A Comparison of Senior-Level Integrative Capstone Courses for Agricultural & Food Systems and Integrated Plant Science Students at Washington State University

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Abstract

Like many U.S. Land-Grant institutions, over the last decade, Washington State University (WSU) has consolidated several of its former agricultural department-based, undergraduate degree programs and restructured them into multi-departmental, interdisciplinary programs. One such program is called Agricultural and Food Systems (AFS, afs.wsu.edu) which has five majors: Organic Agriculture Systems, Agricultural Technology and Production Management, Agricultural Education, Agricultural and Food Business Economics, and Agriculture and Food Security. The other consolidated program is called Integrated Plant Sciences (IPS, ips.wsu.edu) with six majors: Agricultural Biotechnology, Field Crop Management, Fruit and Vegetable Management, Landscape, Nursery and Greenhouse Management, Turfgrass Management, and Viticulture and Enology. These successful four-year degree programs currently have more than 460 undergraduate students enrolled. Students in either program are required to take a culminating, integrative capstone course to assist them in becoming "job ready, day one" upon graduation. For the AFS program, there is one capstone course (AFS 401, "Advanced Systems Analysis and Design in Agricultural and Food Systems") that combines students from all of the AFS majors. For the IPS program, there are three capstone course offerings: VIT_ENOL 433 ("Critical Thinking in Vineyard and Winery Management", for V&E students), HORT 425 ("Trends in Horticulture") and CROP_SCI 435 ("Interdisciplinary Solutions to the Plant Sciences"). Each capstone course includes discipline-integrative, real-world projects, both individual and team-based, and involves interaction with horticultural/agricultural experts inside or outside the classroom. Differing capstone course approaches and examples regarding team assembly, project specifics, presentations, expert engagement, and student assessment (e.g., by self, team, and/or instructor) were compared and contrasted, which identified benefits and limitations of each approach. Professional skill development targets were compared and contrasted. Instructor feedback through student course evaluations, senior exit surveys and student focus groups identified both benefits and limitations to the different approaches.

Background

Well-designed and executed research-based, senior-level undergraduate capstone courses can provide many positive and meaningful outcomes for students (Hauhart and Grahe, 2014; McKinney and Day, 2012). In particular, capstone courses that engage industry experts can significantly benefit soon-to-be graduates as they prepare for a career after college (Layne et al., 2017). Further, capstone courses can also provide a positive means to assess the success of the student learning experience for students at the end of their undergraduate program (Sum and Light, 2010). As noted above, WSU students in the AFS and IPS interdisciplinary undergraduate degree programs take a senior-level capstone course prior to graduation. The specific elements of these capstone courses are presented side-by-side in Table 1 and comparisons are noted as follows:

Teamwork. Course instructors took different approaches to assembling student teams for various projects. For the three IPS capstones (HORT 425, VIT_ENOL 433, and CROP_SCI 435), students self-selected peers to work with. For these classes, team sizes ranged from 3-5 students. For the AFS 401 capstone, the instructor assigned students to teams and team size was 6-7 students. Here, the instructor-selected teams were designed to encompass maximum student diversity in terms of program major, grade point average (GPA), gender and personality profile (as determined using https://www.16personalities.com/). Project team sizes were larger in the AFS 401 class due to the larger student enrollment and the limited number of industry project partners. As noted above, AFS 401 is the single required capstone for students in all five AFS majors.

Projects. Each capstone course required a significant semester-long, team-based project. For AFS 401, the project involved providing real world solutions to an agribusiness challenge of an industry partner. For HORT 425, student teams chose and took a position on a horticulturally relevant issue and prepared a white paper. VIT_ENOL 433 students visited both a commercial vineyard and winery, did site analyses, and prepared a vineyard and winery management plan. Finally, CROP_SCI 435 students identified a particular agricultural problem and developed an original research proposal to address this problem.

Presentations. In each of the capstone courses, a combination of presentation methods are required. This included short oral project updates or "flash talks", final written proposals/papers or management plans, and/or a final oral or poster presentation before their peers.

Engaging Experts. Each of the capstones engaged academic or industry experts as guest lecturers. For AFS 401, student teams had a formal industry project partner who mentored them throughout the semester (Figure 1). Students in both AFS 401 and VIT_ENOL 433 met industry representatives outside of class at their place of business or engaged with them at an industry trade show.

Assessment. Each of the capstone courses required both team and individual submissions. Peer evaluations of presentations were utilized in both HORT 425 and VIT_ENOL 433. In AFS 401, industry partners provided evaluation of final team oral presentations.

