Winning Day One: Setting Up Capstone Students for Success

Alisha Sarang-Sieminski, Alexandra Coso-Strong,
Samantha Michalka, and Jason Woodard
Olin College of Engineering

Engineering capstone projects provide an opportunity for students to gain pre-professional experience in a scaffolded learning environment. The year-long capstone experience at Olin College combines practice working on a real-world engineering project with opportunities to develop skills in teaming and project management. Throughout Olin's project-focused undergraduate curriculum, students are introduced to strategies for maintaining team health and Scrum project management; the longer length of the capstone project provides an opportunity to reinforce the value of these techniques. Here, we describe a strategy for promoting synthesis of these key skills that includes a focus on course kick-off. On day one, students engage with the project, their teams, and faculty advisors to consider both the project ahead and their strategies to approach managing the project and their team health. The activities implemented on day one tie into additional student workshops throughout the year that support professional skill development.

Keywords: Curriculum, Teamwork, Human-Centered Design, Scrum

Corresponding Author: Alisha Sarang-Sieminski, alisha@olin.edu

Introduction and Context

One of the tensions inherent in capstone courses is balancing the nature of an academic course with a substantial pre-professional project experience. Further, while the stated goal of capstones is for students to synthesize and demonstrate mastery of their skills, faculty are often concerned with developing new skills and students often come in not knowing how to apply those and previously acquired skills to such a large project. A focus on student ownership as beneficial to motivation and project success can also be in tension with a programmatic concern of ensuring projects succeed.

SCOPE (Senior Capstone Program in Engineering) is one of the two capstone options at Olin College of Engineering. Students engage in a year-long project with and for an external sponsor; sponsors are primarily corporate, but also include non-profits or governmental agencies. A key factor when developing and selecting projects is that the sponsor must be invested in the outcome and engage with the student team throughout the process; however, the projects must also not be so high stakes or time sensitive that undue pressure is placed on the student team. A goal of the program is to give students as much time and space to tackle these significant projects as possible without spending extraneous time on course overhead.

Towards creating a more authentic working experience that is more continuing education and less content delivery, we have eliminated as much content delivery as possible and worked closely with colleagues throughout the undergraduate curriculum to create an arc of skill building that truly culminates in the capstone project. Relevant areas of focus include teaming, project management, and user-oriented design. In this paper, we describe a new strategy for kicking off the first day of the program that emphasises a larger approach of weaving key skills from earlier in the curriculum into the capstone experience. While our more explicit connections to previous professional skills built is the focus of this paper, it is worth noting that it relies on having those skills built in throughout the curriculum.

Teaming

Olin students work on teams starting in their first semester and throughout many courses in the curriculum. In Products and Markets, a first-year entrepreneurship course, students learn specific tools for giving and receiving feedback and maintaining team health. They also work briefly on randomly assigned teams four times to get a taste of different teaming

experiences. In another first-year course, Design Nature, students set individual learning goals and their teams are collectively accountable for making sure individuals meet their goals. Students are also explicitly told that the typical default strategy of dividing work based on existing experience and skill tends to make the "rich get richer and poor get poorer," and that this pattern often breaks down along gender lines. These interventions encourage students to prioritize individual learning and skill development over specializing in skills they already have; attitudes and priorities developed here appear to persist beyond the first semester.

Project Management

Scrum is a project management approach that focuses on transparency, adaptability, accountability, continuous improvement, integrated and iterative development, collaboration with users with evolving needs, cross-functional teams, and a high degree of team member autonomy over a hierarchical management approach.[1,2] While no one member is the decision maker, the Product Owner is responsible for holding the long-term vision of the project and creating a prioritized list of tasks (the Product Backlog) that the team will accomplish. Work is accomplished in Sprints (typically two weeks) and the tasks to be accomplished in a given Sprint (Sprint Backlog) are agreed upon by the whole team. The Scrum Master is responsible for making sure the team is implementing Scrum appropriately and removing internal and external impediments. The other members of the team are self-organizing in deciding how to get the work done.

The high level of autonomy and an emphasis on individual accountability are intended, and demonstrated, to improve morale, motivation, and productivity. Another key is to make progress and work visible by displaying it on a Sprint Board, either electronic or physical, on which each task is tagged as To Do, Doing, or Done. Each Sprint culminates in a Sprint Review involving key stakeholders and a Retrospective, an internal team reflection on team performance meant to cultivate self-awareness among the team that culminates in a discrete thing to improve in the next Sprint.

We and others have incorporated Scrum into engineering capstones in order to promote team autonomy, engagement, and project completion.[2,3] A distinctive feature of our curriculum is that we have begun to make institution-wide use of these practices and students have seen elements of Scrum in previous required courses. In Products and Markets, students focus on task definition and creating Product Backlogs and doing work in Sprints, culminating in Sprint Reviews. The Product Owner and Scrum Master roles are not explicitly defined, but the projects are short enough (2-4 weeks) that they are not typically necessary.

