrition and Food Science, University of Alberta

This capstone is a methods and applications course. It requires both team work and individual projects. The individual assignment is a two-page newsletter designed to be understood by the general public and a three-page commentary on why the topic was chosen, which segments of the population the given topic is most pertinent to and the science behind the key messages. The top four brochures are presented in class.

The group assignment is a 12-page scientific research paper about a functional ingredient, nutraceutical, or natural health product. The topic chosen for the scientific report must be different from the topic chosen for the individual newsletter assignment. Students are also expected to create a poster that provides a summary of the topic investigated. These posters are presented at a poster symposium open to the public and are judged by special guests invited to the event.

Politics, Regis University

The Regis mission statement emphasises preparing students to take leadership roles and this is reflected in the politics capstone course, in which students are required to produce a major research project focusing on political leadership. Approaches may include theoretical, psychological, constitutional/legal, historical, international, national, local, institutional and bureaucratic perspectives. Students are encouraged to communicate and collaborate with one another, but each is required to produce an individual piece of research.

Sociology, Christopher Newport University

Christopher Newport University's sociology senior seminar is required for student majors and minors in sociology. The seminar includes an overview of the historical development of the discipline, an investigation and review of the major theoretical paradigm with applications to contemporary society, thesis presentation and critique, performing a student outcome assessment and presentations by guest speakers.

Sociology, The University of Virginia's College at Wise

This is a writing and oral communication-intensive course integrating analysis and critical examination of the major fields of sociology. Students are required to design a research project, create appropriate research instruments (e.g., a survey), collect and analyse data and report their findings in both written and oral form.

Sociology/Anthropology, Florida International University

Students prepare and make a public presentation of a paper that addresses an empirical problem. They begin with a research proposal and then continue with an extensive literature review. From the course outline it appears that they make conclusions based on the literature review rather than actually conducting empirical research.

Human Resources (HR)

Marchese and Lorenzet (2010) examine eight HR capstone courses. They note that it is more likely to find a graduate than an undergraduate HR capstone. All the courses in their study include a variety of teaching methods that encourage collaborative learning, for example, facilitated class discussions, on-line discussion boards, debates, group assignments, and case analyses and discussion. Six of the eight courses clearly build on other business coursework, and four of the eight syllabi emphasise internationalisation/globalisation.

Accounting

Johnson and Halabi's (2011) review 24 midwestern Accounting capstone courses suggests that the work required in a capstone course may specifically develop the so-called "soft skills." They found that the courses they reviewed promoted skills in the areas of research, problem solving, critical thinking, reflection, synthesis, teamwork, communication and professional orientation, most of which are personal rather than functional skills.

Office for International Education, Nelson Mandela Metropolitan University (NMMU)

Besides internal capstone courses, NMMU also offers capstone courses for international students in environmental studies, community service learning, and conflicts, human rights, peace and justice. These three courses run Monday – Thursday during the university's midyear break, are worth 6 USA credits,⁴ consist of lectures and field trips and require a portfolio at the end of the course.

Campus Compact

Campus Compact is an American national affiliation of over 1100 college and university presidents dedicated to promoting community service in higher education. Their website, <http://www.compact.org/> gives examples of service-related capstone courses at a number of universities.

⁴ Generally a USA bachelor's degree requires 128 credits, of which 40 should be upper-division credits.

Interdisciplinary courses

General Education, Brigham Young University – Idaho

BYU-I requires that all students follow an interdisciplinary General Education programme called “Foundations.” The Foundations programme includes a capstone entitled “Connections: Analytical Thinking and Moral Judgment.” See Appendix B for an outline of the course, which could be described as addressing ethics and applied philosophy.

Philosophy, Politics and Law, University of Kwazulu-Natal (UKZN)

Students may register for a BA or BSocSc in Philosophy, Politics and Law at UKZN. The programme is constructed drawing on all three disciplines with a focus on two and on the relation between those two. Students must take a central core course entitled “Ways of Reasoning.” In their final year they take a capstone in either Jurisprudence (philosophy and law) or Modern Political Thought (political science and philosophy). There is also a shorter capstone available for other students, entitled “Wealth of the World, Poverty of Nations.”