Professional Skill Development. Professional skills including public speaking, working on teams, and problem-solving were vital components of each course. Interdisciplinary approaches to solving agriculturally relevant problems were key components of AFS 401, HORT 425 and CROP_SCI 435. VIT_ENOL 433 is a focused course for Viticulture and Enology students only.

Table 1: Capstone course side-by-side comparisons

AFS/IPS Capstone Course Comparisons				
	AFS 401	**HORT 425**	**VIT_ENOL 433**	**CROP_SCI 435**
Instructor	**D. Layne**	**C. Peace**	**J. Davenport**	**A. Carter**
Majors in class	ORGAG*; AGTCH; AGED; AGFEC; FDSEC	FVMGT, VE, LNGMGT, TGMGT	VE	AGBIO, FCMGT, FVMGT, TGMGT
Teamwork Elements	Instructor selected teams for max. diversity (major, GPA, gender, personality profile) 6-7 students/team; 9 teams Each team w/industry partner	Self-assembled with written tips on forming and working in teams 3-5 students/team; 8 teams Grade incentive for multi-campus teams	Self selected with instructor adjustment Include both viticulture and enology emphasis/preference 3 - 4 students per team	Self-selected with input from instructor Interdisciplinary teams recommended 3-4 students per team
Project Specifics	Industry partner real world agribusiness challenge Original research Develop strategy Provide recommendations in oral presentation and final written report	White Paper – choose an issue, take a position, convince audience Assemble evidence from 1° (and 2°) scholarly sources Two drafts, with peer input Final written and oral Worth 50% of course assess't	Vineyard and winery sites assigned to each team Develop portfolio addressing location challenges Two draft and one final submission per project	Identification of a problem affecting the plant sciences Development and proposal or original research to combat problem Provide impact of their proposal and budget summary
Team Presentations	Weekly "minutes" updates Biweekly project updates Final oral presentation to industry partners and peers	5-min "flash talk" in last week Accompany with 1-5 slides Evaluation by whole class and by instructor (and anyone who wants to watch)	Oral presentation on vineyard portfolio by team Poster presentation on winery portfolio by team	Final written proposal Oral proposal presentation Biweekly project updates, summaries, and drafts
Engaging Experts	Semester-long project with industry partner Bi-weekly meetings (face-to-face, teleconference, ZOOM) Travel to industry partner's site of business Guest speakers (4) Recent graduate panel	9 weeks + engage with experts in classroom; experts present Tue, discussions Thu; students submit 2+ questions, submit answers & thoughts, 4 write-ups Team project requires documenting engagement with ≥1 horticultural science expert	Guest lectures throughout term Strong focus on Q&A time after lecture Conduct activities with experts in class Walking equipment tour at industry trade show	Guest lectures throughout the course in conjunction with discussion of research articles submitted by students
Team/Self-Assessment	Team-based submissions Individual submissions Team member peer feedback check-in (3x during semester) Post project self and team reflection report Industry partner evaluations of final oral team presentations	Two evaluations of teamwork (self, others, team as whole): mid-semester and end Mid eval: simple 1-3 scores of Communication, Contributions End eval: Fill a form, individually submitted Peer evaluations of White Paper proposals, oral pres'ns	Individual assignments Identify team member for all portions of portfolio Peer evaluation of presentations	Introduction is graded by team participation Development of research project by individual participation Team and individual performance evaluations Individual submissions on case studies
Professional Skill Development	Professional communication with industry partner Public speaking Taking/reporting team meeting minutes Developing project management plan	Large (L)/Small (S) emphasis Scientific writing (L) Text-based arguing; devising interdisciplinary solutions to challenges in horticulture (L) Evaluating scientific sources (L) Teamwork (L) Oral presentation (S) Professional networking (S)	Public speaking Oral and poster presentation development Applying degree based knowledge to find solutions to practical (real world) problems	Public speaking Written communication Resource finding Interdisciplinary communication Teamwork

*Degree program abbreviations are as follows: **AFS Program** – Organic Agriculture Systems (ORGAG), Agricultural Technology and Production Management (AGTCH), Agricultural Education (AGED), Agricultural and Food Business Economics (AGFEC), and Agriculture and Food Security (FDSEC); **IPS Program** – Agricultural Biotechnology (AGBIO), Field Crop Management (FCMGT), Fruit and Vegetable Management (FVMGT), Landscape, Nursery, and Greenhouse Management (LNGMGT), Turfgrass Management (TGMGT), and Viticulture and Enology (VE).

Table 2: Mean student preparedness for WSU's Undergraduate Learning Goals at the beginning of the CAPS courses.

