Practicum in Beekeeping:

A Case Study in Experiential Learning

at the University of California, Davis

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Chapter I. Experiential Education

Introduction

As a Masters student in the International Agricultural Development program at the University of California, Davis, I have focused primarily on exploring the role of experiential learning in agricultural education. This is an outcome of my professional experience prior to attending graduate school: I spent nearly a decade working in the outdoor industry, beginning as a sea kayak and backpacking guide, and eventually built my teaching credentials to work as a kayaking coach for adults and children. I also began to cultivate a strong personal interest in farming and food security, and eventually joined the United States Peace Corps, where I served as an agriculture volunteer in Paraguay. My primary project was a partnership with a women's committee in my small farming community, through which I worked with my neighbors to build vegetable gardens and design culturally sensitive nutrition and cooking classes. I also taught beekeeping courses, working to capture and manage Africanized bees with my community. Across these seemingly divergent professions, my role was the same: to teach.

These experiences informed the way I approach education. I realized that my particular trajectory as a teacher required me to find ways to reach people in situations that are particularly uncomfortable. My work as a kayak coach required me to take people quite literally out of their element: I spent a great deal of time helping people process a deep fear of moving water and reconnecting with their capacity for physical

awareness. And as a volunteer with the Peace Corps, I found myself teaching across often substantial language and cultural barriers, working to find common ground and develop tools that can help people communicate as they explore new concepts. Regardless of context, I found I was at my best as an educator when I was able to structure learning experiences that let students discover new things for themselves. I focused on asking questions rather than telling, on establishing two-way conversations rather than one-way channels of delivering information.

This approach to education is effective even when learners are scared or uncomfortable, and can be a powerful tool for students who are more at ease. Building my own capacity to provide this kind of education to others made me excited to continue to teach, and to return to the role of a student. But when I began my graduate program, I was confronted with the reality that classes in the university setting are rarely structured in a way that feels effective for students or for teachers. Rather than seeking out approaches to education that are accessible to students even when they are not at their best, the university seems to promote a singular style of teaching that does little to support even the most prepared and dedicated students. The priority seems always to be learning *about* something, rather than learning the thing itself, or learning more fundamentally how to learn; this impedes students from connecting deeply with their own educations.

To that end, I designed a Capstone project that seeks to examine some of the paradigms in place that encourage our conventional approaches to teaching and learning in higher education, and to explore some of the alternatives to those

approaches. I created and helped to administer a Practicum in Beekeeping course that embodies some of the alternatives discussed here, and used data collected from that course to provide a small case study on advantages and challenges to providing experiential learning opportunities in agriculture within the university setting. The experience provided me with an opportunity to think more deeply about how we learn, how we teach, and the resources that are available to us in course design and approaches to pedagogy. My hope is that it will serve students and educators in efforts to design future experiential education opportunities.

How we learn

The ways in which individuals learn new skills and ideas have been studied extensively. For the purposes of this paper, I will explore a few foundational ideas about learning and education to understand the diversity of learning styles in students that is often underrepresented in the curricula or pedagogy offered in higher education. One helpful and rather ubiquitous framework for understanding different learning styles was introduced by Walter B. Barbe in the 1980s. It suggests that there are three main modalities through which people learn: a visualizing modality, through which students are able to learn through observation; an auditory modality, through which students absorb information by hearing it; and a kinesthetic modality, which relies on receiving information through tactile or experiential means (Boulmetis 1996). This framework was later expanded to include a fourth modality: social learning, or learning by means of observing and mimicking human behavior (Rogoff 2012).

These schema allow that in general, individuals have the capacity to learn by any of these means or a combination of them; but that each of us also possesses a preferred learning style or styles, through which we are able to absorb information most effectively. Though these frameworks have been challenged and updated, scholarship and common sense both continue to suggest that individuals display a diversity of learning styles. This diversity, however, is rarely represented in the setting of the university or other higher education. Courses instead tend toward a didactic style of teaching that favors auditory learners who are able to gain knowledge from lecture-based formats of instruction; this same format puts students who favor a kinesthetic modality at a strong disadvantage (Knowles 1998). The students who succeed within this system, then, are not necessarily the brightest or the ones who work the hardest, but merely the ones with the most facility in absorbing information disseminated this way, or the ones who have most successfully mastered this instruction mode. The style of teaching implemented can have a profound impact on an individual's ability to synthesize understanding; this suggests that our current education system is designed less to provide all students with the same education and more to reward a specific type of learner, or perhaps to reward the system itself for providing education efficiently but without the collective benefit of real learning.

Moreover, the metrics for student success within this structure are based on class and exam performance rather than broader scholarship or critical thinking. This paradigm indicates an education system in which "the teacher's job is to provide information and the students' job is to learn it, whatever way they can" (Frey 2011),

rather than for teachers to educate their students in the best way possible for each individual student. Many educational theorists seek to construct alternative models that instead promote a more authentic pursuit of learning itself. John Dewey, a pioneer in and champion of progressive education, questioned an education system devoted only to accomplishing to short-term goals (Howden 2012). He suggested that educators' approaches to students be fundamentally reconsidered in order to prepare them not just to perform on their exams but to develop long-term learning skills. "To improve learning, the focus should be placed on engaging students in a process that facilitates optimal learning" (Baker 2012). Education systems that are inclusive to all learning styles can pursue something beyond strong student performance in the classroom: they can in fact teach students how to learn and remain interested in learning beyond the scope of the classroom.

Experiential education

Dewey stated that "amid all uncertainties there is one permanent frame of reference: namely, the organic connection between education and personal experience" (Baker 2012). Seizing on the naturally occurring and powerful mechanism of learning by experience, therefore, offers tools to effectively teach across a diverse group of learning modalities; this approach is often referred to as experiential education. Though the term is used colloquially to include a wide variety of practices, the Association for Experiential Education defines it as "'a philosophy that informs many methodologies in which educators purposefully engage with learners in direct experience and focused reflection

in order to increase knowledge, develop skills, clarify values, and develop people's capacity to contribute to their communities'" (Shellman 2014). The term can, however, be misleading. It is easy to reduce the concept down to the process of simply having an experience, omitting the self-reflection and iterative development that is essential to the successful educative properties of experiential learning. "All learning is experiential. Listening to a lecture is an experience, and sometimes a very powerful one. The term experiential learning is redundant. Learning is a concept that is built upon how experiences change people. However, the experience itself does not constitute learning" (Baker 2012). To constitute experiential learning, more than an experience is required: some kind of structured reflection on that experience is also necessary.

David A. Kolb presented a learning cycle in the 1980s that has become a foundational illustration of the concept of experiential learning. This cycle offers an approach to the iterative and reflective approach to experience that is necessary to constitute real experiential learning. As presented by Kolb (1984), learning takes place over four stages in a cycle, and begins when a student undergoes a concrete experience. That experience is followed by reflective observation, offering the student time to reflect on that experience, after which the student is able to formulate abstract generalizations and deeper concepts. The student is then able to test those generalizations and concepts in the context of something new; this leads the student back into a concrete experience, thus beginning the cycle anew (Vince 1998). Kolb suggested that "learning is the process whereby knowledge is created through the transformation of experience" (Vince 1998). He offers his own definition of the various

learning modalities through which we best access information, but stresses that this learning by way of experience offers opportunities for learners of all styles to process and retain information.

The multiple stages of participation in the learning process that Kolb lays out require that students exhibit substantial agency in their own education. “By being physically involved in an event that impels a learner to do the very thing he or she is learning about, multiple aspects of the person are engaged; thus the process feels genuine, and the outcomes are meaningful and personal” (Howden 2012). The process of personal reflection, and of exploration of the ways in which newly conceived concepts relate to each other, “encourage students to make their own sense of the content, and craft their own connections among the various concepts” (Tomkins 2016). Collaborative approaches to observation, generalization, and application go so far as to bestow students with the responsibility to educate one another, effectively establishing students in a central role in the teaching process. When agency is required of students, it can alter the degree of participation they display in their own education, effectively encouraging more active and attentive learners.

This agency that students can experience by way of experiential learning opportunities can be taken a step further: it can allow for students to question traditional power structures built into our education systems. Because experiential learning requires that students contribute to their own education, top-down hierarchical approaches to education are no longer a requirement (Knowles 1998). Peer-to-peer collaboration further challenges that hierarchy, as it suggests that all participants in the

classroom, not only the teachers, have information and experience worth sharing. “The notion that [experiential learning] is less hierarchical than more traditional forms of learning also invokes instructional designs based on peer-learning and dialogue, thereby potentially making greater use of all the resources and sources of expertise in the classroom” (Tomkins 2016). With the right support, this approach to education, of course, can spread beyond the classroom, contributing to a more robust kind of education that fosters critical thinking and leadership. “The idea that [experiential learning] invites a more active and questioning kind of student participation chimes with the desire to encourage more active and questioning kinds of leadership and organisational behaviour [sic]” (Tomkins 2016), suggesting commitment to education that goes beyond the success of an institution to deliver information and instead seeks to provide more meaningful and collectively beneficial kinds of learning (Knowles 1998).

Because experiential learning is naturally occurring and iterative, it provides a unique tool for cultivating in students the skills they need to become lifelong learners. When educators are able to design experiences that motivate and excite the students as they learn, they succeed not only in teaching the subject matter but in promoting an enthusiastic pursuit of knowledge. “Students who enjoy learning often become lifelong learners and are able to self-regulate their own life path and educational endeavors in manners that keep them both highly engaged and highly productive” (Sibthorp 2011). This approach necessarily prepares students more robustly for the array of challenges that await them beyond the classroom, embracing the idea that effective education can inspire self-motivated and self-directed learners (Frey 2011). This learning-by-doing

framework can in fact simultaneously cultivate skills about how to be an effective educator: when students are able to participate in guided experiences that make complicated concepts easy for them to grasp, they are more likely to remember and be able to duplicate those experiences for others because they have an intimate understanding of how and why those methods are effective (Knowles 1998).

Alternative approaches to education also require alternative methods of assessment. Conventional education often relies on summative assessment, in which students are tested on their capacity for all the material covered over the duration for the course. Progressive educators now often incorporate formative assessment, whereby student knowledge is assessed throughout the course as a way to determine student comprehension and attainment. “The key difference between assessing summatively and assessing formatively resides in the application of the data the teacher collects. If the teacher uses those data to modify instructional practices in ways that accommodate students' developmental positions and promote more learning, he or she is using assessment in a formative way” (Dougherty 1997). By surveying what students know and understand at various times during the course, the teacher is able to better measure and meet the needs of the students. Within this model, “teaching is about what students learn, not what the teacher presents” (Dougherty 1997). This approach to assessment works cohesively with an approach to education that promotes agency in its participants.

Though experiential learning is championed in many sectors, it is rare to find this teaching style celebrated within the framework of higher institutions themselves.

However, many specialties, and agricultural education in particular, offer opportunities to explore the value of experiential learning and progressive approaches to education and assessment. There is a great deal of agricultural information that can be delivered in the context of a lecture hall, but arguably more crucial is the hands-on component—a tension many describe as the difference between teaching *about* agriculture and teaching agriculture itself. Progressive approaches to agricultural education instead promote an "orientation toward linking academics to real-world contexts and purposeful activities" (Krista et al 2016) such that students develop their skills in the applied setting in which they will go on to use those skills in their professional lives. Within the sphere of agricultural education and beyond it, experiential learning offers parallel benefits to students looking to pursue a career in agricultural education, as it simultaneously explores subject matter and best practices in how to teach that subject matter to others.