Portland State University

Portland State University has been widely recognized for implementing an exemplary capstone programme. The university offers 230 capstone courses annually, many of which would be appropriate capstones for a variety of majors. They all have a service learning as well as an academic component in the group-based final project. The approach taken in these capstones would work well for those departments that intend incorporating the goals of the Hope Project into their final year of study. For the full list of Portland State capstones and short descriptions of the courses, go to <http://capstone.unst.pdx.edu/courses/>

Career-planning courses

Communication, University of North Carolina at Wilmington

Intended outcomes for this course are that students should

- Conduct a personal audit of their personality, skills, deficiencies, talents, achievements, and experience
- Construct written and oral audience-centered statements that identify strengths and potential contributions as a college graduate trained in Communication Studies
- Identify and express a clear, specific, short-term plan for life after graduation
- Explore and identify a particular job or graduate school opportunity

- Create and present a personal portfolio for use in career opportunities
- Present themselves in a positive and professional manner during a professional interview

Summary of capstone course approaches

In summary, the following approaches and products are associated with capstone courses:

- Projects – individual, team, multidisciplinary
- Research projects
- Research papers – bibliographic research and research proposal
- Essays
- Literature reviews
- Critical papers
- Presentations
- Portfolios
- Service learning

Much of the work that is done develops both personal and functional skills. A variety of methods is used, including discussion boards, practica, self-reflection, self-assessment, readings, class discussions and case analyses. Teaching methods are addressed in more detail in the following section.

Teaching methods associated with capstone courses

While this section discusses similar material to that of the previous section, the emphasis here is not on course content or approach, but on actual teaching techniques.

Kerrigan and Jhaj (2007) recommend high student-student interaction, low lecturer:student ratios, active learning pedagogies, enquiry-based coursework and real-life learning as effective methods employed in the highly commended capstone courses offered by Portland State University. They also comment on the value of lecturers' developing and sharing best practices.

Articles regarding teaching methods for capstone courses often describe changes in approach that have been made in response to critique by outside or accrediting bodies. Metcalf's (2010) article on the Marketing course at California Polytechnic described above (see p. 10) is an example of an innovative response to an external evaluation. Another example is a study conducted by Cox, Cekic and Adams (2010) in response to reports by various engineering bodies criticizing higher education institutions for their failure to instill leadership abilities in their engineering students. Cox, Cekic and Adams interviewed engineering lecturers at a midwestern university to determine ways to incorporate leadership qualities into the engineering curricula. Those interviewed said that leadership could be incorporated into several courses, including the

capstone course, and that real-life experiences and extra-curricular activities were of special import in developing leadership skills. Some specific suggestions were making more use of open-ended problems, design courses and projects that required teamwork and presentation skills, and rotating leadership during work on a design project so that everyone had an opportunity to be the leader.

There is a fair body of published work outlining teaching approaches employed in various disciplines with specific reference to capstone courses. A few of these articles are summarized below.

Psychology

Goldstein and Fernold (2008) start from the proposition that capstone “courses provide students with the opportunity both to reflect on their academic experiences in previous courses and to apply outside of academia what they have learned” (p.27). Applying this definition to an internship capstone, they argue that because capstone courses should emphasise student experience and learning rather than course content, the capstone should include five features consistent with humanistic education: (1) student-centered learning, (2) empathic listening, (3) affective and experiential learning, (4) collaborative learning and self-disclosure, and (5) writing assignments that focus on personal and professional growth.

Sociology and Psychology

Hauhart and Grahe (2010) provide an overview of sociology and psychology capstones in the western United States, in terms of content, format and design. They comment on the paucity of recent empirical studies on capstones. In response to this limited research literature, they designed and conducted a survey of sociology and psychology departments in the western United States. Generally, capstone courses included major projects with some data collection resulting in research papers that had to conform to a specific writing style with peer-reviewed supporting materials. During class, students were most likely to encounter instructor-led discussion. Common readings, student-led discussion, and peer review of paper drafts were also frequently reported. In comparing sociology with psychology requirements, the authors found that sociology capstones were more likely to require extended papers with literature reviews. Sociology capstones never required poster presentations at the institutions, whereas psychology courses did. Undergraduate institutions were less likely to report integrating material between the discipline and general education, and were more likely to include instructor-led discussion during class. There was no difference between how private and public universities organized or conducted their capstone courses. Some responses to the question of what worked well in a capstone courses were: “integrated and cooperative learning through various subjects and departments,” “enabling students to find their sense of independent scholarship and learning,”

“students work closely with faculty to develop their projects,” “students learn to ‘workshop’ one another’s work and to manage time and work on a large project and to work together.”