In the second year course, Principles of Engineering, students engage in an eight week project in teams of five. The emphasis of each Sprint is risk assessment and system integration (another key aspect of Scrum).While Sprint Planning and Retrospectives are encouraged, they are not assessed. Documentation and process are at the center of the learning goals for this project, providing an opportunity for students to explore how Scrum can be implemented on a longer-term technical project.

User-Oriented Design

All Olin students take a sequence of design courses that have a common thread of prioritizing user needs. In particular, second year students take User Oriented Collaborative Design (UOCD), in which they engage with a specific user group and develop the concept (but not the technical implementation) of a product or service that can have a substantial impact on this group. In the course, students develop tools for interviewing users and making sense of the complex information gained from engaging with people. They use tools for generating and developing divergent and expansive ideas, and practice crafting a story of users' needs and how a solution meets those needs. Further advanced courses build upon this foundation through delving into more specific topics or approaches to design.

Win Day One

The first day of any course is an opportunity – to set the tone, to hit the ground running, and to create rapport and community among and with your students.[4] In addition, positive experiences on the first day can positively impact students' motivation within the course.[5] To help students and faculty reframe the experience of the first day of class into one that creates excitement about the course and demonstrates to students what to expect in this new learning environment, two Olin faculty have created a model of "Winning Day One".[6] Through workshops and in-person consultations, this model has helped faculty within and outside of Olin rethink the first-day experience. The subsequent sections illustrate how we have redesigned the first-day experience of SCOPE.

Historically, the first day of SCOPE has been spent going over the syllabus and having students set up their project spaces and meet with advisors. Students' official class time is 9am-5pm on Wednesday. Since the second Wednesday of the course is a kick-off event with the

sponsor and the next meeting between the faculty and students is three weeks into the course, the first day time was not being leveraged well. In the current year, we employed the concept of Win Day One to create an experience that engaged students more effectively, scaffolded teaming activities, and activated memory of existing skills.

Preparing for Day One

Several preparatory steps were needed to facilitate an engaging Day One. Prior to the first meeting, students were presented with the 14 projects for the year and asked to rate each project independently based on their interest and ability. A semi-automated process was used to place students on teams;[7] students all receive team assignments that they rated highly and many receive their top choice. They receive teaming assignments the day before the class starts.

Along with the 14 projects, students were presented with the three overarching learning goals for the capstone course (Figure 1):

1) Reflect on and further develop a professional identity
2) Create and maintain team health
3) Successfully execute a client-based project

Students were also asked to generate a list of personal learning goals for SCOPE, sign non-disclosure agreements if applicable, and fill out a "Guide to Working with Me" that asked about time commitments outside of SCOPE, past teaming experiences, and styles of giving and receiving feedback.[8]

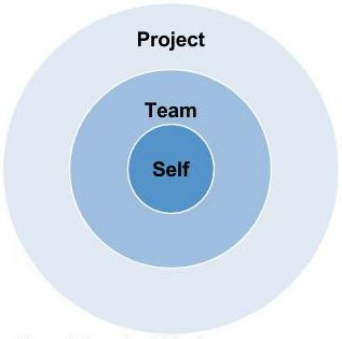

Figure 1. Learning Objectives

Starting Day One

Upon arrival, students were asked to sit with their newly formed team. They were (re)introduced to the SCOPE faculty and staff and the learning objectives in the course, which were used as a mapping for the day's activities. These objectives had been greatly simplified to fully emphasize the importance of self and team in the successful execution of a project and to allow the students to see more clearly how project activities were aligned with the objectives (Figure 1).

Do Your Project in 45 Minutes

After this brief introduction, teams were then given their single-page project brief for the first time and asked to read them and to "complete" their project in 45 minutes. Faculty advisors were available to answer questions and coach students, and prototyping supplies (e.g., paper, rubber bands, tape, etc.) were also available. This activity had several objectives. First, it was a fun, low-stakes experience for the students to start to engage with the project and with their teammates. Even though Olin students do multiple projects each semester, SCOPE is the biggest project of their undergraduate career and the magnitude of what they are being asked to do can be daunting. This quick experience helps jump-start their work as a team and on the project. Second, it forced the students not to just start at the beginning, but to think about their whole project and lay the groundwork for writing a project planning document, their next written assignment. The activity culminated with teams presenting to the other teams in their studio (two to four teams are in each studio with a single faculty advisor connected to each studio).