Challenges

An obvious argument against the utilization of experiential learning methods is that this approach requires additional resources, both in terms of additional time and effort required on the part of the educators and in terms of the costs associated with getting students out of the classroom and into the field (Jacobsen et al 2016). A central explanation for why our conventional education system favors lecture-based, didactic methodology is because it allows for large numbers of students to receive the same information in a relatively efficient and cost-effective way. This perspective, however, fails to consider the potential in improved quality of education for students living in a

rapidly changing world, which suggests that “if institutions of higher learning do not address the changes needed, their colleges and departments of agriculture may eventually become irrelevant” (NRC 2009). Neither does it weigh the more profound societal costs of failing to sufficiently educate the future of agricultural leadership at a time of precipitous environmental and cultural change.

Some critics of experiential education also suggest that its provision of agency to its students is inappropriate (Jacobsen et al 2016). To require students to actively participate in their own education and the education of their peers “suggests that valuing student experience above all other learning resources casts the educator as marketeer and the student as customer, with a consumerist right to be made happy” (Tomkins 2016). This criticism is predicated on the assumption that students are not the customers, but in a very real sense, of course, they are: university students spend tens of thousands of dollars to receive an education that, by many societal standards, is all but required of them in order to be successful. Moreover, this argument suggests that students should approach education as a privilege rather than a right, which perhaps stems from a legacy of academia controlling public access to information. In an age where information is more accessible than at any point in history, however, teachers in higher education must shift from the role of gatekeeper to knowledge and instead commit to teaching students how to learn, to discern, and to navigate the information that is so readily available to them (NRC 2009).

The land grant university context

Land grant institutions bear a particular responsibility to support a transition into a more experiential approach to agricultural education. The legacy of land grant universities is a “unique history of practical instruction to citizens of ordinary means” (Jacobsen et al 2016). These institutions are charged with the responsibility of providing agricultural education to the public, and often simultaneously help to produce the instructors who end up providing that education by providing “the applied agricultural needs of students, integrating both the scientific theory and practice of agriculture, making the curricula both relevant and accessible to the working classes” (Jacobsen et al 2016). These designations, however, were laid out in the late 19th century, and land grant universities have in many cases strayed from their original purpose of serving the greater community (NRC 1996); critics call for “transforming the status quo of [land grant university] curricula and pedagogy, away from Ivory Tower, didactic teaching from the perspective of a single discipline, toward ‘innovative multidisciplinary and systems-based course materials and curricula’” (Jacobsen et al 2016) in order to effectively educate a new generation of agricultural educators.

One pathway to providing experiential learning opportunities to students of land grant universities could be through collaboration with cooperative extension, a network of educators and researchers from within the nation’s land grant universities who are tasked with serving as a liaison between the university and the public. Because the needs of the public are most often applied rather than theoretical, cooperative extensionists are often uniquely able to link “academics to real-world contexts and

purposeful activities" (Jacobsen et al 2016), thus offering a more practical approach to agricultural education. If the resources available to the broader community through the University of California's cooperative extension were offered to its students, it might serve to meet the "applied agricultural needs of students, integrating both the scientific theory and practice of agriculture, making the curricula both relevant and accessible to the working classes" (Jacobsen et al 2016), while serving the dual purpose of modeling effective approaches to agricultural education for the public.

Practicum in Beekeeping: A case study in experiential learning

In the chapters that follow, I offer a case study of the efficacy of experiential education in agriculture in the form of a Practicum in Beekeeping that was offered at the University of California, Davis during the Fall Quarter of 2018. I designed and helped to execute this course in consideration of the ideas explored above. This case study offers an example of one of a variety of pathways that can be taken to establish experiential learning opportunities for students at UC Davis. Only twelve students participated in the pilot program of this course, so it is by no means intended to offer a comprehensive exploration of the subject. It does, however, serve to offer a point of entry into the conversation about how to approach and incorporate experiential learning in the context of higher education, and may serve as precedent for students hoping to design their own practical or applied coursework at UC Davis. It may also help to inform other institutions hoping to introduce similar classes into their own curricula on how best to approach coursework in bees and beekeeping.

Chapter II. Case Study: Developing a Practicum in Beekeeping

Introduction

The intention of this project was to establish an ongoing opportunity for university-level students to have hands-on access to apiculture education. This course design was intended to both exemplify dedicated and sustainable beekeeping practices, and to ensure the longevity of the curriculum itself. The project was designed under the assumption that students learn across a variety of modalities as explored in Chapter I, and that an experiential approach to this coursework serves both to more effectively educate students in apiculture, and to inform their future work in educating others. The seminar will be available to approximately twelve students each Fall Quarter, and will cater both to upper division undergraduate students interested in pursuing beekeeping, and to graduate students seeking technical training and extension tools in apiculture.

Project design: Why a beekeeping class?

I designed this project as a product of my unique background in beekeeping, agricultural extension, and outdoor education. I was first introduced to beekeeping during my term in the Peace Corps in Paraguay, where I served as an agricultural extension agent. In addition to learning about how to keep bees in resource-poor environments, and experiencing first-hand the economic incentives beekeeping can offer to subsistence farmers, I also worked more generally to lead hands-on and discussion-based trainings in building vegetable gardens, and worked with local

counterparts to deliver culturally sensitive nutrition classes. I have also spent the majority of the last decade in outdoor education, where in addition to on-the-job experience, I have completed extensive coursework that focused on developing pedagogy that serves all learning types. This formalized training has allowed me to refine my natural ability to imbue teaching opportunities with excitement and enthusiasm in a variety of environments, especially those in which participants may feel initially uncomfortable.

To inform my design of this course, I was able to take advantage of a number of education opportunities. Building on my own experiences with keeping Africanized bees in the Peace Corps, I attended a number of classes offered through the E. L. Niño Bee Lab's extension facility, where I learned about apiculture specific to European honey bees. I was able to attend the annual Bee Symposium facilitated through the UC Davis Honey and Pollination Center, where I heard a number of experts discuss both the challenges facing honey bees specifically, and the broader issues that threaten native and other pollinators. In Spring Quarter of 2018, I took Entomology 119: Apiculture, through which I learned a great deal about honey bee biology, behavior, and organization, and became familiar with some of the other bee species now being used to provide pollination services in conventional agricultural systems. I volunteered at the Harry H. Laidlaw Jr. Honey Bee Research Facility ("Bee Biology") throughout the summer of 2018, working closely with facility manager Charley Nye to learn more about working efficiently and effectively in large numbers of honey bee hives. I was also able to work with a number of community members in backyard beekeeping where I gained

experience in small-scale apiculture, including swarm captures and hive management. I used these experiences to design a course syllabus that reflected both the breadth of information to which I had been exposed, and the depth of certain subjects that are central to the study of bees and beekeeping.

Though my primary goal was to establish an apiculture-specific program, my broader motivation for this project was to gain experience in developing educational materials and infrastructure for cooperative extension programming by collaborating with my peers and with faculty and staff at UC Davis. This project offered a new pathway for the university to invest in diverse educational approaches as part of a broader effort to reach students from all backgrounds and with all learning styles. Further, it created a valuable new resource for UC Davis students in a world that is increasingly concerned with the future of honey bees and native pollinators, and their tremendous impact on conventional agriculture. My hope was that the establishment of this course would provide the ideal exercise to develop my abilities in providing experiential education opportunities that are relevant to contemporary issues in agriculture, while providing a new opportunity to educate and empower UC Davis students.

UC Davis context

The University of California, Davis boasts a wide array of researchers devoted to studying Western honey bees, native bees, and other native pollinators. The university is home to the Williams Lab of Pollinator and Pollination Biology, where studies are

conducted on resource and habitat management and their effects on native pollinator vigor; the E. L. Nino Honey Bee Lab, which offers the only apiculture-specific extension resources in the state of California, and the UC Davis Honey and Pollination Center, which is devoted to research on the economics and quality standards of hive products. These many resources, however, tend not to collaborate with one another, and offer only limited opportunities for student education and participation. Although the university currently offers an introductory lecture class in apiculture through the Department of Entomology and Nematology, there are currently no course offerings that include hands-on components in beekeeping, or discussions of the ecological and agricultural considerations of native pollinators and pollination services more generally.

UC Davis' location provides further context for a need for education in apiculture. Commercial beekeepers profit primarily from providing pollination services, an industry that is now valued at around $17 billion annually (Cavigli et al 2015). Perhaps the most valuable crop in need of pollination services is almonds, and some 80% of the world's almonds are grown in California's Central Valley. For that reason, every February and March the Central Valley becomes the temporary home for approximately 60% of the country's commercially kept honey bees, or almost two million hives (Cavigli et al 2015). California's almond industry comprises the cornerstone for the pollination service industry, making the Central Valley the nexus of a complicated web of commercially-kept hives that are moved around the country throughout the spring and summer to crops that require or benefit from pollination services. It is fitting that a more robust education in honey bees and pollination be offered at UC Davis, whose role as

the land grant university of California makes it a vital resource for understanding the changing challenges facing honey bees and other pollinators.

The planning phase

Once I had gathered background information on what the course should entail, I began the process of planning the class itself. An initial challenge to implementing this project was finding it the proper home. I had initially conceived of this course as part of a larger apiary program run by and for the UC Davis Student Farm. In its early stages, the plan was to install several hives at the Student Farm that would provide pollination services for the farm in addition to offering a workshop space for students interested in participating in the course. This would be in conjunction with a dedicated student intern who would care for the bees year-round, thus ensuring both the health of the hive and the preservation of the project more generally. This intern would fit into the established network of interns that are integral to operations at the Student Farm, and would be supervised by a permanent staff member with extensive beekeeping experience. More generally, this curriculum would support the Student Farm's central mission to facilitate students' connection with and exploration of sustainable food systems.

Though there was initial enthusiasm for housing this project within the Student Farm, it soon became evident that there were a number of issues with this plan. One concern was ecological: it was problematic to consider introducing additional hives into an environment already saturated with honey bees, especially given the proposal that these hives would primarily be cared for by novice keepers. This concern was

heightened by the inevitable difficulty of ensuring the sustainability of a project comprised of students, who tend not to be able to offer long-term commitment because their tenure at the university is only temporary. There were also issues of risk and liability: because this project requires students to be in close proximity to stinging insects, there was understandably a degree of hesitation around the idea of exposing the organization, the participants, and others working at or near the Student Farm to unnecessary injury. Finally, there were significant financial barriers as well: though I was able to secure some materials through donation and identified a number of potential funding sources, the farm would have to start from scratch to establish a working apiary.

Because my initial conception of the course offered too many barriers, I began exploring options for partnering with more established organizations already operating on campus. The University offers a course in apiculture once a year (ENT 119: Apiculture), which at one time had included a small hands-on component but which has since been discontinued. I reached out to the faculty member behind this course to see if there was interest in establishing a beekeeping practicum as a sort of optional lab opportunity for students, but for liability and other reasons this faculty member was not interested. I instead connected with Dr. Elina L. Niño, a specialist in apiculture with cooperative extension working within the Department of Entomology and Nematology at UC Davis, who expressed interest in teaching the class and exploring the potential for developing a long-term course offering that would both educate individuals in the best practices associated with beekeeping, and allow for conversations about the caveats associated with introducing more beehives into an already precarious ecosystem. I also

reached out to Dr. Neal Williams, a pollinator ecologist and assistant professor within the Department of Entomology and Nematology, who was interested in helping establish this course in the hopes of producing a pool of knowledgeable and motivated students who could be recruited to work in the Williams Lab. Dr. Williams and Dr. Niño agreed to co-sponsor the class within the Department of Entomology.

The final challenge for establishing this course arose when I tried to get it registered in the university's course catalogue. Though I was able to work closely with Dr. Williams and with the Entomology Program Coordinator, I found it surprisingly difficult to list the course for both undergraduate and graduate students. Once the class was finally listed both for graduate students and for upper-division undergraduates, it was listed under the wrong name, causing no small confusion for students attempting to register for the course. Furthermore, though the undergraduate course was set up as Pass/No Pass as requested, the graduate course was irreversibly established as a letter-graded course for reasons that never became totally clear. It should perhaps come as no surprise that navigating university bureaucracy proved inscrutable; but the process made it abundantly clear that this system is not designed to invite or support student innovation or involvement in the development of new course offerings.

