

Wildlife and Waders: Experiences from a Biology Capstone Course

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Abstract

In fall of 2019, a new capstone course, wildlife biology, was offered as part of the biology curriculum at the University of Saint Joseph. The course fully embraced problem-based learning (PBL), project-based learning, and service-learning strategies. It provided a service to the campus community through the task of creating a management plan for two wetlands located on the campus given the problem of invasive plants. Student engagement in the topic and project was enhanced through the development of student teams and the opportunity to work with stakeholders. In responding to stakeholder project requests, students showed increased motivation, ownership in the project, and skill development. Through implementing this course, we unexpectedly observed increased development of students' leadership, maturity, and scientific curiosity.

Keywords: problem-based learning, service-learning, field biology, undergraduate biology

Introduction

Problem based learning (PBL) dates to the early 1960s as a novel educational method of teaching at McMaster University's medical school (Graaff and Kolmos 2007). This method engages students to seek answers in an active independent manner as opposed to being passively fed the information by an instructor (Graaff and Kolmos 2007). It has since seen successful use across the world in K-12 and secondary education and has been implemented in nearly all disciplines (Graaff and Kolmos 2007). While touted as the first pedagogy that promotes student-centered problem-solving learning styles, there are others such as case-study based learning (Hmelo-Silver 2004), service-learning (Furco 2011) and project-based learning (Graaff and Kolmos 2007). These varying pedagogy styles can overlap in practice or be carried out within a narrower scope. Case study and project learning as the terms imply, focus on material presented by the instructor to the students to work with or build from. Service learning has morphed over the decades and numerous definitions can be employed in its execution (Furco 2011), with the common element that a service must be provided to a body outside of the classroom (e.g. campus community, local town community, etc.). Thus, one can see that it is possible to combine some of these styles of learning for utilization in a course. One example would be combining service learning through the scope of a particular project and/or problem (PBL + Service learning; Tawfik, Trueman, and Lorz 2014) that is presented to students to solve. Elements of these three strategies were used in combination for the design of our Wildlife Ecology course and will be described here in this paper.

At the University of Saint Joseph (USJ) in West Hartford, CT, excellence in teaching is a priority for which innovation and active learning are encouraged. Several courses in the biology curriculum have included PBL, or at least parts of PBL, including: Advanced Cellular Biology, Introduction to Cellular Biology, Microbiology, and Principles of Environmental Science. Project based learning strategies has historically been embraced by the biology department as the Driving framework of its capstone courses by utilizing research projects in all capstone courses. Additionally, as a Mercy institution, the University's mission and core values ("USJ History, Mission & Goals" 2021) are reflected in various aspects of course work as well by developing a student's sense of responsibility to the needs of society through identifying where knowledge gaps exist and attempting to fill them through research. Student-centered problem-solving pairs well with community engagement and civic service, which is required of all USJ clubs, the honors program, sports teams, and some core curriculum courses. Therefore, it should be a natural fit for integration into more courses at USJ via research projects.

While the University of Saint Joseph's undergraduate Biology program is intended to provide students with a general exposure to topics from all the main branches of biology (molecular, cellular, organismal, and environmental), as is the case with many smaller liberal arts universities, most courses presently offered to students are in the health and biomedical based fields. Much of this stems from the fact that cellular and molecular focused courses are often "required" or at least "strongly recommended" courses for professional

programs such as physician assistant studies, pharmaceutical sciences, and medical school. This creates an unbalanced curriculum with a deficiency in organismal, environmental, or ecological topics.

Currently, biology majors are only required to take two courses that focus on organismal or environmental biology. During their freshmen year, students take BIOL 117: Introduction to Evolution and Kingdoms, then during their sophomore year, students take BIOL 237: Principles of Environmental Science. At this time, there are no regularly available upper-level undergraduate organismal biology or ecological courses offered at the University. Therefore, a gap is apparent in providing students exposure to this valuable part of a general biology degree. This new capstone course is able to help in filling this gap.

As part of the biology degree requirements, all biology majors at USJ must complete the Biology capstone course. Students are not allowed to enroll in the capstone course until after they have completed all their mandatory required Biology classes (BIOL 114: Introduction to Cellular Biology, BIOL 117: Introduction to Evolution and Kingdoms, BIOL 232: Scientific Writing, BIOL 237: Principles of Environmental Science, and BIOL 250: Introduction to Biological Research). Capstone course topics change yearly. Only one capstone course is offered at a time each fall semester so that students do not have an option of choosing a specific topic. Following completion of the capstone course it is expected that students show mastery in quantitative reasoning, critique of logical arguments, and the ability to solve biological problems. In addition to learning new knowledge in the course, they are expected to pull upon information and skills learned in prior courses and utilize them in the capstone course.