Liberal Arts and Sciences, Truman University

The following is an abridgement from the university website.

Skills identified as critical objectives for the university include the ability to write various types of papers, speak comfortably both in formal and impromptu presentations, work collaboratively with fellow students and think critically.

To assess student skills such as communicating and collaborating, faculty might ask students to formally present their research to the class, to argue and defend an issue position, to sit for an oral examination, or to work in groups to solve a problem and/or conduct a research project. Many of the capstone courses also consciously attempt to assess various levels of critical thinking through student ability to apply concepts and theories of the discipline to new situations, and to analyze, synthesize, and evaluate. Others focus more generally on problem-solving ability. Case studies, literature reviews, argumentation papers, audience analysis, canon discussions, and student self-evaluation are some methods that combine knowledge objectives with skills assessment. Objectives regarding attitudes are more difficult to specify and assess than knowledge and skills, but faculty in many majors developed a consensus on several objectives and developed approaches to assess them, working with the following four foci:

1. Does the student demonstrate openness to more than one position and make fact/value distinctions?
2. Does the student possess positive self-esteem and practice self-evaluation?
3. What are the students’ attitudes toward the university and the major?
4. Does the student demonstrate ethical and social responsibility?

Case studies present students with ethical dilemmas to resolve, and role-playing might be used to demonstrate multiple perspectives to an issue. Students may also be asked to argue for a position other than the one they hold.

Many of the capstone courses provide multiple opportunities for students to self-assess. Students may be asked to identify their strengths and weaknesses during an exit interview or to evaluate the curriculum.

Team teaching the capstone course provides frequent opportunities for colleagues to reflect on and discuss student learning in the major. Such discussions would cover the curriculum, specific assignments, and pedagogy. Lecturers have the opportunity to learn teaching strategies and discipline subfields from each other.

See Appendix C for examples of capstones offered at Truman.

Computing, Pace University

Most of the Information Technology projects described above under “Discipline- and department-based courses” require teams working on real-world projects. Tappert and Stix (2010) investigated what procedures would enable the successful functioning of development

teams in an online, rather than a face-to-face, environment. They found that by adapting methods of team management it was possible to manage distributed rather than co-located teams and that peer assessment and other remote assessment techniques allowed for effective assessment of distributed teams.

To facilitate communication among the project stakeholders, lecturers required that communication between a team and instructor and between a team and a customer be through the team leader, with all team members copied on communication e-mail and given summaries of face-to-face meetings. This reduced communication to the instructor from individual students and kept all stakeholders updated on project activities. Project team leaders had to be local, either living or working in the greater New York City area, where the university was situated. This allowed for easy communication and meetings between the project team leaders and the project customers, who were local. It also allowed for similar contact between the project team leaders and the instructor, enabling the instructor to keep informed of the progress of the project work. Students met face to face three times during the course of the project. The Blackboard educational software system (Blackboard, 2010) was used for quizzes, for collecting digital deliverables, and for discussion forums. Discussion forums were used for archiving all instructor e-mail to the whole class, for student introductions, for discussions related to the textbook and other course material, and for discussions relating to each of the projects. Project forums were used to discuss project-related material, and each project team was required to post a weekly project status report on their project forum.

One disadvantage of the online class was that students were not present to hear the presentations of other groups, and although they had access to the presentations of other groups, they were less likely to be familiar with what was happening in other groups than would have been the case if they had been in class to hear the presentations.

Reflections on capstone courses

We now move to evaluations and analyses of capstone courses. Four aspects are addressed: the evaluation process, critiques, identified challenges and recommendations.