The practicum

Throughout my time moving through the challenges and opportunities outlined above, I also began drafting a syllabus for the course. It went through several iterations as the idea of the class itself evolved and as I learned more about what I believed to be

fundamental to understanding beekeeping and pollination services in California. Though the development of this project was drawn out, it put me in contact with a number of people whose insights helped me finalize the syllabus such that it offered structure for a strong final product. From the project's earliest stages, I worked closely with Student Farm Director Dr. Katharina Ullmann, who offered insights on how best to articulate the course objectives and student participation; she also helped me structure the course in such a way that it left space for guest lectures on native pollinators and other considerations often omitted from discussions about pollination services. When Dr. Niño joined the project, she was able to apply her considerable experience in teaching beginning beekeeping classes to the syllabus, helping me determine what was necessary and realistic for a ten-week course. Bee Biology Facility Manager Charley Nye also offered advice on the seasonal restrictions we would face with working with bees during fall and early winter. Thanks to their inputs, we were able to design a class that offered a combination of lectures and hands-on workshops, followed by a series of guest speakers. The syllabus can be found attached as Appendix I, and the proposed schedule can be seen below in Table 2.1.

	Table 2.1: Proposed Practicum Schedule	
Date	**Topic**	**Lecturer**
Week 1	Introduction to Beekeeping and Bee Biology	Elina L. Niño
Week 2	Basics of the Hive	Charley Nye
Week 3	Identification of Castes and Robbing Prevention	Charley Nye
Week 4	Pest Identification and Management	Charley Nye
Week 5	Feeding and Winterization	Charley Nye
Week 6	Hands-on Assessment and Honey Extraction	Elina L. Niño, Charley Nye, Julia Wentzel
Week 7	Africanized Bees and Beekeeping in Developing Countries	Charley Nye, Julia Wentzel
Week 8	Contemporary Challenges in Beekeeping	Elina L. Niño
Week 9	Native Pollinators and Honey Bees in the Farm Context	Neal Williams, Katharina Ullmann
Week 10	Round-Table Discussion	Julia Wentzel

In its final form, the course was set up as both an undergraduate class (ENT 198) and a graduate level class (ENT 295), and was listed as a two-unit course. The course was advertised first through my graduate program of International Agricultural Development, as many IAD students had expressed early interest. It was then advertised more broadly through the Student Farm. Because of the nature of the course, it was necessary to restrict the class sizes to no more than twelve total students, not including myself, so that everyone could work safely in the hives.

I structured the class such that the majority of student assessment would take place in a hands-on environment. The original syllabus called for five weeks of workshops in the beehives, followed by a practical assessment adapted from the

assessment used by the California Master Beekeeper Program. At the request of Dr. Niño, I also incorporated two other methods of assessment. The first was a comprehensive exam that was administered at the beginning of the first class as a formative assessment, and readministered at the end of the class as a cumulative assessment. This allowed us to track overall increase in knowledge. The second approach to assessment was via weekly quizzes, which served both to motivate students to study and retain information, and to track their successes in doing so. Students received their quiz grades quickly, which offered immediate and external feedback about their performance in the class. These assessments contributed to students' overall grades, as did attendance and participation. The syllabus also includes an assignment in which students were to form small groups and select an article related to the course content that they would share with the class in a round-table discussion; this assignment was cancelled when the campus was closed due to poor air quality from the Camp Fire wildfire.

The class met for two and a half hours once a week in the classroom facility at Bee Bio, which supported us moving directly from a lecture format to a hands-on format. The final schedule can be seen below in Table 2.2, while the complete syllabus can be found in Appendix I. The first six weeks of the course involved hour-long lectures focused on specific aspects of beekeeping, after which students donned the appropriate equipment and headed out into the apiary to learn about basic health checks in the hive, integrative pest management, honey extraction, winterization, and more. In many cases, students were able to break into small groups so that each student was able to spend

time working through the hives. The setting was necessarily informal, with students asking questions as they encountered them, and instruction was based around the real-time discovery of what we found in the hives. The students in this class were as a group incredibly enthusiastic and curious, asking questions at every opportunity and never hesitating to participate; this is perhaps an outcome of the somewhat self-selecting demographic of the student body, which is explored more thoroughly in Chapter III. Though the first few activities with live bees were a bit tense, by the end of this segment the students had all relaxed considerably, and demonstrated comfort and confidence around the bees. We had only one bee sting throughout the entire class!

	Table 2.2: Final Practicum Schedule	
Date	**Topic**	**Lecturer**
Week 1	Introduction to Beekeeping and Bee Biology	Elina L. Niño
Week 2	Basics of the Hive	Charley Nye
Week 3	Pest Identification and Management	Charley Nye
Week 4	California Beekeeping Calendar	Charley Nye
Week 5	Feeding, Winterization, Products of the Hive	Charley Nye
Week 6	Hands-on Assessment and Honey Extraction	Elina L. Niño, Charley Nye, Julia Wentzel
Week 7	*cancelled*	
Week 8	*cancelled*	
Week 9	Native Pollinators and Honey Bees in the Farm Context	Neal Williams, Katharina Ullmann
Week 10	Africanized Bees and Beekeeping in Developing Countries	Julia Wentzel

Once the weather got too cold for us to continue working with the bees, we changed our format to focus more on bringing in guest lecturers to offer other perspectives on beekeeping and pollination. These guest lecturers included Dr. Williams, who talked about a variety of other bee species being used for pollination; and Dr. Ullmann, who discussed how to measure available resources for native pollinators in a given landscape. I also gave a lecture that focused unpacking the mythology around Africanized bees, and then segued into a discussion on beekeeping in resource-poor environments; this was designed both for the International Agricultural Development students who might be considering apiculture extension for future projects, and for any students interested in low-budget backyard beekeeping.

Chapter III. Case Study: Outcomes

Objectives

The Practicum in Beekeeping was designed in response to the growing beekeeping industry and the increased fragility of both honey bee and native pollinator populations. The primary learning objectives for the course were outlined as follows: increased competence and confidence working with and caring for honey bees; development of a foundation in honey bee biology and pest management; increased familiarity with habitat and resource needs for honey bees and native pollinators; and an improved understanding of the increasing complications associated with apiculture in the context of agriculture, including the relationship between managed beekeeping and the future of crop pollination. Metrics were built into the course by way of various forms of assessment in order to determine student performance in meeting those objectives. Surveys were designed to capture somewhat more qualitative aspects of the course, like enjoyment and retention of information.

These methods of data collection were combined to inform this case study, the objective of which is to offer a concrete exploration of the efficacy of experiential learning in the education of undergraduate and graduate students of agriculture. The combination of different types of data compiled here, contextualized through more qualitative feedback channels, is intended to offer a layered explanation of the process of conducting the course. Though we wanted to design progressive forms of assessment for our participants, we were also interested in creating a variety of

methods for evaluation with the intention of examining how to improve the course in the future, both in the UC Davis context and beyond. Further, our aims were to collect data that would facilitate the creation of informed recommendations for other courses that also hope to approach learning experientially.

Methods for data collection

Students enrolled in the practicum were given a survey during Week Six of the quarter. This survey contained both a retrospective section devoted to students' experience with and understanding of bees and beekeeping before the class began, and a set of questions about their current levels of experience and understanding. This survey was offered in lieu of a weekly quiz, and students received credit for participating; this may explain why there was a 100% rate of response among students for the first survey. A second survey was sent out two months after the course was completed; this survey focused on retention and continued enthusiasm for course material. Participation was voluntary, and there was an 83.3% response rate. Results in the figures shown in this section are expressed as a percentage of respondents. Both surveys included opportunities for students to offer feedback on ways to improve or refine the course.

These surveys were developed in order to solicit both quantitative and qualitative responses from students participating in the practicum. My intention was to gather information on student background, including prior knowledge of and perspectives on bees and beekeeping, and to measure how their knowledge and perspectives changed

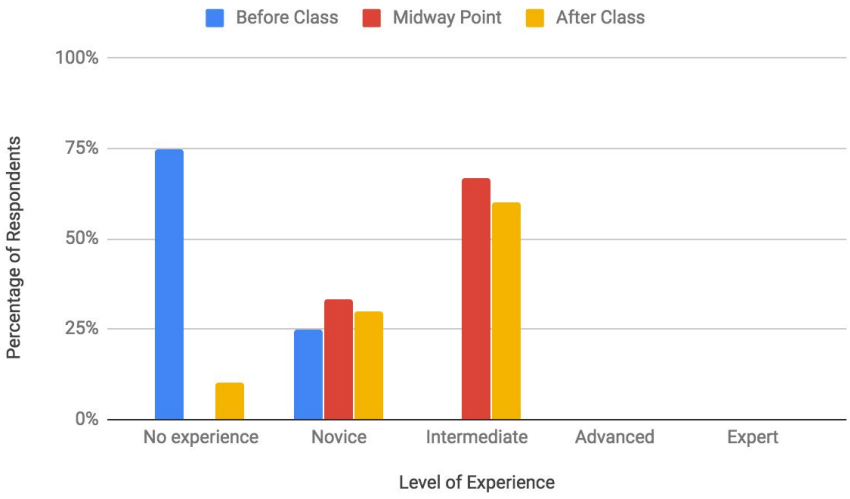
during and after participation in the class. Survey questions were designed not only to determine individual retention of information from the class itself, but to provide metrics for how the structure of the class impacted student learning. I also wanted to record the degree of enthusiasm students had for the course material, and their interest in sharing their new knowledge with others, as well as their understanding of course material in a broader agricultural context. These surveys were designed to complement the various graded assessments, explored below, in order to offer a more well-rounded snapshot of the relative success of the class as a teaching tool.

Students took a comprehensive written assessment on the first day of class. Though they were not graded on their performance, their scores were recorded in order to track their improvements over the course of the class. The assessment itself was available to them throughout the quarter as a resource. Students then took the same assessment again on the last day of the class, and their scores were recorded and went toward their final grade. Both individual and group performance on this assessment can be found below. Students also took weekly graded quizzes covering material discussed in the previous week; these scores were also counted toward their final grades. Finally, students were asked to participate in a hands-on assessment of their ability to move unassisted through an active hive; this assessment was based on tools developed for the California Master Beekeeper Program and was graded on a pass/fail rubric.
All materials discussed here can be found attached in Appendix II.

Survey data results

The following data demonstrate students' experience with and understanding of course content before, during, and after the class. Students indicated their level of experience with beekeeping at each of these stages; as seen in Figure 3.1, 75% of students had no experience and the other 25% considered themselves novices at the beginning of class; midway through the class all students selected either "novice" or "intermediate" levels of experience. With the exception of one outlier, students continued to categorize themselves as novice- or intermediate-level beekeepers after the class was over.

Figure 3.1: Percentage of respondents' experience with beekeeping while enrolled in beekeeping course assessed before, mid-way, and after class (n= 12).