At the 2019 Northeast Natural History Conference Dr. Chace presented information about a Conservation Biology course that he conducted at Salve Regina University in Newport, RI on Conservation Biology. The approach for Dr. Chace's course involved students working on a campus community-based project (Chace et al., 2018). Dr. Chace's presentation served as an inspiration for two University of Saint Joseph Biology faculty, Dr. Kirsten Martin and Dr. Michelle Kraczkowski, to develop a new capstone course for the biology program. In the fall of 2019, a new capstone course, wildlife biology, was offered to senior Biology majors at USJ. This paper presents a case study which will describe the course's development, execution, successes, and

challenges encountered. The intent of sharing these lessons learned is to encourage others to be develop similar courses using such an advanced and combinatorial teaching strategy of PBL, project based, and service-learning.

Development

To maintain the ability to incorporate many different topics, the new course was broadly named "Wildlife Biology". To cover such a range of material, utilization of two instructors with complimentary expertise was ideal. One instructor's expertise included entomology, environmental science, and wildlife management, while the other instructor had expertise in fish biology and molecular ecology. However, both had general depth of knowledge and experience in the various field skills that were used throughout the course. Additionally, guests were brought in on four occasions to provide presentations or interest-based workshops on parasitology, aerial drone footage, and state wildlife management practices. Because this course would be utilizing the campus landscape and taking a project-based approach to solve a problem for the campus community's benefit, various stakeholders were necessary. The utilization of many experts and stakeholders was a unique and critical piece of the course development that moved the experience for students from a classroom setting to a "real world" setting.

Incorporating stakeholders provided students an incentive in the project as they could put a face to the name of who the resulting information from their project would be communicated to. The composition of the stakeholder group was diverse and included administration, facilities staff, colleagues from other disciplines, and other biology faculty. Two of the most important stakeholders were the University of Saint Joseph President Dr. Rhona Free, and the University of Saint Joseph Director of Facilities Andrew Levesque. Additionally, the Provost, the Dean of the School of Arts, Science, Business, and Education and the Biology Department Chair were all consulted and invited to be stakeholders. The "buy-in" of these stakeholders before the class even started was important. As these were upper-level administrators and colleagues, their approval and involvement had to be acquired and reserved prior to the start of the fall semester. This was accomplished at the end of the prior spring semester through a presentation, discussions, and meetings. Through these conversations, funding of new equipment for the course from Sodexo (the facilities contracted

corporation) was secured and commitment by the stakeholder group for scheduling of meetings for the coming fall semester was obtained. The role of the stakeholder group was to not only support the initial development of the course, but to be an integral component of the course's project development throughout the semester by giving students feedback and guidance.

Students ultimately were working on developing a product that could be utilized by the administration to make decisions about the future of the campus landscape, specifically regarding the problem of invasive species in the wetlands. This made the role of the stakeholders into "clients" that the students were communicating with and working for. Therefore, the stakeholders had a "say" in the focus and outcome of the project that the students had to respond to. The incorporation of stakeholders presented challenges, but they were outweighed by the benefits of their involvement. The setting was the first challenge, in that students hardly interact with administration; therefore, the students were intimidated. However, this was also a motivating factor that forced them to prepare very well for each stakeholder meeting (four in total). Another challenge was to move students out of a classroom frame of mind where they are given instructions and then they execute, because in these meetings they had to lead and drive the conversation in order to maintain their agenda and get answers to their questions. This too can be viewed as a strength as it placed the students in a real-world scenario, providing them skills that would not normally be learned. Lastly, from the instructor perspective, relinquishing some control was a challenge, as ultimately the students needed to respond to the requests put forth by the stakeholders. The instructor's role was to provide them the means (teaching them field and computer skills) and direction (guidance on implementation and data collection design) for how to get there. However, this provided students with the opportunity to strengthen their leadership, critical thinking, and communication skills. Providing an opportunity to grow all of these skills simultaneously was a unique experience and an outcome of this course that would not have likely occurred in their prior educational experiences.

The wildlife biology capstone course focused on encouraging students to examine interactions between organisms and their environment and consider how these interactions might be applicable to wildlife management practices. The course had a

very flexible design, with content instruction and lab experiences being blended (often to accommodate weather). The class was designed around a semester-long class project (problem= investigation and management suggestions for two wetlands on campus). The class-project provided students with the real-life task of working with stakeholders to address a problem, investigating through fieldwork and research, and ultimately providing updates and a product to the stakeholders that specifically addressed their issues of concern. While this was an upper-level class, and students had not had any introductory material in the content area, the focus of the wildlife biology capstone course was not to teach large quantities of upper-level content, but rather as a background for setting the stage in which they would work to acquire new skills. The instructors specifically designed the course in a way to encourage students to become active participants, and ultimately leaders in the project. The ultimate goals of this capstone course were the development of a management plan for the chosen area and to leave a legacy of learning beyond the end of the class. It was evident that there was some success in achieving both these goals, as students did develop a comprehensive management plan for use by USJ and several students went on to further pursue field research projects.

While a syllabus, a "projected course schedule", and a textbook were initially provided to students, the class had a flexible structure based on student interests and learning needs. Class topics also shifted based on the elements brought up in the stakeholder-student discussion meetings that were held periodically throughout the semester.