A primary concern when designing a new course is assessing the efficacy of that course. Achieving this presupposes a clear vision of the purpose of the course, and continual interrogation of whether the course actually achieves this purpose. Furthermore, if one is to evaluate a capstone experience, clearly the appropriate evaluation tools must be used. While a detailed investigation of evaluation tools is beyond the scope of this report, one article is included here, simply to highlight the point that the validity of results is dependent on the methods employed. Everett, Otto and Luera (2009) explore the efficacy of different measurement instruments in assessing growth in student teacher knowledge about science models and their use in school classrooms. They also investigate whether their science capstone course, focused on models, increased student knowledge of models. The instruments used were yes/no

questionnaires, concept maps, open-ended questions and Likert-scale responses. They found that yes/no questionnaires were useful for assessing pre-course knowledge, concept maps were useful for measuring gains in student knowledge, Likert scales were of limited usefulness, and open-ended questions were not useful for determining knowledge growth. The authors conclude that there do not appear to be any suitable instruments assessing model pedagogical content knowledge for preservice elementary teachers.

While this study examines a single specialized capstone course and one could criticize the small number of assessment tools used before concluding that no suitable instruments were available, it does remind us of the importance of choosing correct measurement methods before attempting to evaluate a teaching or curriculum practice.

Beyond the question of choosing the correct tools is the question of the validity of the learning experience being evaluated. While a capstone may indeed be an effective measure of student mastery of stated outcomes (Berheide, 2007), accomplishing specified learning goals, even though these are apparently pedagogically sound, may not achieve the ultimate aims of a programme of study. Brown and Benson (2005) explore perceptions of lecturers and students regarding a graduate capstone in secondary education at Piedmont College. On the face of it, the course is well designed. Students are required to complete a performance assessment in the form of a capstone exhibition intended to demonstrate mastery of the programme curriculum and philosophy. The exhibition consists of a 30- to 50-minute oral presentation combined with slides, tapes, videos, portfolios or multimedia tools. Each exhibition is designed to meet the individual learning style and talents of the student concerned. Lecturers and students agree that the capstone process is beneficial in terms of providing opportunities for more thoughtful student reflection, enables students to make sense of the graduate programme in a systematic way and encourages students to apply skills and theories. There is thus a great degree of face validity in the course and its evaluation. However, the authors found that their capstone process was “not a predictor of student success in the classroom despite the fact that the goal of the capstone is to indicate a student's readiness to teach” (p. 674).

This study highlights the value of performance assessment rather than traditional or even reflective and other innovative methods if these are shaped more by in-class activities than by actual performance of tasks that will be required on graduation. Indeed, the design of a capstone would do well to include post-graduation evaluations of student preparedness for the work in which they have engaged. This is not to advocate that the university should become an advanced trade school, but rather that along with knowledge, theory and research there must also be a component of career preparation.

This leads us to critiques of capstone courses. While on one hand we find the concern that the capstone may not prepare students for applying knowledge in the work environment, that is, what happens after completion of the capstone, there is also a concern about readiness to enter a

certain kind of capstone. One critique raised by students is that previous courses do not prepare them for synthesizing past material (Shaw, 1994). This is, of course, not so much a critique of a capstone course as it is a reflection of a poorly constructed curriculum or a limited pedagogical approach. The capstone should be a logical last step in an ongoing process, not an unarticulated add-on.

In a criticism of the practice of requiring capstone projects, Wright (2010) suggests that one cause of declining numbers of students registering for computer science degrees and of a high dropout rate is the perception that extraordinary programming skills are required. He recommends replacing capstone or senior programming courses, which by implication are judged to be too demanding, with internships. This article drew vigorous response from a number of bloggers challenging his view. Their comments and defense of capstone projects (see <http://third-bit.com/blog/archives/3772.html>) reflect their sense that a capstone is indeed a stimulating and motivating learning experience. One could argue that those defending senior projects are the competent minority. They, on the other hand, suggest that Wright is pandering to the academically weaker student. This debate, while of restricted scope, does touch on current tensions between high performance -- which might be reflected in a challenging capstone course -- and constructing a curriculum that facilitates greater throughput, an unfortunate “numbers game” that limited funding sometimes requires universities to play.