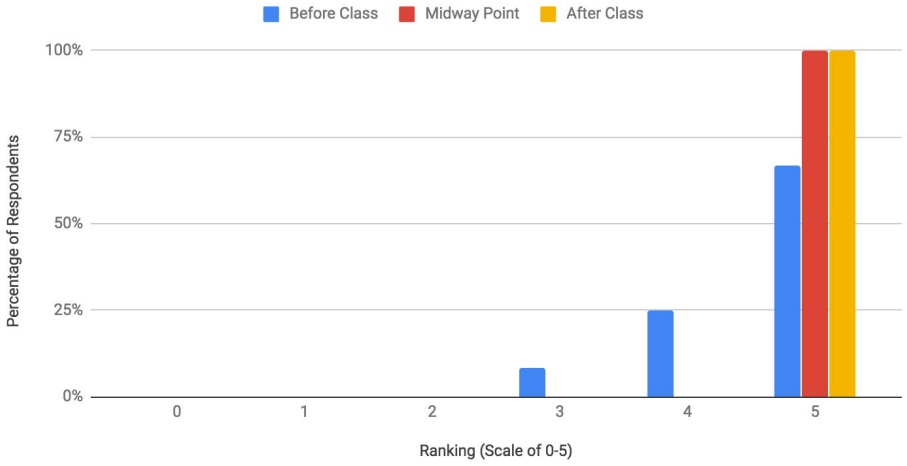
Interest level in bees and beekeeping among students shows a somewhat more nuanced trajectory. Though at the beginning of class students expressed a variety of levels of interest (Figure 3.2), with 25% of students selecting either mild or moderate interest and fewer than 50% selecting a strong interest, by the midway point 50% of

students said they had a strong interest in the subject. Two months after the class was completed, 50% of students maintained a moderate interest in bees and beekeeping, and the other half of respondents said they had a strong interest or passion.

Figure 3.2: Percentage of respondents' interest level in bees and beekeeping while enrolled in beekeeping course assessed before, mid-way, and after class (n=12).

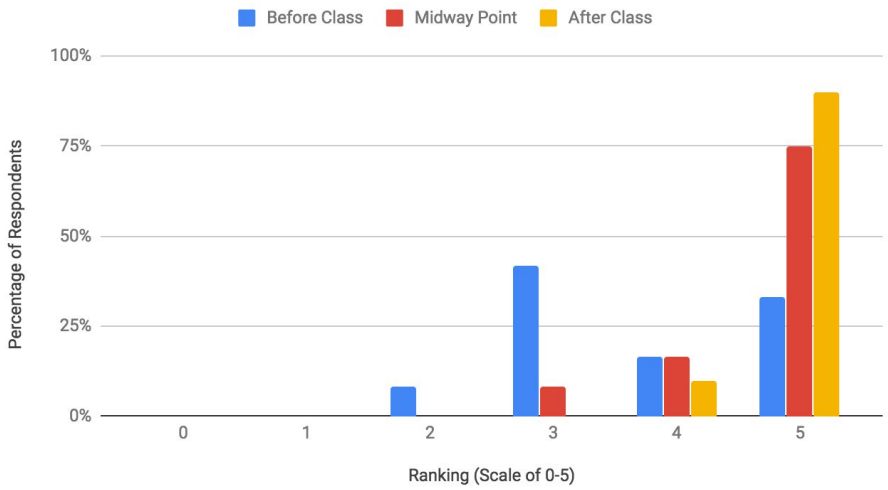
Beyond measuring the timeline of individual interest in course content, I was curious to see how students' understanding of honey bees and pollination services changed within the greater context of California agriculture. Figure 3.3 illustrates that at the beginning of the class, 25% of students considered beekeeping and pollination services a 4 out of 5 on a scale of importance, with another 8% selecting only a three. Both by the end of the class and after the class was completed, 100% of students ranked beekeeping and pollination services as a 5 out of 5 on a scale of importance to agriculture.

Figure 3.3: Percentage breakdown of respondents' ranking of importance of beekeeping and pollination services to agriculture while enrolled in beekeeping course assessed before, mid-way, and after class (n=12).



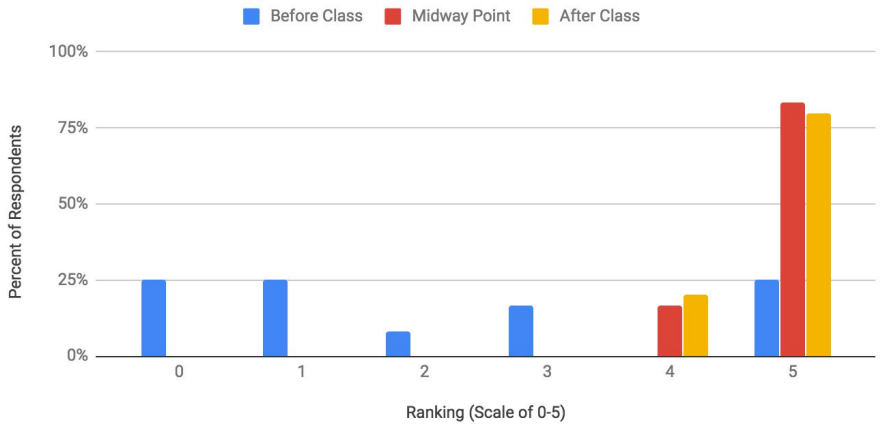
Both by the end of the class and after the class was completed, 100% of students ranked beekeeping and pollination services as a 5 out of 5 on a scale of importance to agriculture; initial rankings were much more widely dispersed. Also notable is the changing appreciation of how important beekeeping and pollination services are within the context of cooperative extension in California agriculture. Though at the beginning of the class only 33% of respondents ranked this importance a 5 out of 5 (Figure 3.4), at the midway point of the course some 75% of students ranked it a 5 out of 5. More interesting is that after the class ended, the percentage of respondents who consider pollination services a 5 out of 5 in importance to cooperative extension in California jumps to 90%. It's possible this number is influenced by the material covered in the latter part of the course; it could also be that student perspectives continued to change as they moved on from the class and considered their understandings of beekeeping and pollination services in other contexts.

Figure 3.4: Percentage breakdown of respondents' ranking of importance of beekeeping and pollination services to California cooperative extension while enrolled in beekeeping course assessed before, mid-way, and after class (n=12).



Because a personal metric of mine for the success of a class is how excited I feel as an individual to share my knowledge with my peers, I also asked students how likely they were to share knowledge with others about bees and beekeeping (Figure 3.5). I was gratified to see that while before the class began only 25% of participants chose “5: Most Likely,” more than 75% of students selected “5: Most Likely” both at the midway point and after the class was completed. Anecdotally, a number of students who participated in the course continue to share articles and ideas related to bees and pollination services via a group thread established during the class.

Figure 3.5: Percentage breakdown of respondents' likelihood of sharing knowledge of bees and beekeeping with others while enrolled in beekeeping course assessed before, mid-way, and after class (n=12).



Formative and cumulative assessments

Students were issued a formative assessment on the first day of class to measure the knowledge they possessed before the course began, and to inform students of the material we planned to cover over the quarter. The same assessment was administered again on the last day of the quarter. A blank copy of this assessment was made available to them throughout the course, which allowed students to refer to it as a resource as they moved through the course material. This offers a metric for improvements in comprehension and retention for students. No previous knowledge or experience was required for students to participate in the class; therefore it's not surprising that initial scores were quite low almost universally. Though this may have been a bit demoralizing for our students to be confronted by the amount of knowledge they lacked on the topic, it also motivated them to learn the material in question in order to perform better on the final assessment. Students' initial and final scores, expressed

as percentages, can be found in Figure 3.6 below; overall improvement between first and final assessment is shown in Figure 3.7, also expressed as percentages. Students have been assigned a number to protect their anonymity.

Figure 3.6: Percentage breakdown of student performance on assessment issued on first and final day of beekeeping course (n=12).

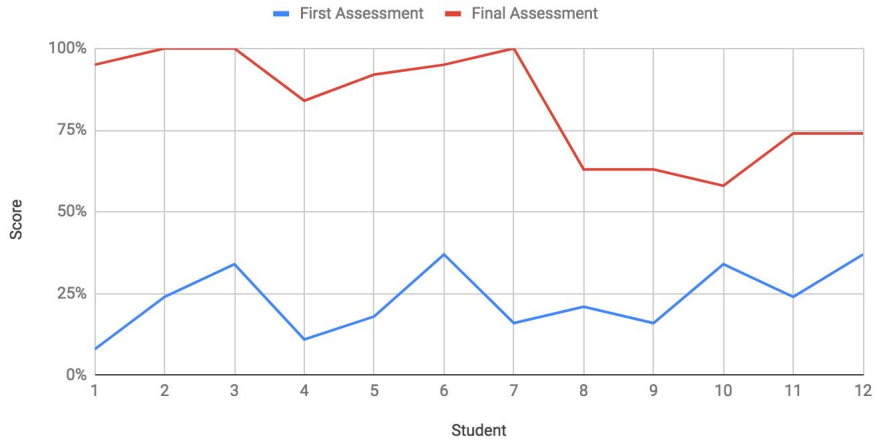
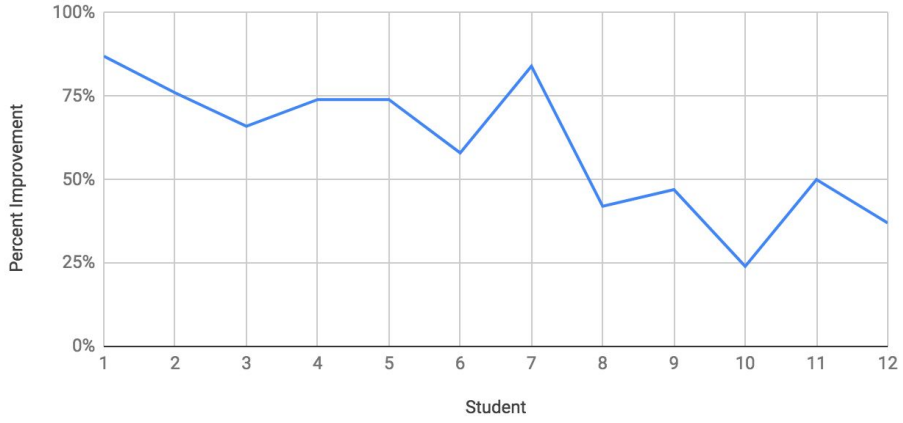


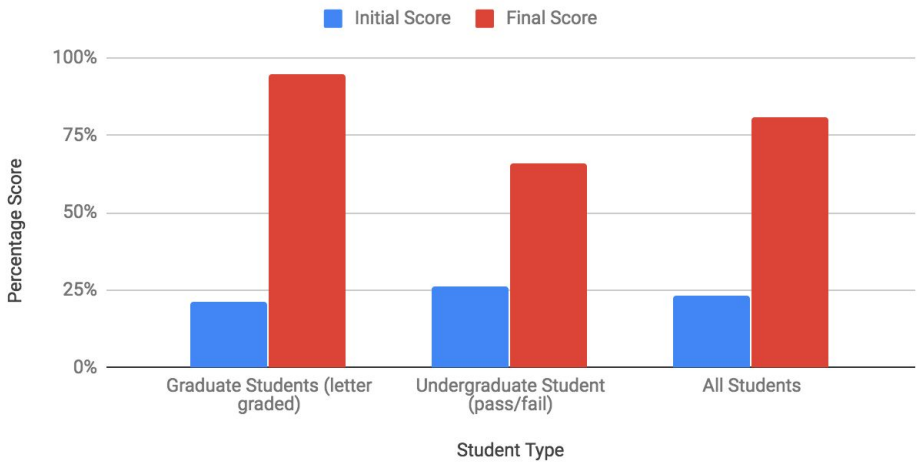
Figure 3.7: Percentage improvement by student on assessment issued on first and final day of beekeeping course (n=12).



The class was offered to a mix of graduate students and undergraduate students. In the figures above, Students 1-7 are graduate students, while Students 8-12 are undergrads. Figure 3.7 indicates that undergraduates improved somewhat less than

graduate students in general. This suggested that it might be interesting to view these data across student demographics. In Figure 3.8 below, average initial and final scores are shown for graduate students, undergraduate students, and as an average of all students. It shows that on average, graduate students scored somewhat lower than the class average on the formative assessment, while undergrads scored somewhat above average. However, graduate students scored substantially higher on their final assessments than the class average, while undergrads scored somewhat lower than average.

