

This article should not be reprinted for inclusion in any publication for sale without author's explicit permission. Anyone may view, reproduce or store copy of this article for personal, non-commercial use as allowed by the "Fair Use" limitations (sections 107 and 108) of the U.S. Copyright law. For any other use and for reprints, contact article's author(s) who may impose usage fee.. See also [electronic version copyright clearance](#)
CURRENT VERSION COPYRIGHT © MMXIX AUTHOR & ACADEMIC EXCHANGE QUARTERLY

Considering Capstones: What, Where, Who and How

Nancy Trantham Poe, James Madison University, VA

Poe, PhD, MSW is Associate Professor of Social Work and Family Studies in the College of Health and Behavioral Studies.

Abstract

Teaching and learning methods in 21st century education increasingly carry expectations for approaches described as high-impact, self-directed, and project-based. In undergraduate contexts, such curricular experiences are frequently consigned to “capstone” courses, presenting attendant demands for insuring across-the-curriculum cohesiveness. Capstones for interdisciplinary programs pose additional challenges as educators must facilitate engaged learning while simultaneously linking content from disparate academic arenas. The nature of capstone courses is examined, including delineation of qualifying criteria, description of curricular structures in which they are situated, and discussion of faculty roles and implementation challenges.

Introduction

Tell me, and I will forget.

Show me, and I may remember.

Involve me, and I will understand.

-Xun Kuang (250 BC; attributed by Liu Xiang, 818 AD)

This ancient proverb has reverberated through the millennia. Its echoes are heard in the observation attributed to educational philosopher John Dewey (1916) that “true learning is based on discovery guided by mentoring rather than on the transmission of information” and in the current call for engaged learning. Arguably, the title “professor” in higher education has become a misnomer. Current pedagogical norms require educators to move beyond “professing”; that is, conveying information with the aim of having students assemble a canonized knowledge base in a specific subject area. Instead, professors are expected to outfit students with a sound knowledge base *as a starting point*, but then to involve them in *using* subject expertise to create and deploy real world applications. In many disciplines, this expectation is communicated via accreditation standards that compel educators to address and assess instructional design that equips students with professional competencies and workplace preparedness (Konrad, Hall-Phillips, and Vila Parrish, 2018; Pembridge and Paretto, 2019). This type of hands-on, active learning goes by many names: high-impact, authentic, project-based, engaged, and is situated into curricula in myriad formats and positions. A common practice is to concentrate such teaching and learning in “capstone” courses.

The literature on capstones contains a limited body of conceptual articles explicating general characteristics and qualifying criteria but, as Konrad, Hall-Phillips, and Vila-Parrish (2018) noted, “scant research exists in the capstone design teaching community concerning best pedagogical practices” (p. 184). This view was corroborated by Pembridge and Paretto (2019) who found that “most research [on capstone design] focuses on theoretical foundations...with fewer studies addressing context-specific instructional practices” (p. 198). Among those few, they continue in the vein that Brownell and Swaner (2010) observed nearly a decade ago: they are largely non-conceptualized descriptive pieces. Indeed, a preliminary search for published works to inform the present article yielded detailed accounts of specific course designs, assignments, facilitation strategies, evaluation methods, and

pedagogical reflections. There was a dearth of examinations that merge the conceptual and the practical; those exploring challenges of capstone experiences within various curricular contexts, especially interdisciplinary milieu, were effectively absent.

The aim of this article is to address this limitation in the literature by delineating some operating principles of capstones and linking them to curricular and pedagogical realities. To that aim, I review the character and criteria of undergraduate capstones, consider various curricular structures in which they are embedded, and examine some concerns related to role enactment for teachers and students in capstone situations.