Emphasis on Teaming

After the activity, students were asked to do a "baggage drop" to unpack their hopes and fears for themselves, the team, and the project. The goal was that the first activity would have prepared them for this conversation, given them a taste for working together, and also helped them start to generate hopes and fears. This baggage drop led into the discussion and creation of a team agreement, which was also scaffolded using a worksheet. We emphasized that, while they had been on many teams previously, they could not just get by without tending to their team health for a project this big. Students started by sharing their learning objectives and information from Guide to Working with Me. Creating explicit time and structure for team agreements meant that all teams dedicated time to developing shared strategies and norms to work collaboratively, defining team roles, establishing communication channels, and creating a team working plan to promote team health. Faculty reviewed and gave feedback on these agreements to help reinforce key ideas and ensure teams were implementing good practices. Creating an explicit structure and setting aside dedicated time were new additions and improved the depth and quality of the agreements as well as apparently increasing student buy-in about the importance of team health in project productivity.

Project Management

This was the first year that all student have seen elements of Scrum in their first and second year required courses. They had been previously introduced to the whole system of Scrum but had not implemented it fully. The faculty from those earlier courses, who are Scrum enthusiasts, ran a brief workshop to refresh students about the Scrum philosophy and then go deeper into elements they might be less familiar with. Students were engaged and asked thoughtful questions that demonstrated that they were grappling with how to use this tool and not just passively listening.

The Syllabus

Only at the end of the day did we spend a brief lecture-style time going over the schedule, assessment, and other relevant syllabus information. While this information was also on the course website and students were directed to it, the time permitted the faculty to respond to questions about the syllabus and highlight key points. Given that the students had already been exposed to different aspects of the course through the earlier activities, their questions were more targeted and engaged than in previous years.

After Day One

To further develop skills and reinforce attitudes, several other workshops were offered after the first day. Besides these, student contact is primarily in the form of weekly faculty advisor meetings and biweekly sprint reviews. Teams present to their sponsors and provide them with a written report at the end of the fall and spring semesters. Workshops included Sprint and Project Planning, UOCD-in-2-weeks (optional), Teaming, and Storytelling, as well as optional Scrum check-ins.

- The Sprint and Project Planning Workshop was done in studio, led by each faculty advisor. Teams respond to a series of prompts that should lead them to the outline of their Project Blueprint (a project planning document). From this, they also start to populate their Project Backlog and plan their first Sprint.
- The UOCD-in-2-Weeks workshop was designed to help students recall the tools and strategies they had learned in UOCD and other design courses and to think about how to employ them in their own projects. Attendance was optional and faculty encouraged teams with a strong design component to attend. The activities were tailorable to each project, allowing teams to focus in on the aspects of human-centred design most applicable to them.
- The Teaming workshop was meant to reinforce messages sent on Day One as well as to provide dedicated time for students to reflect on their processes to date and refine them as needed.
- Scrum check-ins were primarily targeted at the Scrum Masters and the Product Owners and were an open forum for these students to learn more about their roles and how to improve their performance. Students from most teams attended.
- The Storytelling workshop was offered in the Spring. It was offered by a design faculty member with a focus on graphic design. He gave students an overview of the basics of good graphical representation. Posters at the final event have been demonstrably more aesthetically appealing and effective at conveying information after running this workshop in previous years..

Summary

We described approaches for kicking off a successful capstone course by developing key skills in students in previous curriculum and reinforcing these skills and an engaged attitude on the first day of the course.

References

1. J Sutherland and K Schwaber, “The Scrum Guide,” http://www.scrumguides.org/docs/scrumguide/v1/scrum-guide-us.pdf (accessed March 2016)
2. J.G. Kuhl, “Incorporation of Agile Development Methodology into a Capstone Software Engineering Project Course,” *Proceedings of the 2014 ASEE North Midwest Section Conference*, Iowa City, IA, 2014.
3. A. Sarang-Sieminski and R. Christianson, “Agile/Scrum for Capstone Project Management,” 2016 Capstone Design Conference.
4. B. Gross Davis,. *Tools for Teaching*, John Wiley & Sons, 2nd edition, pp. 37-47, 2009.
5. J.H. Wilson and S.B. Wilson, “The First Day of Class Affects Student Motivation: An Experimental Study”, *Teaching of Psychology*, 34(4), 226-230, 2007.
6. M. Somerville and J. Stolk, “Win Day One: Diving Into Experience Design,” Meeting the Needs of the 21st Century: Designing for Student Engagement, Olin College Collaboratory Summer Institute, June 2-6, 2016.
7. M. Chang and A. Downey, “A Semi-Automatic Approach for Project Assignment in a Capstone Course,” 2008 ASEE Conference Proceedings.
8. Based on “Guide to Working with Me,” Triad Consulting Group, 2016.