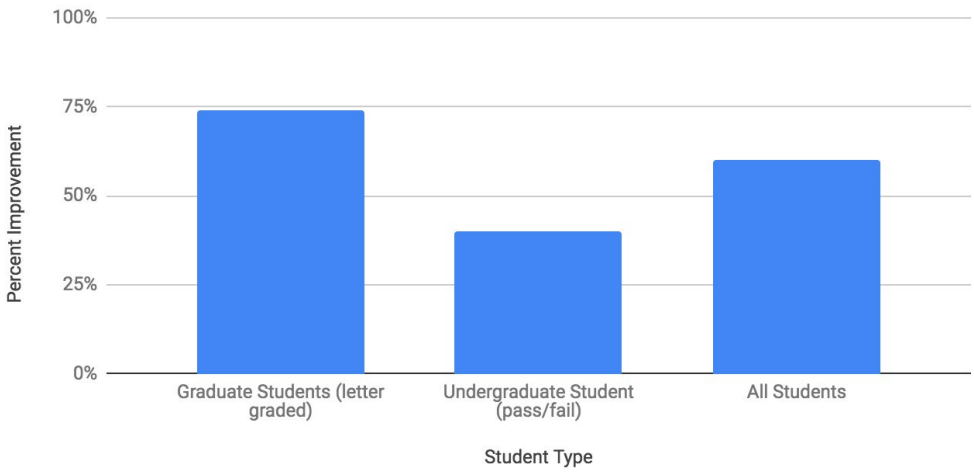
Figure 3.8: Initial and final scores across demographics on assessment issued on first and final day of beekeeping course (n=12).



Student improvement, expressed as a percentage, can be seen in Figure 3.9, below. This also shows that graduate students, on average, improved by almost 75%, while undergraduate students improved by less than 50%. This may indicate trends among older or more experienced students in taking initiative and ownership of their

education. However, it may simply be an outcome of a small sample size, or the somewhat self-selecting populations of students in question here.

Figure 3.9: Percentage breakdown of student improvement across demographics on assessment issued on first and final day of beekeeping course (n= 12).



In-person assessments

The hands-on assessments were intended to move away from the artificial constructs of traditional exams and instead encourage students to study the material they need to perform as successful beekeepers not just for the duration of the assessment but as they move forward with their careers. It was surprising, therefore, that the hands-on assessment still seemed to cause a substantial amount of anxiety among students as they prepared, perhaps because it is such an unfamiliar approach to assessment for most students. The hands-on assessment was based on a rubric used by the California Master Beekeeper Program to assess comfort in moving through the hive unassisted, identifying bee castes and hive products, determining overall health of the hive, and identifying what actions if any need to be taken to care for the hive; it can

be found in Appendix II. We determined to grade this assessment as a pass/fail exercise, and passed students who were able to accomplish these tasks while answering a series of questions about what they were encountering in the hive over the course of 20 to 30 minutes. Each student passed their assessment with varying degrees of success.

Discussion

By all available metrics, this class was a resounding success. Student feedback was almost universally positive, as was feedback from the course instructors. In each survey, students were given opportunities to provide qualitative responses about various aspects of the course. When asked what they liked most about the class, the majority mentioned the hands-on structure. As one student said, “the combination of learning in the classroom and with hands-on lessons was very effective for engagement and learning” (Midpoint Survey). Another appreciated that it “was the perfect balance of information and practical skill building. The facilitators created a low pressure and effective learning environment” (Midpoint Survey). Some particularly valued the experiential component: “I value the lectures to obtain the theoretical knowledge, but actually getting to experience what we talk about is so valuable” (Follow-up Survey). A number of students also commented on the quality and enthusiasm of the instructors and mentioned that it was central to their enjoyment of the class.

A particularly telling metric appeared in response to a prompt asking students whether they would take another class with a similar structure: some 90% of

respondents said they would. This strong positive response suggests that the participants in the practicum found that they thrived as learners within this particular class structure. We as educators were able to design experiences that motivated and excited our students while they learned; and the students were able to direct the scope of the class to some extent through their engaged participation, hands-on interactions, and thoughtful questions. Through informal channels, I have learned that a number of students who participated in the class during fall 2018 still regularly share articles and ideas about bees and beekeeping, and many have mentioned that they often find themselves sharing information they learned from the practicum with their friends and family. This suggests that the class succeeded in fortifying a profound curiosity about this subject matter in students, and that students are fundamentally more excited to learn when they are invested in the experience.

In response to the question of what they would change about the class, several students mentioned that they would prefer even more hands-on time in the hives; some students suggested that if the class were to meet twice a week it might be possible to accommodate this. Students offered a number of additional suggestions on what they thought could improve the class in future quarters: one student mentioned that more contact with both industry professionals and graduate students studying pollinators would add value to the course (Follow-up Survey). One student suggested including discussion groups as part of the class structure, and another called for study guides or structured homework assignments to help with comprehension and retention. Yet another suggested including information on the diversity of beekeeping practices across

different cultures, and also presented the idea of including volunteer opportunities within the structure of the class for students who wanted more practical experience (Follow-up Survey).

Students were also asked what they took away from the beekeeping practicum. Many mentioned that they now feel sufficiently confident and enthusiastic to start keeping their own bees. One student said they gained a “deeper knowledge of bees and confidence to share what I know with my community” (Midpoint Survey), and another concurred: “I feel like I can effectively educate others on the importance of bees, pollination, and pollinator habitats. Also, sharing cool facts about bees gets people excited to learn more” (Follow-up Survey). Students also commented on appreciating an increased understanding of beekeeping within the greater agricultural context. One student commented: “Besides the techniques and management ideas associated with keeping bees, I really enjoyed gaining more information and understanding about the challenges this industry faces and how to balance the practices you use to minimize your impact while also managing for as healthy bees as possible” (Follow-up Survey). One student went so far as to say they gained a “model for practical agriculture education” (Follow-up Survey).

Survey questions that examined students’ understanding of bees and beekeeping within a broader agricultural context presented interesting data. Before the class was offered, student participants ranked the importance of beekeeping and pollination as between a 3 and a 5 on a scale of 1-5; but by the end of the class and after the class was completed, 100% of students ranked beekeeping and pollination

services as a 5 out of 5 on a scale of importance to agriculture. This is interesting to consider given that the majority of students enrolled in the practicum are studying agriculture, plant sciences, or a related field. By some estimates, pollination services are required for the reproduction of more than two thirds of the world's crop species (Xerces), and yet it is rarely discussed as a critical component of plant science or agricultural coursework. A granular exploration of beekeeping clearly presented pollination services as a critical consideration in agricultural studies.

Also interesting to consider is the changing appreciation of how important beekeeping and pollination services are within the context of cooperative extension in California agriculture. Though at the beginning of the class only 33% of respondents ranked this importance a 5 out of 5 (Figure 3.4), at the midway point of the course some 75% of students ranked it a 5 out of 5. More interesting is that after the class ended, the percentage of respondents who consider pollination services a 5 out of 5 in importance to cooperative extension in California jumps to 90%. It's possible this number is influenced by the material covered in the latter part of the course; it could also be that student perspectives continued to change as they moved on from the class and considered their understandings of beekeeping and pollination services in other contexts.

Reflections

There are a number of outstanding variables that may have contributed to the relative ease of successfully offering this class. First and foremost, UC Davis is home to

California's apiculture extensionist, Dr. Niño, which meant I was able to connect with an experienced and able educator who was generous enough to take on this class. Not only did she and her staff provide strong leadership for this course, they were also able to house the class at the Bee Biology facility, which means that there were essentially no additional expenses required for the university to acquire the necessary equipment to set up an apiary, nor were there any fees that were passed on to students in order to purchase proper beekeeping equipment. Through its support of this class, the Bee Biology facility beautifully demonstrated a central mission of cooperative extension: to educate and support the broader community through applied research.

I was also able to receive a great deal of training during the time that I was putting together the curriculum for this course. Dr. Niño invited me to participate in two courses offered through apiculture extension, which allowed me to develop my foundational knowledge of backyard beekeeping and apply it to a California-specific context. I was also able to take the established UC Davis course in apiculture (ENT 119) for a broader understanding of bee biology, commercial beekeeping for conventional agriculture, and the specific health and environmental risks now facing both honey bees and other pollinators. Bee Biology facility manager Charley Nye let me apprentice with him for several months to learn more about how to manage large numbers of honey bee hives effectively. I collaborated with staff at the UC Student Farm, especially Head Gardener Julia Schreiber, and Davis community members for more hands-on experience capturing swarms and establishing and caring for hives. I was also able to draw upon my own history of working with Africanized bees in Peace

Corps Paraguay to put together a guest lecture both on the history and reality of Africanized bees, and on how to adjust beekeeping practices for the developing world or resource-poor context.

The broader UC Davis community also offers a number of other resources I was able to draw upon to fill out the quarter's curriculum. Dr. Neal Williams, a UC Davis professor in the Department of Entomology and Nematology, was able not only to co-sponsor the class, but to give a guest lecture on pollinators beyond the honey bee who are beginning to be used to provide pollination services in the conventional agricultural context in light of the decline of health and vigor in honey bee hives; he also talked more generally about bee biology and foraging behavior. The Williams Lab, in collaboration with the UC Davis Student Farm, is now conducting a study on native pollinator foraging across different mixes of native wildflowers; two students from the practicum are now participating in this study as interns. We were also joined by Dr. Katharina Ullmann, who received her Ph.D in Entomology and Nematology while working with Dr. Williams at UC Davis. She now works as Director of the UC Davis Student Farm, and was able to offer a guest lecture on conducting assessments on forage resources available to pollinators in an agricultural or urban context. Other facilities looking to replicate this course, or similarly structured UC Davis courses with different course content, may struggle to find such readily available and appropriate resources.

The participants in this class were also somewhat self-selecting toward a particularly successful group of students. The majority of participants were graduate

students, who could perhaps be assumed to be more experienced and independent and who might be more comfortable with being self-motivated in their academic endeavors. To the extent that this culture was created within the classroom, it may have affected the undergraduates participating as well; these undergraduates to their own credit also had to demonstrate strong interest and motivation to participate in the class, as there were only a few seats open to them. Finally, the majority of students who participated in the class had some connection to me, whether as friends and colleagues from within my graduate program or elsewhere; this may also have served to encourage students to participate fully. Though ultimately the motivations for these students' commitment to the course may remain speculative, it is clear that the class was comprised of interested and engaged individuals who took full advantage of this opportunity. It is quite possible that a more random sampling of students might not have been so internally motivated to make the class such a success.

Another constraint that contributed to the success of this course was the small class size. Given the size of the facility and the difficulty of overseeing a large number of novice beekeepers in an apiary, Dr. Niño limited the class size to twelve students, two instructors, and myself. Even with this low ratio of students to instructors, I received feedback that students would have liked more time in smaller groups; because we only had a few hours a week for hands-on work in the hives, students often felt rushed. In general, students were able to break into small groups of three or four and look through a hive together with an instructor on hand to direct them; but because the conditions of each hive are variable, it was sometimes difficult to be consistent in ensuring that each

student was able to observe everything. This became especially apparent during the hands-on assessment when students worked through a hive unassisted: both the student's previous experience working in the apiary and the hive selected for the assessment were somewhat variable in nature. It was for this reason that these assessments were graded on a pass/fail rubric.