Capstones: Character and Criteria

A capstone course or project is generally defined as a multifaceted and integrative experience, typically at the end of an academic program that serves as a culminating exercise (Abbott, 2014). This definition corroborated the Boyer Commission (1998) which stated that capstones should “enable the student to bring to a symbolic conclusion the acquisition of knowledge and skills that has preceded [the] final effort” (p. 28). This feature has been consistently noted as essential to the capstone experience as captured by Konrad, Hall-Phillips, and Vila-Parrish who explained, “a key characteristic of capstone design projects is that [they] require demonstration of comprehensive knowledge and skills from multiple courses” (p. 183). In their examination of a capstone process in a program of teacher education, Brown and Benson (2005) wrote that it must provide opportunities for students to critically reflect on earlier learning that led up to the comprehensive conclusion in their final year. Indeed, as culminating and integrative activities, capstone experiences presuppose that students complete a prior sequence of coursework sufficient for preparing and supporting the higher order learning required in capstone contexts. This developmental process is described by Marin, Armstrong, and Kays (1999) as “crawl, walk, and run” (p. 19).

The crawl, walk, and run conceptualization presumes that academic programs choosing to include the pedagogical device of a capstone experience are conceived and delivered as cohesive “wholes.” Programs must be designed to exert differential challenges and supports from the outset to equip students to manage the demands that will be placed upon them at the endpoint. Unfortunately, many so-called capstones are delivered without attention to developmental curricular design. The predictable result is dissatisfaction and frustration for both teacher and learner. It is not appropriate, productive, or fair to present high impact learning as the culminating step in a program of study while neglecting to expose students along the way with exercises to build capacities for integration and application. Capstone experiences vary in type and design including internships, independent studies, portfolios, product design projects, exhibitions, research assistantships, and multi-course spreads. Regardless of format, the inherent character of capstones is rigor, requiring “serious intellectual work.” (Office of Educational Assessment, 2019). To insure such a threshold of rigor is met, many scholars (Levine, 1998; Sill, Harward & Cooper, 2009) contend that capstone learning must include benchmark requirements matched to the following criteria:

Integration. A hallmark of capstone experiences is a shift from learning centered on acquisition of new material to learning that is catalytic and creative. The focus is not further accumulation of students’ empirical and conceptual knowledge; rather, on challenging them to draw upon acquired content to construct new questions, explore new possibilities, and devise new conceptualizations. “While many capstone courses include some new content knowledge, they typically do not focus on mastery of...concepts. Instead, they develop students’ ability to address open-ended problems by...drawing on prior knowledge” (Pembroke and Paretti, 2019, p. 198). One of the most important and vexing responsibilities for the instructor is to create an environment wherein students are provided the structure, support, and space to risk the leap from the comfort of collecting certainties into the vastness of uncertainty, and become competent and confident curiosity-seekers (Hackman, Sokol, and Zhou, 2013).

Breadth. This criterion poses a brutal paradox. As previously defined, capstones are culminating experiences, occurring at the point where students are reaching the conclusion of their studies and realizing the greatest level of expertise in a specific academic area. At that moment, an effective capstone challenges them to reach beyond the boundaries of increasing specialization (Levine, 1998) and to consider the relevance of their subject area for, and in light of, other areas. At the undergraduate level, this often involves revisiting earlier coursework and mining it for value to the selected field. This stance is supported by Shoaf (2000) who argued, in a study of preparing secondary education math teachers, that capstones should offer opportunities for reflection on previous learnings and make meaningful connections that can have great impact on their future professional experiences. For students whose

schooling included a general education component, attention to the breadth criterion often produces “aha!” moments where the significance of a liberal arts foundation comes into meaningful focus.

Application. Application is the essential element of capstone learning. According to Bloom’s taxonomy of cognitive skills (Anderson & Krathwohl, 2001), application challenges learners to use knowledge in new situations, in increasingly complex ways, and employ abstract ideas for concrete problem-solving. As the concept relates to capstone experiences, Sill, Harward, and Cooper (2009) define application as “using expert knowledge to examine a discrete issue and produce a substantial product” in response to that issue (“Opening,” para. 3). To meet this criterion, capstone activities must require activation of expertise whereby students demonstrate the concrete utility of ideas.