Learning Goals	Not Prepared	Somewhat prepared	Well Prepared	Cannot Rate
Critical & Creative Thinking	8.8	36.3	55.0	0.0
Information Literacy	5.0	30.0	63.8	1.3
Communication, Written	11.3	56.3	31.3	1.3
Communication, Oral	2.5	43.8	51.3	2.5
Communication, Visual	0.0	56.7	43.3	0.0
Depth, Breadth & Integration of Learning	8.8	41.3	50.0	0.0
Quantitative Reasoning	8.3	25.0	66.7	0.0
Scientific Literacy	10.0	40.0	50.0	0.0
Mean	**6.8**	**41.1**	**51.4**	**0.6**

Note: Combined data based on instructor reporting for 2017 Spring semester university UCORE CAPS course assessment reports for AFS 401, HORT 425, VIT_ENOL 433 and CROP_SCI 435

Table 3: Mean student achievement of WSU's Undergraduate Learning Goals at the end of the CAPS courses.

Learning Goals	Do Not Meet Expectations	Partially Meet Expectations	Meet Expectations for Graduating Senior	Exceed Expectations
Critical & Creative Thinking	1.3	15.0	56.3	27.5
Information Literacy	2.5	6.3	60.0	31.3
Communication, Written	1.3	12.5	61.3	25.0
Communication, Oral	0.0	8.8	53.8	37.5
Communication, Visual	0.0	6.7	56.7	36.7
Depth, Breadth & Integration of Learning	1.3	17.5	57.5	23.8
Quantitative Reasoning	0.0	15.0	51.7	33.3
Scientific Literacy	2.5	11.3	53.8	32.5
Mean	**1.1**	**11.6**	**56.4**	**30.9**

Note: Combined data based on instructor reporting for 2017 Spring semester university UCORE CAPS course assessment reports for AFS 401, HORT 425, VIT_ENOL 433 and CROP_SCI 435

Figure 1: AFS 401 student capstone project team with industry partner.

Results

UCORE CAPS Assessment Reports: As part of the university's best practices, all capstone course instructors complete an assessment report in the semester immediately following completion of offering their courses. These reports document student preparedness at the beginning of the CAPS course relative to WSU's Undergraduate Learning Goals (https://ucore.wsu.edu/students/learning-goals/). They also document the percentage of students who meet or exceed these learning goals at the end of the course which coincides with the time of their graduation. The combined average scores for the four AFS/IPS capstone courses for each of the learning goals both at the beginning and end of the CAPS courses is summarized in Tables 2 and 3, respectively.

At the beginning of the capstone courses, instructors noted, on average, that more than half of the students were well-prepared relative to WSU's Undergraduate Learning Goals (Table 2). Students were best prepared in the areas of information literacy and quantitative reasoning and least well prepared in terms of written and visual communication.

At the end of the capstone courses, instructors noted, on average, that nearly 90% of the graduates either met or exceeded the student learning goal achievement for graduating seniors (Table 3). Students were best prepared in the areas of information literacy, visual and oral communication. For students that only partially met learning goal achievement, the greatest deficiencies occurred in critical and creative thinking and depth, breadth and integration of learning.

Discussion and Conclusions

The assessment of learning based on evidence of students work is critical to inform decision-making regarding program improvement or change in higher education (Cerny-Koenig et al., 2007; Jonson et al., 2014). Like other universities, WSU has identified seven key learning goals for students in the undergraduate degree program. Based on Spring 2017 assessment of capstone course students in our AFS and IPS interdisciplinary degree programs, the majority of our graduates meet or exceed these learning goals.

Recently, WSU's College of Agricultural, Human, and Natural Resource Sciences (CAHNRS) developed a student experience advisory council (SEAC). The SEAC comprises faculty, staff, alumni, industry partners, etc. and it engages in biannual meetings to help us ensure that our academic and experiential learning opportunities are indeed transformational so that our graduates will be "job ready, day one". SEAC partners from industry have informed us that they are particularly interested in graduates who have good teamwork, critical-thinking and real-world problem solving skills. The capstone courses noted herein were designed to foster continued development of students in these particular skills and others. As noted by Layne et al. (2017), partnering with and engaging experts (both academic and industry representatives) can substantially enrich the student capstone experience.

Whether capstone courses are discipline-specific or interdisciplinary in nature, engagement of program instructors with each other is also very helpful (e.g., sharing syllabi, discussing best practices, ideas/experiences). We have utilized teaching faculty retreats, capstone workshops and capstone course panel discussions to strengthen this part of our AFS/IPS programming at WSU. Based on our experience, a diversity of capstone approaches can lead to the common goal of achieving student learning and career readiness preparation.

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