Chapter IV: Recommendations

Introduction

Overall I was quite satisfied with the realization of the Practicum in Beekeeping, and believe it could successfully be offered again without adjustment. A testament to this fact is that Dr. Niño is planning to offer the class again next fall, and has already moved through the tedious initial stages of cataloging the course with the university registrar. That being said, there were certainly aspects of the class that we as facilitators learned from, and elements that could be changed in order to make the class a more successful and sustainable part of UC Davis course offerings. Furthermore, Dr. Niño is interested in establishing a guide of sorts to support other institutions in offering their own version of this course; close consideration of how to improve the existing class will not only help to improve the course within the UC Davis context but will help us to prepare our recommendations for other institutions as well.

Recommendations for UC Davis Practicum in Beekeeping

An initial difficulty we encountered in establishing this course was determining where it should meet. The Bee Biology facility was the obvious choice for the weeks in which we would be working in the apiary: the equipment, the hives, and the bees themselves are located at the facility, which all but required us to hold our hands-on sessions there. However, it was difficult to commit solely to this facility for the entirety of the course: though the Bee Biology facility has a classroom space, it is not listed among

official classrooms that can be reserved for coursework, and in fact is located several miles from the main campus of UC Davis, a school where most students commute by bicycle and often have to make those commutes within ten-minute passing periods. Though we elected to hold our lecture-based classes in the Entomology building in order to mitigate these obstacles, we ended up holding almost all of our classes at the Bee Biology facility. In future quarters, I would suggest that the entire class be offered at Bee Biology, though for logistical reasons it may need to be scheduled in an official UC Davis classroom. Flyers and announcements advertising the class should advise students that they should factor in an above-average commute time to attend the class, and should be encouraged to set up carpools.

Another difficulty we encountered was how to list the class in order to encourage the student body we most hoped to attract. Our initial concept was to establish the course specifically for graduate students, guided by an assumption that more experienced students would be more likely to be self-motivated and adaptable to a fledgling class. This led us to establish the Entomology 295 Graduate Group Study course. However, Dr. Niño had expressed interest in reaching a few undergraduates as well, in the hopes that they might be recruited and prepared to later go on to work in her lab. With this in mind we added an Entomology 198 Group Study as well. Though I think we succeeded in creating a nice mix of age and experience levels among participants, it might be easier in the future to simply list the class as Entomology 198, and advertise it across channels that reach graduate students in order to encourage them to register for it. Graduate students often take upper division undergraduate courses, and those who

are interested in the subject matter should have no issue registering for an undergraduate class. It would also help clarify the exact number of students in the class and streamline communications: rather than having to manage two online modules through Canvas, the cloud-based learning management system that is used across UC Davis, future organizers of the class would only have to work with one. A more nuanced solution to this problem would be to enroll all students in the undergraduate course, but offer an additional credit as a directed, graduate-level study which would require an additional component for graduate student participants.

We may also want to slightly reimagine how we approach the first class session. Because no experience in beekeeping is required for students to enroll in the course, there is necessarily a substantial amount of information to cover on the first day in order to prepare students for working in the hives during later class sessions. This resulted in a 150 minute lecture covering all the basics of bee biology and foundational knowledge about honey bees. It could serve students more fully if we could find a way to break this lecture up a bit, perhaps doing one half of the lecture during the first session, along with some preliminary time in the apiary; the remainder of the lecture could be moved to the second week, with additional time spent in the apiary. A few student responses to the surveys suggested that the class should meet twice a week for two hours rather than once a week for three; this could allow either an hour lecture/hour workshop format twice a week, or a more traditional approach of one lecture session and one “lab” session a week. Experimenting with this structure could also help make more time for other topics and activities, as we did always have a bit more to cover than time allowed.

It would also address another common response received by means of the surveys: a number of students requested even more time for hands-on experience in the hives.

Another possibility for navigating the tension between providing a strong foundation and offering more time for hands-on work in the apiary would be to require the existing Entomology 119 Apiculture course as a prerequisite for students hoping to enroll in the Practicum in Beekeeping. Though I originally explored the idea of offering the practicum as a sort of alternative approach to a laboratory component to the existing apiculture course, it quickly became clear that the faculty behind the course was uninterested in assuming the liability that comes with hands-on work in honey bee hives. If, however, students were asked to take the apiculture course prior to taking the practicum, they would have the foundational knowledge in bee biology and behavior to allow us to move them more quickly into the apiary, freeing up more time for the parts of the course that student feedback indicates was the most engaging. This approach would require greater student awareness of both courses, as Entomology 119 is offered each spring quarter and the practicum will be offered every fall quarter. Students who have not taken the apiculture course but who can demonstrate equivalent knowledge or experience could also be considered for the practicum. We did make an effort to offer some foundational information to students through Canvas before the class began, and a few students reported that they found this helpful. This approach could be fortified by way of additional online resources, which might even include an initial video lecture or similar tool.

Our approach to assessment seems to have been generally successful, but there may be some adjustments to be made that would facilitate student enjoyment and involvement in the class. As discussed above, the first class session includes quite a lot to learn; this was exacerbated by administering an assessment to students who had no prior knowledge and therefore, quite understandably, did poorly. This was not great for morale, though I believe our explanations of the purpose of this formative assessment did help mitigate this. Because students are conditioned to feel that their merit is judged on their performance on such assessments, more care could perhaps be taken to explain the purpose of offering this formative assessment at the beginning of the course, establishing more trust with students and putting them more at ease. We may also want to update the rubric used to grade students on their hands-on assessment conducted halfway through the quarter. We relied on a resource used for students of the California Master Beekeeper Program; though this served our purposes, it might be useful to pare this rubric down somewhat to be more suitable for beginner beekeepers. Having fewer variables would also support more consistency in grading, given that a number of individuals conduct the assessment. This could also help us move through the assessment more quickly, as timing did become an issue.

It may also be necessary to rework one or two of the guest lectures offered during the final weeks of the class. An initial concern expressed by everyone I reached out to was their uncertainty around whether they could commit to participating in the course on an annual basis, which means it may be necessary at times to enlist a rotating cast of guest lecturers. The subject area covered by guest lecturers may also

require some adjustment: in the Fall 2018 class, we had a number of students from the International Agricultural Development graduate group, and to suit their needs I provided a guest lecture on how to adapt best practices in beekeeping to low-resource environments, cost-efficient alternatives in equipment, and collecting hive products for cottage industry-scale production. Depending on the demographics of future classes, this particular lecture may not be as relevant. Though there are a limited number of faculty who might be appropriate to call upon for guest lectures, one survey responder suggested reaching out to graduate students doing research in entomology, ecology, or sustainable agriculture; this could offer a solution to keeping the class well-rounded and current without exhausting the faculty who were willing to support the early stages of this project.

We were unable to follow through with the Round-Table Discussion assignment included in the original syllabus due to campus closures during the Camp Fire. Because it was included in the initial curriculum, however, students expected to participate in this assignment and were given background information on how to complete the assignment. We asked students to break into small groups and select an article of interest that contributed to the content of our course, and then prepare a brief presentation of that article to the rest of the class on the last day of the quarter. Students had begun to send in their articles for approval at the time of campus closure. Under less unusual circumstances and allowing the full ten weeks of coursework, this assignment should be a strong addition to the curriculum and could even generate potential topics for guest lectures in future offerings of the class.

Recommendations for a Practicum in Beekeeping at other institutions

There is great potential for faculty and staff at other schools and universities in the area to offer courses in beekeeping as well. Certainly California's Central Valley context, as explored in Chapter II, is just as relevant for our neighboring institutions as it is for UC Davis. Schools in and around the Central Valley, especially those with agricultural programs, have a responsibility to help their students explore the realities of the pollination service industry as a corollary to the larger questions around the sustainability of our current conventional agricultural systems. Neighboring institutions, however, do not have the advantage of housing the Bee Biology facility, whose educators, resources, apiary, and equipment were central to the success of our Practicum in Beekeeping. In many cases, other institutions will entirely lack the infrastructure necessary to offer a class like this, and will have to commit to a great deal of preliminary work before the class becomes a real possibility.

A vital component of the success of the class was the expertise of Dr. Niño and her staff. Institutions interested in offering courses in beekeeping will need one or more individuals who are interested in undergoing a substantial amount of basic training in order to possess the foundational knowledge required to educate others. Ideally, someone with at least some experience in beekeeping could be identified to fill this role, as comfort and familiarity working with stinging insects is central to the success of this project and is a skill that requires a degree of prolonged exposure. Training programs for these educators will be a vital part of course development to ensure that accurate

subsequent courses offer accurate information and are conducted safely. There are a number of beginner and intermediate beekeeping classes that are currently offered through the Bee Biology facility that might serve this function, complemented by a number of small businesses and organizations that offer classes designed to teach individuals to become backyard beekeepers. It would be worth exploring the capacity of UC Davis' apiculture extension to determine how they could best support the education of potential future educators in beekeeping.

As with any new endeavor, funding will be a central challenge in establishing a Practicum in Beekeeping. Because our class was able to use the apiary and equipment already utilized by the Bee Biology facility, we found ourselves in the rare position of having almost no financial challenges or startup costs; this is unlikely to be the case for most institutions. A new beehive can cost several hundred dollars to purchase and set up, and it would be wise to invest in at least two hives given the likelihood of something befalling one of the hives. Protective equipment, safety gear, hive tools, and pest management strategies will constitute additional necessary investments. Though most of this equipment will last for quite some time, thus removing most of the costs associated with the class for subsequent years, it will require a significant initial investment; my preliminary budget proposal required about $2000 for a class of fifteen participants, and did not include transportation, leasing a location, or other potential external costs. There are also more subtle costs associated with time and commitment on the part of the staff: though the beehives may only be used for coursework for a few months of the year, they will require care and supervision throughout the year.

Considerations of liability and risk assessment will also be central to establishing coursework in beekeeping. Though this is true with any new material, it is of course particularly central to a class that requires frequent exposure of both participants and the broader community to a population of bees. In a litigious society in which universities have varying approaches to supporting faculty and students embroiled in liability issues, it should not be surprising that individuals and groups may be hesitant to sign on for a program that brings with it a small but inherent risk. It will be important for institutions hoping to introduce this course to scout out appropriately remote locations for an apiary to minimize broader risk to the community; to screen students for known allergies to bees; and to understand policy around first aid and emergency response, including what training is required in order to administer EpiPens® in the event of an allergic reaction. A demonstrated knowledge of how to safely use smokers during the dry season will also be significant.

The broadest challenge that may face those hoping to introduce the Practicum in Beekeeping to their schools may be institutional buy-in. If there is no precedent for courses with this kind of content, it may be necessary to find ways to demonstrate the value of this subject. This challenge may be mitigated somewhat by the relative charisma of honey bees, and the frequency with which Colony Collapse Disorder appears in the news; though it is perhaps not the best time for honey bees, we are at a uniquely opportune moment to promote education around bees and the future of pollination services. More entrenched, in many cases, is an institutional understanding of what a class curriculum should look like: some schools may resist a class structure

that is so hands-on and relies so much on student agency and enthusiasm. It may be necessary to identify alternative paths to the establishment of the course, like those explored below in the recommendations for the future of the practicum at UC Davis; if, for example, the course is first introduced as a First-Year Seminar or equivalent, this may serve to demonstrate the value and popularity of the course, paving the way for a more sustainable class structure for the future.

Recommendations for other UC Davis courses

The first step in creating a new course at UC Davis is, of course, to come up with a good idea. My inspiration for creating the Practicum in Beekeeping came out of conversations with permanent staff at the UC Davis Student Farm, and evolved through discussions with faculty in the Department of Entomology and Nematology and with staff at the Bee Biology Facility. Regardless of course content or structure, anyone hoping to design and implement a new class at UC Davis will need faculty and staff support. The idea for my course went through a number of iterations, as explored in Chapter II, and this evolution was only made possible because I was able to work through the curriculum with a number of experts who gave me invaluable insights into how to make the course feasible and functional. It also helped me become more fully familiar with the course offerings currently available at UC Davis, which allowed me to find and fill a niche for my own curriculum.