Transition. The fourth criterion is “transition” and taps into the very heart and purpose of education: posing and exploring questions of relevance in the real world. This criterion requires students to engage in perspective-taking that considers an “other” as the vantage point of classroom activity, bridging academic work to the “real world.” Typically, this is accomplished by linking capstone efforts with a target audience outside the halls of academia that benefits from the academic product. But the concept can also be conceived as being inwardly-directed, focused on students’ transition to post-scholastic roles or professional aspirations. In both cases, Budwig and Jessen-Marshall (2018) stated that capstone projects must challenge students to “practice the kinds of sustained work that will be part of their lives whatever they do, enhancing abilities to become critical thinkers who are skilled in analysis and argument around a complex problem” (“Opening,” para. 2).

These four criteria of capstones are fairly well considered in the limited literature. However, they are usually discussed without consideration of the institutional environments in which such courses are carried out. It is folly to advance a capstone experience without critical examination of the academic eco-system in which it is situated as curricular contexts exert significant pedagogical impacts on the viability of a capstone offering.

Curricular Structures: Majors, Minors, and Interdisciplinary Offerings

As previously mentioned, Abbott (2014) observed that capstone activities are typically positioned at the conclusion of an academic program and are intended as culminating exercises. In undergraduate education, “academic programs” can take on multiple configurations with important implications for the design and implementation of a capstone course or experience. Three typical configurations—majors, minors, and interdisciplinary programs—are considered below.

Majors. In the United States, baccalaureate students are impelled to declare a “major”—a disciplinary specialization requiring at least two years of devoted study, usually founded upon, or interlaced with, a program of general education in the liberal arts. With few exceptions, majors are located in delineated organizational structures (eg. departments, units, schools), staffed by faculty with expertise in the identified field and who are members of a discrete disciplinary “community.” Majors are developmental in design, with deliberately constructed course sequences. Students begin with the “crawl” of broadly conceived introductory classes, progress to the “walk” of more rigorous and focused requirements, and conclude with the “run” of upper-level courses predicated upon the lower-level work, requiring demonstration of disciplinary norms. This configuration lends itself well to the implementation of a culminating capstone experience. It supports a capstone that can be well defined, understood, and serve as a point of reference throughout the program for faculty and students alike. In many disciplines, the capstone is meaningfully linked to the “signature pedagogy” of the selected field such as student teaching, field practica, senior exhibitions/recitals, and clinical rotations to name a few (Budwig & Jessen-Marshall, 2018; Shulman, 2005).

Minors. Many American universities provide students opportunities to select a “minor”—a sanctioned program of study that augments a declared major, or provides avenues to explore fields of interest outside the major discipline. Some students value such an option as it provides a structure for intellectual exploration without the commitment required by a major field, and/or believe the added credential will enhance their transcript. These course configurations go by many names: minor, concentration, secondary area, cognate.

In contrast to majors, minors are apt to be more loosely structured, arranged around a particular topic, and may not carry a disciplinary designation. Organizationally, minors are typically comprised of a set of approved courses, horizontally arranged without delineated progression standards that are found in a major. In these configurations, a final course is designated as “the capstone” and is intended to provide the lens by which the collection of courses is brought into some sort of meaningful focus. Faculty “ownership” of capstones in minors is more narrowly concentrated than in majors; perhaps residing with a sole instructor who has responsibility for implementing the course or project, with limited, if any, input from faculty colleagues or administrators.

Interdisciplinary Programs. Holding that “disciplines are academic conveniences, not sacred constructs” (James Madison University Cross Disciplinary Studies, 2019, Goals section, para. 2), interdisciplinary programs, which exist at both major and minor levels, encourage faculty and students to think across conventional boundaries of disciplinary inquiry in the quest for knowledge. Ordinarily, they are developed to address an articulated question, problem or issue by drawing on the expertise of faculty from multiple academic areas irrespective of disciplinary identity or approach to the subject matter. These features of interdisciplinary offerings align with the criteria of breadth and integration for a capstone activity as discussed above. However, designs of interdisciplinary programs often pose logistical snags to the meaningful incorporation of capstone experiences.