In their overview of sociology and psychology capstones, Hauhart and Grahe (2010) report that 90% of respondents judged the capstone course to be a valuable component of the major. The single most common response by lecturers, however, was concern about students’ approach to the course, in terms of motivation (e.g., “student burnout”) or ability (e.g., “students are not prepared [for] this type of course”). Common dissatisfactions were limited lecturer resources and heavy student workload. In addition to concerns about resource demands, some respondents expressed more conceptual concerns, such as “how to integrate theory with data, tension between breadth and depth,” a discrepancy between faculty members’ expectations and departmental goals, and the opinion that “the capstone focuses on program-wide learning objectives, and sometimes faculty want a more narrowly defined course” (p. 12).

Before initiating a capstone course the issues highlighted by Hauhart and Grahe (2010) need to be addressed, in terms of student readiness, workloads and a common understanding of the purpose of the course and the best way to achieve that end. It is also important to assure the integrity of the course. Johnson and Halabi (2011) warn that a capstone could turn “into a repository for teaching goals and objectives that could not be accommodated elsewhere in the... curriculum” and should not “be relied on to complete unfinished business from other courses in the major,” which would result in “a series of disconnected topics and learning activities” (p.271).

In some cases there may also be a need to help lecturers develop an appreciation for the value of a capstone course. Cox, Cekic and Adams (2010), for example, observe that one of the anticipated obstacles to implementation of an engineering capstone course including a leadership component was the lack of conviction on the part of some faculty that this type of training was necessary and the associated change of mindset that would be required for lecturers to include leadership experiences in their classes. One interviewee commented, “So now you’re talking about changing the Engineering faculty’s mind. Good luck... We don’t want to change” (p. 29). Other “roadblocks” were: the lack of institutional recognition for initiatives of this kind, inflexibility in the curricular process and a structure that did not lend itself to this type of innovation. The authors therefore suggest that a more realistic approach might be to leverage relationships with other Social Sciences or Humanities courses and use these to achieve the desired ends. They also point out the need for teacher training.

The issue of pedagogical soundness is raised by Thambyah (2011), in commenting on the final-year project required of most engineering students. He suggests that because such projects are research-based and open-ended in format, they tend to be more pragmatic in approach and often do not have well-defined learning outcomes that are clearly aligned to a pedagogical philosophy. He recommends a 24-outcome assessment template based on Anderson and Krathwohl’s (2001) revision of Bloom’s taxonomy integrated with expectations of an engineering graduate, to allow for a more critical evaluation of what is to be accomplished by the capstone research project. He provides examples of applying this method in project assessment.

McKinney and Busher (2011) compare the objectives, structures, and outcomes of a sociology research capstone course as taught at three Illinois institutions. They found that the main foci of the course were to conduct research, produce a paper or thesis, develop writing and presentation skills, and integrate past learning. While instruction in the course followed best practice in teaching and learning, there seemed to be an under-emphasis on the use of theory in conducting the research project. McKinney and Busher make the following recommendations for a sociology capstone course:

- Course designers should consider strategies to change some of the features of the senior research/thesis capstone that may limit overall thesis quality (e.g., [by] offering additional, earlier research experiences for majors, ... providing small research funds; and employing more graduate students as teaching assistants or mentors).
- Instructors of the course should think about, discuss, and assess what pedagogies can be used to strengthen students’ ability and performance in terms of thinking and writing the introduction/literature review and discussion/conclusion sections (e.g., providing more models to follow, giving earlier assignments, perhaps in prior courses, on applying theory, encouraging thesis topics that are meaningful to students, requiring more pre-drafts, providing more practice in earlier courses that apply the sociological imagination

to original research findings, and finding more time or opportunities for peer review or review by other faculty).

- Discussion by faculty about instruction related to creating and/or applying theory to original research... (e.g., Where and how in the curriculum should the use of theory be learned and practiced?).
- A broader conversation within some departments about where certain learning objectives for majors, such as the ability to use statistics or to apply theory in novel situations, fit in the major curriculum.
- Increasing integration of key ideas and skills across courses in the major.

McKinney and Busher's recommendations for future research regarding sociology capstones, which could also be applicable to other capstone courses, are:

- clarifying the role of theory in the research experience capstone
- looking for correlates of the quality scores on senior theses
- determining the most effective pedagogies for the learning objectives
- understanding student experiences in the capstone.

They conclude that many more published studies using direct measures of learning outcomes in capstone courses—including the research capstone—are needed in order to draw any conclusions about the effectiveness of such courses in the major.