As discussed in Chapter II, one of the most fundamental challenges in setting up the Practicum in Beekeeping was navigating the bureaucracy of the university itself. I'm

not confident that this process gets easier with experience, but at least it gets more familiar; this makes it incredibly beneficial to work with faculty and program advisors who are familiar with the process and can support course designers through the process. An added complication for the Practicum in Beekeeping was the double-listing of the course as both an undergraduate- and graduate-level class; avoiding this would at least somewhat streamline the process. Creating a Group Study 198 offers a relatively easy route toward establishing a course: this structure allows for student-led, faculty-mentored coursework with variable units in the upper division. Another option, depending on course content and design, would be to create a First-Year Seminar. Though first-year students have the first opportunity to register for these seminars, they are in fact open to all students. They are automatically limited to 19 students, which allows for a flexible and interactive course structure. An important advantage to the First-Year Seminar option is that it comes with its own funding: each two-unit seminar has a budget of $3000, and additional grants for which faculty can apply. Regardless of the structure the course designer selects, they should be prepared to be dogged in their pursuit of getting the course listed and available for enrollment.

A faculty sponsor will be required regardless of approach, though their level of involvement may vary depending on the course and the individual. An important element of finding the appropriate faculty sponsor is to figure out how to demonstrate the course's worth for that individual: UC Davis faculty are notoriously busy, in my experience, and are unlikely to make time for a course that they do not see the merit in. Having a good idea for a class that would be appealing to a large number of students is

a strong foundation, but it is in the course designer's best interest to illustrate the ways in which the course also serves the faculty member's career. In the case of the Practicum in Beekeeping, the course offered immediate value to Dr. Niño and Dr. Williams because it offered the potential to intrigue and even train potential interns or student assistants for their respective labs. In addition, it offered the longer-term value of providing a new vehicle, both at UC Davis and potentially at other institutions, for disseminating information about their areas of research.

Anyone hoping to design a course to be offered at UC Davis will need to be realistic about the time commitment required to make it happen. As a graduate student, I was able to take research credits in order to designate time for the creation of the Practicum in Beekeeping curriculum, which made it possible for me to incorporate this process into my workload. Undergraduates and other students may not have access to this option. A possible workaround would be to identify a faculty member who has already taught a similar class or who is independently motivated to create or revise their own curriculum, but this in and of itself can be quite time-consuming, and depending on the course and the faculty may ultimately prove to be unrealistic. It may also be possible to identify courses offered at other institutions that would satisfy the needs or interests of the course designer; those institutions' willingness to share their course documents would likely be quite variable.

It is also important to remember that there is a wide variety in approaches to providing experiential learning opportunities, and that in some cases the classroom may not provide the right setting. To provide the Practicum in Beekeeping, I was able to rely

on educators and resources from UC Davis's apiculture extension, working with enthusiastic and qualified partners to reimagine curricula taught for the general public in such a way that it would be appropriate for undergraduate and graduate students. For other course content, this particular model may not be a good fit. Course designers could instead seek out other structures that would also provide experiential opportunities: a wide variety of internships on campus offer a hands-on approach to education, and could be used either as models or as vehicles for new offerings. For example, the Student Farm currently offers a variety of styles of internship across several distinct programs; the farm's structure allows for committed interns to eventually develop into self-guided learners with opportunities to pursue the topics that interest them. Another pathway toward providing experiential learning opportunities is the Center for Community and Citizen Science, which works from the School of Education to support collaborations between institutional scientists and the broader community that promote an engaged and democratic approach to science.

It is also interesting to consider the role of cooperative extension in the pursuit of alternative paths to providing experiential education opportunities for students of agriculture at a land grant institution. As discussed in Chapter I, the central mission of land grant universities is to provide education to the broader community; the individuals working as educators in extension therefore tend to be uniquely experienced in teaching in applied settings. At most land grant universities, cooperative extensionists serve a certain percentage of their time teaching students of those universities, providing potential for more experiential or innovative approaches to education. The University of

California, however, is structured such that extensionists do not teach within the school; this serves to isolate the extension efforts of the institution from the faculty and student body. Though it is difficult to imagine that structural changes to the university will occur in the near future, individual extensionists like Dr. Niño may be willing to take on coursework that they recognize as having value to their work, to student participants, and to the broader community.

Conclusions

I embarked on this project because I was interested in examining alternative approaches to teaching and learning in higher education. My hope was that through the development and implementation of the Practicum in Beekeeping, I would find an avenue for incorporating my own values for education into a course appropriate for the university while demonstrating to my fellow students the potential of experiential learning to deeply engage participants in the process of their own education. I feel that on these fronts, I was successful. The students who were able to take part in this class seem to have enjoyed and benefited from the class immensely, and as a whole seem interested in pursuing future opportunities for experiential learning. Though I was at first apprehensive that the course would not live up to my expectations of it, I found that I was quite gratified with the overall success of the class: I believe we succeeded in putting together a class that was inspiring, informative, and fun to be a part of.

Much of the motivation for this course came out of a sense of disappointment I have experienced in the classroom as I have pursued my Masters degree. After

spending a decade outside of the realm of academia, I found it very difficult to transition back into the university setting. I felt I brought with me to the classroom a natural curiosity, a passion for learning, and a strong identity as a lifelong learner, but that I left the classroom feeling deflated, undersupported, and exhausted from the process of engaging with often mindless requirements. A world-renowned institution of higher education should be able to provide to its students more than just the coursework required to fulfill a degree; it should also offer them the tools they need to continue to learn and engage as they move beyond the university. As access to information becomes more universal, I believe that universities have an increasing obligation to use whatever means possible to foster the development of critical thinkers, lifelong learners, and capable educators. This will require incorporating a more diverse approach to education. Though creating changes in an entrenched approach to education is challenging, it is also an exciting opportunity to make higher education valuable and relevant in a changing world.

My hope is that this course can serve as a modest example of the progressive approaches to education that have become the responsibility of the university to provide to its students. I believe it offers a point of entry into a complex conversation about how and why we educate, and how to approach and incorporate experiential learning in the context of higher education. I am optimistic that it will offer some guidance for students hoping to design their own practical or applied coursework at UC Davis. It may also help to inform other institutions hoping to introduce similar classes into their own curricula on how best to approach coursework in bees and beekeeping. Most fundamentally, this

experience allowed me to engage more deeply with questions about how we learn, how we teach, and what we are able to do to improve our approaches to education within the university setting. I look forward to carrying those lessons with me as I move forward into a career in agricultural education.

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Appendix I: Course Syllabus

Beekeeping Group Study
ENT 198 and ENT 295
Fall Quarter 2018

Course Overview
As a response to both the growing beekeeping industry and the increased fragility of both honeybee and native pollinator populations, a small group of interested students and staff have developed a curriculum for an independent study course that will be offered during Fall Quarter 2018. The course will consist of six hands-on learning opportunities and assessments in which students will work directly with honey bee hives on seasonally relevant tasks. These sessions will be followed by a short series of guest lectures, which will rely on scholars from the Honey Bee Research Facility, Williams Lab, Student Farm, and other locally available resources.

Primary Learning Objectives
In this course, we hope for students to develop the following:

- Competence and confidence working with and caring for honey bees
- A foundation in honey bee biology and pest management
- Familiarity with habitat and resource needs for honey bees and native pollinators
- A deeper understanding of the increasing complications associated with apiculture in the context of agriculture, including the relationship between managed beekeeping and the future of crop pollination.

Assignments, Assessments, and Grading
This course will be offered as pass/no pass. Students will be expected to attend every week, and to keep up with any required readings. Supplemental readings and materials will be offered for students seeking further information.

Each week will begin with a short quiz. This will be an opportunity for students to demonstrate retention of material covered the previous week.

The final assessment will be hands-on: students will be required to move through a hive independently, to successfully identify bee castes, hive products, and to communicate and conduct all necessary safety measures.

Attendance and Participation: 40%
Quizzes: 10%
Assignments: 25%
Final Assessment: 25%

UC Davis now requires that all students acknowledge the Code of Academic Conduct, which can be accessed at http://sja.ucdavis.edu/files/cac.pdf.

October 2: Introduction to Beekeeping, Basic Bee Biology
Lecture: Elina L. Niño
Location: Briggs Hall 158

- Discussion of expectations and desired objectives for the course
- Brief history of beekeeping
- Life stages and castes
- Colony life cycle
- Bee behavior
- Introduction of safety protocols while working in a hive

October 9: Basics of the Hive
Workshop: Charley Nye
Location: Harry H. Laidlaw Jr. Honey Bee Research Facility

- Personal safety
- Environment for the hive
- Approaching the hive
- Opening hive
- Moving through the hive
- Compare Langstroth and top bar
- Closing the hive
- Cleanup

October 16: Identification of Castes and Products/Preventing Robbing
Workshop: Elina L. Niño
Location: Harry H. Laidlaw Jr. Honey Bee Research Facility

- Review of basics
- Review castes, brood, products
- Opening and moving through the hive
- Fill out checklist for what we see in the hive
- Entrance reduction: how and why
- Discussion of what findings indicate for hive health

October 23: Pest Identification and Management
Workshop: Charley Nye
Location: Harry H. Laidlaw Jr. Honey Bee Research Facility

- Review status of hive from last session
- Review ways to identify common pest problems
- Look for common pest problems

- Perform varroa sugar shake/alcohol tests

October 30: Feeding and other Winterization
Workshop: Charley Nye
Location: Harry H. Laidlaw Jr. Honey Bee Research Facility

- Review status of hive from last session
- Discuss when and why supplemental feeding can be necessary
- Discuss different feeders and feeding methods
- Install frame feeders and pollen patties

November 6: Hands-on Assessment and Honey Extraction
Workshop: Elina L. Niño, Charley Nye, Julia Wentzel
Location: Harry H. Laidlaw Jr. Honey Bee Research Facility

- Each individual will be asked to move through a hive with limited assistance
- Honey extraction demonstration

November 13: Beekeeping in Developing Countries
Lecture: Julia Wentzel

- **Cancelled: may be made up as an optional discussion during finals week**

November 20: Contemporary Challenges in Beekeeping
Lecture: Elina L. Niño

- **Cancelled: will be made up on December 7**

November 27: Native Pollinators and Honeybees in the Farm Context
Lecture: Neal Williams, Katharina Ullmann
Location: Briggs Hall 158

- Brief introduction to native bees
- Other bees that can be managed
- Threats and opportunities for native bees, especially in native landscapes

December 7: Contemporary Challenges in Beekeeping
Lecture: Elina L. Niño
Location: Briggs Hall 158

- Commercial beekeeping
- Initiatives with growers
- Issues in commercial beekeeping and urban beekeeping

Appendix II: Assessments

Formative and Final Assessment
ENT 295/198

1. What is the social structure in honey bees called
    a. Semi-Social
    b. Full-Social
    c. Eusocial
    d. Bee-Social

2. Drones' main purpose is _____

3. This caste has the ability to lay eggs in the colony
    a. Worker
    b. Queen
    c. Drone
    d. Larva

4. Propolis is a substance from _____ that foragers collect and is also called _____

5. _____ is a sex determination system in which males develop from unfertilized eggs and are haploid, and females develop from fertilized eggs and are diploid.