Interdisciplinary programs are commonly comprised of coursework originating from two sources: 1) established courses from multiple academic departments selected and approved for their relevance to the stated goal or focus of the program, delivered by a cadre of faculty experts in separate disciplines who likely do not identify with the curricular structure in any significant way; and, 2) courses especially developed for the program by faculty collaborators from multiple disciplines, who “team-teach” said courses. Organizationally, interdisciplinary programs are frequently situated in an office, center, or “home department” within the larger institution with a faculty member serving as an administrative coordinator. Loose curriculum design and from-the-margins involvement of faculty in the delivery of the program precludes any assurances that students are getting the crawl, walk, run developmental milestones needed to arrive ready for a legitimate capstone experience.

There exist some innovative strategies for addressing diffuse/tenuous identification with interdisciplinary programs that are worth consideration. Some include supporting the administrative coordinator with curricular oversight responsibilities and opportunities, and to establish “affiliate” or “associate” designations for participating faculty. These two processes of recognition and inclusion, along with possible incentives for contributing to the program’s goals may enhance faculty commitment for a more meaningful capstone experience.

Regardless of curricular context—major, minor, and interdisciplinary—the character of capstones can present unclear expectations for faculty members and students alike, and contribute to role ambiguity for both. The familiar conventions of teacher-pupil relationships, cultivated over years of schooling, often cede to unfamiliar arrangements and interaction patterns. As such, it is valuable to examine salient teacher-learner dynamics that frequently emerge in capstone contexts.

Clarifying Roles and Relationships

An oft-cited pedagogical question asks, “is the role of the instructor to be ‘the sage on the stage, or guide on the side?’ “ (King, 1993, p. 30). And what of the student? Repository of professed knowledge and wisdom? Assistant? Protégé? Collaborator and emerging colleague?

These questions are especially acute at the baccalaureate level. For primary and secondary schooling, students are usually children engaging in lessons intended to lay a foundation of general knowledge. As naïve learners, such students “don’t know what they don’t know,” much less possess a method for constructing a meaningful educational framework. Therefore, they usually require the direction of “sages.” For graduate education, students are adults who have developed an academic foundation and are engaging in lessons to build more specialized expertise for real world application. As well-schooled learners, such students are equipped to be active in charting the direction of their education and may best be served by the support and challenge of a “guide on the side.”

Baccalaureate students are somewhere in between. They are adults, but those of traditional college age are novices in that status with limited experience in the freedoms and responsibilities attached to adulthood in social as well as academic spheres. While they are choosing an area of concentrated study and are in the process of developing

expertise, they cannot yet legitimately claim it. At the beginning of their studies, they may best be served by “sages.” At the conclusion, some may be ready to thrive with the encouragement of “guides.” A challenge for the baccalaureate capstone teacher is how to be both, and in what measure, with any given student.

The literature suggests that both teachers and students struggle to define and enact their respective roles in undergraduate capstone classes. While published accounts were limited to anecdotal evidence based primarily on course evaluations and pedagogical reflections, some consistent challenges arising in undergraduate capstones in the area of role ambiguity emerged: 1) definition of faculty function: instruction versus supervision; 2) clarification of student responsibility: responder versus initiator; and 3) communication: conferences and consultation versus grading and directive feedback (National Survey of Student Engagement, 2007). Given these challenges, it is recommended that every capstone include a component of “orientation/socialization” to explicitly address expectations, alleviate anxieties, and engage in norm-setting to establish a constructive culture of open inquiry that undergirds capstone learning.