Many of the capstones described in this report involve service learning. While considering recommendations regarding the offering of a capstone, it may therefore be useful to look briefly at principles associated with this type of learning. Mullen (2010) points out that service learning is more than simply giving service: it is intended to connect the personal and the intellectual, build a capacity for critical thinking and lead to questions about learning and about society. He refers to principles developed by Howard and McKeachie (1993) regarding service learning. Among these are:

- Academic credit is for learning, not for service
- Academic rigour must not be compromised
- Learning goals must be set for students
- Community service placements must be carefully selected
- Help students learn how to harvest community learning.

Thus the lecturer must integrate academic instruction, community service and guided reflection.

Aspects that would need to be in place before initiating a capstone course would be:

- Overt institutional support for such courses, in terms of policy, process and resources
- Interdepartmental cooperation in the design and presentation of the course, as needed
- Internal coherence such that the capstone is consistent with, and a logical extension of, previous coursework
- Departmental agreement on the nature of the course, including the balance of breadth and depth and the inclusion of co-curricular activities
- In the case of co-curricular activities, a clear understanding of the ownership, management and administration of such activities
- Prior student learning experiences of a nature similar to the requirements of the capstone
- A curriculum structured in such a way that students are not overloaded or in danger of burnout
- The development of carefully considered, well defined course outcomes that are clearly aligned to a pedagogical philosophy
- A sense among academics and students of the value of the capstone
- The assignment of lecturers best suited to the course, in terms of academic qualification, personal commitment and appropriate teaching approach
- Equitable teaching loads for academics involved in the programme
- The provision of the necessary teaching resources and facilities
- Ongoing teacher development

Once the course is initiated, evaluation methods will have to be developed that assure that the course meets its broad as well as more immediate aims. With all these components in place, the capstone can provide a fitting rounding off of a thoroughgoing undergraduate educational experience.

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Appendix A

Abridgment of Skidmore College web page on capstone courses

The website for Skidmore College includes a section on staff development containing information about capstones. It begins with a definition: “A capstone course is a course designed to be offered in the final semester of a student’s major, a course that ties together the key learning objectives that faculty expect the student to have learned during the major, interdisciplinary program, or interdepartmental major.” The page then lists and explains various capstone options, as abridged below:

The major project course:

The major project course requires students to work primarily on one project, such as a research paper, experiment or creative project. The course can be designed so that students work on the project in stages, allowing faculty to determine students’ abilities to revise and/or reconceptualise their work. Student presentations of the project may be both written and oral, allowing faculty to assess both of these student abilities in addition to knowledge and/or skills.

The multiple experiences or exercises course:

Lecturers design the course so that students must provide evidence through a variety of means, such as examinations, research papers, oral presentations, group work, and multimedia presentations.

The portfolio in the capstone course:

The major project for a capstone course may be a requirement that students produce a portfolio of work. The portfolio can be designed so that students include a variety of evidence regarding their abilities.

The field experience or internship as a capstone course...

(The web page then continues with advice to lecturers on constructing a capstone course and on evaluation options.)

Appendix B

General Education capstone course, Brigham Young University-Idaho

Foundations Capstone: Analytical Thinking and Moral Judgment

Credits: 2

Outcomes

Students will develop analytical reasoning and moral judgment skills as they:

Identify important factors within the context of the issue

Gather evidence and analyze factual claims for accuracy

Consider biases and spot logical weakness in arguments

Think creatively for courses of action and anticipate consequences of possible solutions

Articulate positions both orally and in writing

Description

The Foundations Capstone course is designed to help you develop confidence in your abilities to make good judgments. The purpose of this course is to give you a realistic understanding of your responsibilities as a decision maker and to provide you with a set of practical tools to help you make and then act on your decisions. Your responsibilities as a Disciple leader to yourself, your family, your work and community will need to be considered. Leaders, in any capacity are responsible for making crucial decisions... Moreover, we will be grappling with the idea that there may be more than one... answer to any given problem. Not every decision will be black and white. We will work to analyze and understand all the shades of grey within a problem and help you develop skills that will enable you to understand the effects of and defend the decisions you make. Working collaboratively, you will discuss and solve complex, challenging, and sometimes uncomfortable cases.