6. Drones take _____ days to develop from egg to adult.

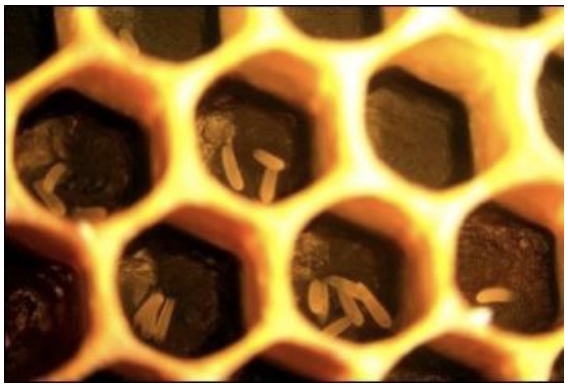
7. When a queen starts intermixing drone brood and worker brood it often means she is
    a. Getting ready to swarm
    b. Running out of sperm

8. A queen will die if she stings you
    a. True
    b. False

9. List four tasks house bees perform: _____
_____

10. _____ is used as the protein source for the hive and _____ is used as the carbohydrate source.

11. These eggs
    a. Will develop into queens
    b. Are laid by workers
    c. Are from a healthy colony
    d. Will develop into workers
    e. Will develop into drones



12. A good apiary site has the following attributes:
    a. Access to water
    b. Windbreak
    c. Heavy drainage into the site
    d. No shade

13. What are the four main components of a honey bee hive _____
    _____

14. _____ hives are the most common type in the US.

15. List at least two physical characteristics of healthy larvae _____

16. This disease is characterized by larval meltdown:
    a. American Foulbrood
    b. Nosema
    c. European Foulbrood
    d. Sacbrood

17. Name three reliable methods for monitoring varroa mite levels
    _____
    _____

18. Corbicula is used for _____

19. Identify this pest:

Beekeeping Practicum
Week 2 Quiz

1. A drone's main purpose is_____.

2. Name the three castes or kinds of honey bees found in a colony:
    1. _____
    2. _____
    3. _____

3. Can worker bees lay eggs?

4. Name three things that foragers collect:
    1.
    2.
    3.

5. What sense do honey bees rely on most to communicate?

6. What is propolis?

7. What is the most significant California crop for the beekeeping industry?

8. What caste of bee emerges out of a cell shaped like a peanut?

9. Name three products we can get from a beehive:
    1. _____
    2. _____
    3. _____

10. Name three things house bees do:
    1. _____
    2. _____
    3. _____

Practicum in Beekeeping
Week 3 Quiz

1. What is bee space and why does it matter?

2. Name two advantages of Langstroth hives
    1.
    2.

3. Can you have an allergic reaction to your first ever bee sting? Why?

4. What is a queen excluder and where is it found in the hive?

5. What pests can be prevented with an entrance reducer?

6. Where in the hive do we expect to find the queen?

7. What are the upper levels of a Langstroth hive called?

8. What is yellow material stored in the cells? Why is it often stored near the brood?

9. How do we know this honey is ready to eat?

10. Why do we smoke the hives we work in?

Beekeeping Practicum
Week 5 Quiz

1. Name two things we do as California beekeepers in February:

2. How late in the year can you safely split hives?

3. Name two ways to prevent swarms:

4. At what time(s) of year is robbing a particularly big problem?

5. What does a good laying pattern look like?

6. Name two things we can do to support beehives in the winter in California:

7. What's being stored here and why does it look so cool?

8. Name three things that help us spot the queen:

9. What are our first steps as we approach and begin to work through a hive?

10. List at least four things that we look for when we do a safety check of the hive:

Practicum in Beekeeping
Week 9 Quiz

1. Are the majority of bee species social or solitary?

2. Name three different nesting sites or materials used by bees:

3. Why is learning about native bee nesting habitat and behavior important for us in an agricultural context?

4. What bees are kept commercially to provide buzz pollination?

5. In general, what is the relationship between bee size and bee flight lengths?

6. Name three risks that agriculture poses to native bees:

7. Explain the nesting behavior of cleptoparasitic bees:

8. Why is it advantageous to farmers to support native bees for pollination services?

9. Why don't honey bees like to pollinate alfalfa?

10. Name two ways we can support native bee populations:

EXTRA CREDIT: What is required for honey to be considered "natural" or "pure"?

Practical Exam

CAMBP Practical Exam 2017

Name

Skills

☐ **Ignited Smoker (5pt)** ☐ **Smoker Remained Lit (5pt)**

Comments and Deductions:

☐ **Approach and Open Hive (5pt)** ☐ **Hive Inspection (15pt)**

Comments and Deductions:

☐ **Bee marking (10pt)** ☐ **Queen Installation (10pt)**

Comments and Deductions:

☐ **Sugar Shake (15pt)**

Comments and Deductions:

☐ **Combine Colonies (5pt)** ☐ **Splitting Colonies (5pt)**

Comments and Deductions:

Identify

☐ **Worker (2pt)**
☐ **Drone (2pt)**
☐ **Queen (3pt)**

☐ **Nectar (1pt)**
☐ **Pollen (1pt)**
☐ **Honey (1pt)**

☐ **Open Brood (1pt)**
☐ **Capped Brood (1pt)**
☐ **Eggs (3pt)**

☐ **Deep Super (1pt)**
☐ **Medium Super(1pt)**
☐ **Uncapping Fork (1pt)**
☐ **Comb Super (1pt)**
☐ **Bee Brush (1pt)**

☐ **Warre Hive (1pt)**
☐ **KTB Hive (1pt)**

☐ **TBD (1pt)**
☐ **TBD (1pt)**
☐ **TBD (1pt)**

Written Score

Practical Score

Examiner

Midpoint Survey

ENT 198/295 Survey

Feedback from student participants on ENT 198/295 Practicum in Beekeeping course during Week 6 of Fall Quarter 2018.

1. **Email address** *

Please answer the following questions based on your knowledge and experience before the quarter started:

2. **What was your level of experience with beekeeping?**
Mark only one oval.

- ◯ No experience
- ◯ Novice
- ◯ Intermediate
- ◯ Advanced
- ◯ Expert

3. **What was your comfort level around bees?**
Mark only one oval.

- ◯ Totally uncomfortable
- ◯ Somewhat uncomfortable
- ◯ Neutral
- ◯ Somewhat comfortable
- ◯ Totally comfortable

4. **What was your interest level in bees and beekeeping?**
Mark only one oval.

- ◯ No interest
- ◯ Mild interest
- ◯ Moderate interest
- ◯ Strong interest
- ◯ Passionate

5. **How likely were you to keep bees?**
Mark only one oval.

	0	1	2	3	4	5	
Would not keep bees	◯	◯	◯	◯	◯	◯	Would definitely keep bees

6. **How likely were you to share knowledge with others about bees and beekeeping?**
Mark only one oval.

	0	1	2	3	4	5	
Would not share knowledge	◯	◯	◯	◯	◯	◯	Would definitely share knowledge

7. **How important would you have said beekeeping and pollination services are to agriculture?**
Mark only one oval.

	0	1	2	3	4	5	
Irrelevant	◯	◯	◯	◯	◯	◯	Extremely important

8. **How important would you have said beekeeping and pollination services are to cooperative extension in California?**
Mark only one oval.

	0	1	2	3	4	5	
Irrelevant	◯	◯	◯	◯	◯	◯	Extremely important

Please answer the following questions based on your current knowledge and experience:

9. **How would you characterize your current level of experience with beekeeping?**
Mark only one oval.

- ◯ No experience
- ◯ Novice
- ◯ Intermediate
- ◯ Advanced
- ◯ Expert

10. **What is your current comfort level around bees?**
Mark only one oval.

- ◯ Totally uncomfortable
- ◯ Somewhat uncomfortable
- ◯ Neutral
- ◯ Somewhat comfortable
- ◯ Totally comfortable

11. **What is your current level of interest in keeping bees and beekeeping?**
Mark only one oval.

- ◯ No interest
- ◯ Some interest
- ◯ Moderate interest
- ◯ Strong interest
- ◯ Passionate

12. **How likely are you to keep bees?**
Mark only one oval.

	0	1	2	3	4	5	
Will not keep bees	◯	◯	◯	◯	◯	◯	Will definitely keep bees

13. **How likely are you to share your knowledge of bees and beekeeping with others?**
Mark only one oval.

	0	1	2	3	4	5	
Will not share knowledge	◯	◯	◯	◯	◯	◯	Will definitely share knowledge

14. **How important would you say beekeeping and pollination services are to agriculture?**
Mark only one oval.

	0	1	2	3	4	5	
Irrelevant	◯	◯	◯	◯	◯	◯	Extremely important

15. **How important would you say beekeeping and pollination services are to cooperative extension in California?**
Mark only one oval.

	0	1	2	3	4	5	
Irrelevant	◯	◯	◯	◯	◯	◯	Extremely important

16. **What part of ENT 198/295 has been the most effective teaching tool?**
Mark only one oval.

- ◯ Lectures
- ◯ Hands-on workshops
- ◯ Additional readings/resources
- ◯ Combination of the above
- ◯ Other: _____

17. **Would you prefer the class to offer:**
Mark only one oval.

- ◯ Less hands-on time
- ◯ More hands-on time
- ◯ Satisfied with hands-on time
- ◯ Other: _____

Please answer the following questions in a few sentences:

18. **What do you enjoy most about this class?**

_____

_____

_____

_____

_____

19. **What would you change about this class?**

_____

_____

_____

_____

_____

20. **What are you most likely to take away from this class?**

_____

_____

_____

_____

_____

21. **Would you be interested in taking another class with this kind of structure?**

22. **Is there anything else you'd like to add?**

Thanks for your time and participation!

Follow-up Survey

ENT 198/295 Survey

Feedback from student participants on ENT 198/295 Practicum in Beekeeping course during Week 5 of Winter Quarter 2019.

1. **Email address** *

2. **How would you characterize your current level of experience with beekeeping?**
Mark only one oval.

- ◯ No experience
- ◯ Novice
- ◯ Intermediate
- ◯ Advanced
- ◯ Expert

3. **What is your current comfort level around bees?**
Mark only one oval.

- ◯ Totally uncomfortable
- ◯ Somewhat uncomfortable
- ◯ Neutral
- ◯ Somewhat comfortable
- ◯ Totally comfortable

4. **What is your current level of interest in keeping bees and beekeeping?**
Mark only one oval.

- ◯ No interest
- ◯ Some interest
- ◯ Moderate interest
- ◯ Strong interest
- ◯ Passionate

5. **How likely are you to keep bees?**
Mark only one oval.

	0	1	2	3	4	5	
Will not keep bees	◯	◯	◯	◯	◯	◯	Will definitely keep bees

6. **How likely are you to share your knowledge of bees and beekeeping with others?**
Mark only one oval.

	0	1	2	3	4	5	
Will not share knowledge	◯	◯	◯	◯	◯	◯	Will definitely share knowledge

7. **How important would you say beekeeping and pollination services are to agriculture?**
Mark only one oval.

	0	1	2	3	4	5	
Irrelevant	◯	◯	◯	◯	◯	◯	Extremely important

8. **How important would you say beekeeping and pollination services are to cooperative extension in California?**
Mark only one oval.

	0	1	2	3	4	5	
Irrelevant	◯	◯	◯	◯	◯	◯	Extremely important

9. **What part of ENT 198/295 was the most effective teaching tool?**
Mark only one oval.

- ◯ Lectures
- ◯ Hands-on workshops
- ◯ Additional readings/resources
- ◯ Combination of the above
- ◯ Other: _____

10. **Would you prefer the class had offered:**
Mark only one oval.

- ◯ Less hands-on time
- ◯ More hands-on time
- ◯ Satisfied with hands-on time
- ◯ Other: _____

11. **How much of the course material would you say you have retained from this class?**
Mark only one oval.

- Less than 10%
- 10-25%
- 25-50%
- 50-75%
- 75-90%
- More than 90%

Please answer the following questions in a few sentences:

12. **What did you enjoy most about this class?**

13. **What would you change about this class?**

14. **What did you take away from this class?**

15. **Would you be interested in taking another class with this kind of structure?**

16. **Is there anything else you'd like to add?**

Thanks for your time and participation!