Conclusion

Kuh (2008) proposed that all first and final year undergraduate students be provided a high impact learning experience, confirming and expanding the earlier call from the Boyer Commission (1998) that “capstone courses...need to be part of every undergraduate program” (p. 28). While these recommendations may seem, on their face, to be worthy goals, this article laid out some pedagogical challenges and structural factors that need to be carefully considered in order to deliver on such a sweeping mandate in a meaningful way.

While several recommendations for addressing some of those challenges were presented in the current discussion, further examination is needed to evaluate their effectiveness and to identify best practices for the development and delivery of high quality capstone experiences across a range of curricular contexts.

References

- Abbott, (2014). Hidden curriculum. In S. Abbott (Ed.) *The glossary of education reform*. Retrieved from <https://edglossary.org/hidden-curriculum>
- Anderson, L. W., & Krathwohl, D. R. (Eds.). (2001). *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of educational objectives*. New York: Longman. Boyer Commission on Educating Undergraduates. (1998). *Reinventing undergraduate education: A blueprint for America's research universities*. Carnegie Foundation for the Advancement of Teaching. Princeton, NJ.
- Brown, A. H., & Benson, B. (2005). Making sense of the capstone process: Reflections from the front line. *Education*. 125(4). 674 – 692.
- Brownell, J. E., and L. E. Swaner. 2010. *Five High-Impact Practices: Research on Learning Outcomes, Completion, and Quality*. Washington, DC: Association of American Colleges and Universities.
- Budwig, N. & Jessen-Marshall, A. (2018). Making the case for capstones and signature work. *Peer Review*, 20 (2). Retrieved from <https://www.aacu.org/peerreview/2018/Spring/Kelen>
- Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education*. New York: Macmillan.
- Hackman, S., Sokol, J., & Zhou, C. (2013). An effective approach to integrated learning in capstone design. *INFORMS Transactions on Education*. 13(2): 68-82.
- James Madison University. (2019). <http://www.jmu.edu/cds/>
- King, A. (1993). From sage on the stage to guide on the side. *College Teaching*, 41 (1). 30 – 35 Taylor and Francis Ltd.
- Konrad, R., Hall-Phillips, A., & Vila-Parrish, A. R. (2108). Are our students prepared? The impact of capstone design pedagogical approaches on student skill development during industry-sponsored fieldwork. *INFORMS Transactions on Education*. 18(3). 183-193.
- Kuh, G. 2008. *High-Impact Educational Practices: What They Are, Who Has Access to Them, and Why They Matter*. Washington, D.C: Association of American Colleges and Universities.
- Levine, A. (1998). A president's personal and historical perspective. In J. Gardner, G. VanderVeer, and Associates (Eds.), *The senior year experience: Facilitating integration, reflection, closure, and transition* (pp. 51-59). San Francisco: Jossey-Bass.

- Marin, J.A., Armstrong, J. E. & Kays, J. L. (1999). Elements of an optimal capstone design experience. *Journal of Engineering Education*. 19 -22.
- National Survey of Student Engagement. 2007. *Experiences That Matter: Enhancing Student Learning and Success*. Bloomington, IN: Indiana University Center for Postsecondary Research.
- Office of Educational Assessment (2019). Retrieved from <http://www.washington.edu/assessment/academic-assess/assessment-at-uw/departmental/capstones/>
- Pembridge, J. J. & Paretti, M. C. (2019). Characterizing capstone design teaching: A functional taxonomy. *Journal of Engineering Education*. 108. 197 – 219.
- Shoaf, M. M. (2000). A capstone course for preservice secondary mathematics teachers. *International Journal of Mathematics Education in Science and Technology*. 31(1). 151-161.
- Shulman, L. S. (2005). Pedagogies of uncertainty. *Liberal Education* 91 (2), 18 – 25.
- Sill, D., Harward, B.M., & Cooper, I. (2009). The disorienting dilemma: The senior capstone as a transformative experience. *Liberal Education* 95 (3). 50 – 55.