Learning Model Architecture

Each unit will require students to:

Prepare (by reading, researching, and meeting with learning teams)

Teach One Another (by sharing ideas, participating in case discussions, and commenting on others' work)

Ponder and Prove (by completing evaluations, summaries, and the final examination)

Appendix C

Excerpt from Truman University website

VARIOUS MODELS OF CAPSTONE EXPERIENCES

Since the university granted faculty in each discipline the autonomy to interpret the capstone requirement for their major programs, a wide variety of models has evolved. Several models are presented in the following pages showing the knowledge, skills, attitudes paradigm. These various models provide a more complete description of capstone courses at Truman State University...

DISCIPLINE: Agricultural Science

CREDIT HOURS: 2

This Fall/Spring series of classes is the capstone experience. The overriding goal and purpose for this course is to provide a senior-level experiential class in which our students will be forced to utilize much of the theoretical information they have learned since beginning our curriculum as freshmen. The plan is that, each year, students in AGSC 490-491 will propose a project for their class that will focus on some production idea or problem. Not only will this allow the practical application of our students' classroom training, but it will also allow us as a faculty to instill in our students the liberal attitudes and values desired as outcomes of the Truman experience: problem-solving, management, frugality, self-reliance, teamwork, responsibility and an understanding of the democratic society in which we live, along with opportunities for enhancing development of communication skills, an understanding of the scientific method and the application of science to solve problems, and life-long learning skills.

DISCIPLINE: Interdisciplinary Studies (BA) and (BS)

CREDIT HOURS: 3

This course brings together students pursuing a wide range of self-designed majors. Students will review their experiences in terms of their initial stated expectations, and will pursue individual capstone projects in cross-disciplinary, critical collaboration with other students and the instructor of record, with input where appropriate from the student's program mentor.

Knowledge:

1. Understand advance concepts, terminology, methodology, subject matter, problems, and issues from multiple academic disciplines.
2. Be aware of the strengths and limitations of individual academic disciplines.
3. Develop and increase the precision and depth of one's understanding of issues and academic disciplines by employing multiple perspectives, experiences and approaches.

Skills:

1. Develop the writing, speaking, analyzing and computing abilities expected of all Truman students.
2. Recognize connections between traditional academic disciplines and integrate knowledge from multiple disciplines to develop a better understanding of a single issue.
3. Communicate knowledge using the conventions of multiple academic disciplines.

4. Develop a versatility of thought that allows one to apply knowledge learned to issues and problems associated with varied subject areas.

Attitudes

1. Recognize the importance of individual disciplines as a means to address problems and to generate knowledge.
2. Understand the interconnectedness of knowledge and academic disciplines.
3. Appreciate the value of a liberal education.
4. Value “life-long learning.”

DISCIPLINE: English

CREDIT HOURS: 4

The purpose of the course is to offer a forum for senior English majors to examine their progress toward an English major, determine directions for future studies in the major and share new studies.

TYPES OF EXPERIENCES

One example of an English capstone experience for four semesters of seniors required student self-assessment through reflective journal entries and through design and submission of the LAS portfolio, collaborative seminar presentations of research, and individual “personal best” projects presented in public forums beyond the seminar. Knowledge and skills assessment are reflected in the seminar activities.

METHODS OF CONDUCTING SEMINAR

Seniors reviewed and strengthened their knowledge of disciplinary content areas in discussion of language, literature, and literacy issues, through the discussion of the formation of literary canons and application of critical perspectives to canonical works, and by writing two “meditations” on languages and a self-portrait as an “English major”.

They demonstrated their abilities in making interdisciplinary connections through their research and presentations and through their review and selection of material for the portfolio.

They demonstrated writing skills in the production and revision of statements of personal philosophy for graduate school applications, letters of application to graduate study or employers, resumes and curriculum vitae. They demonstrated speaking skills in extemporaneous seminar discussions, in formal, collaborative seminar presentations and in public presentations in forums outside the seminar setting. Self-assessment protocols assisted the students in evaluating their performance in the formal speaking activities. They also reflected on their collaborative skills through the self-assessment protocols.

CONCLUSION

The English faculty are redesigning the capstone course so that it provides seniors with more opportunities for integrating their studies in five strands of the major and for interdisciplinary and collaborative capstone projects.