Course Design

The design and implementation of this class was very far removed from the classic "lecture and lab" that students were used to. The course had to be designed to be as flexible as possible because many of the meetings would entail students doing field work, and thus, weather dictated moving some tasks to later dates. With the input by the stakeholders, it would also be necessary to remain flexible to adding elements as much as possible. One unexpected influence on the need for a flexible schedule was the length of time that the students took to perform field work. What had not really been accounted for was that nearly all these students, even though they were seniors had only had one course that entailed substantial field work. Much of the field work required students to implement new skills, their

learning curve often resulted in extra time in a subsequent class meeting as necessary to complete the tasks.

Depending on what prior courses students had taken they may or may not have been exposed to PBL, project-based, or service-learning previously. The course was designed to provide the students with learning new skills and information in the context of a singular class project that everyone contributed to. Many challenges were faced in this course, including student buy-in, independent learning, teamwork, equal contributions of effort, problem solving, self-confidence, autonomy over design, working outdoors, and insect phobias. To explain a few of these in more detail, it is important to acknowledge that the typical PBL is more case study oriented. These students were presented with a study subject, in this case, wetlands, and were asked to study them in detail in order to generate solutions to a problem of landscape management of invasives. This open-ended instruction was unsettling for many of the students because they wanted to know what it was that they were looking for or what would be the “right” data that they should include in their final report. Answers to these questions did not exist yet, as that was the whole point of their project; there was a gap in knowledge about these wetlands on campus and they needed to fill it. This led to an issue in their self-confidence, as they did not feel they were “qualified” to be doing this. There was an instance during a stakeholder meeting that a student asked of the stakeholders “Do you really have confidence that students can get you good data?”. Their answer was emphatically yes. The stakeholders also trusted the instructors to provide quality assurance, but they felt that the senior biology students would be more than capable of not only completing but doing a professional job on the project. This was a major defining moment for some of the students. Hearing that the stakeholders truly believed in them really seemed to increase their confidence and resulted in fewer repeated questions to the instructors. That stakeholder meeting was also a turning point in how the students viewed the overall project. Following that meeting, students seemed to take more ownership of the project, and students also started to take their leadership roles within the groups more seriously. It was interesting and a surprising development to see them “quality-check” each other’s work.

Another challenge of the course design was that as a capstone course, this was an upper-level class,

which did present some challenges to students. The novelty of the material in the book and information presented in class did overwhelm some of them. This was evident in their quiz scores that assessed material that they were expected to read from the book and was similarly reflected in their report writing. While this challenge was not necessarily overcome during the course, it did distinguish the A level from B level students in the course as these assessments took up approximately 25% of their grade.

The last major challenge to explain in this course was teamwork. This coupled with the need for independent work left many to flounder in their confidence and leadership skills, resulting in a desire to “sit on the side-lines”. For example, to survey the wetland’s regarding width and length, manoeuvring through dense brush was necessary in some locations. The class of 13 had been divided into 3 groups of 3 and one with 4, therefore, they had to work with their group to collect the data on a certain section of their assigned wetland. The instructors could not hover over every group all the time due to the multiple locations; so student groups had to work independently and were checked in on periodically. Every group was also given a walkie talkie in case of emergency and to communicate between wetlands. However, some groups did not communicate well with each other within groups, and were therefore slow to make decisions, missed some data points or got duplicates, and/or executed the field work incorrectly. The instructors therefore had to work very hard to manage these issues and facilitate resolutions through mediation in the groups.

One interesting characteristic about this class that has not been discussed yet, is the fact that the class was entirely made up of female students. It is unlikely that the make-up of the class had much impact on their involvement in the project, as this senior cohort of students was one of the last all-female cohorts. USJ made the decision to become co-ed at the undergraduate level two years prior. The students did seem to want to make a statement about their all-female class, however, because when they were asked to come up with a name for their group, they chose to call themselves “Women of Wildlife”.

Success Stories

The course was successful in many ways, including production of a final management plan for the two wetland areas and development of an involved stakeholder-student partnership, but perhaps most importantly the class was successful in its ultimate goal, fostering of both academic and

personal growth in the students. Through the experience of having to navigate group dynamics, learn new methodologies, problem-solve, and present to peers there were many examples of increased confidence and leadership skills in many of the students. Students were constantly out of their comfort zone, as they were dealing with unfamiliar environments, topics, and probably the most intimidating of all, the prospect of having direct interactions with the stakeholder group. Initially the thought of having to present and discuss project progress with the President of the University, the Provost, the Dean of the School and others, seemed impossible to the students, and they often looked for guidance and support from the instructors. By the final stakeholder meeting, however, students were able to interact directly with the stakeholder group in a mature and professional manner.

Student ownership of the project and professional pride in the integrity of their work also increased over the course of the semester. As students became more invested in the project, they began to become more actively involved in the path that the project took. At the start of the semester, students would often revert to the more traditional “student in a lecture classroom role” and would only respond to questions directly asked of them, but once they began to be immersed in the fieldwork, communication (both between students and with the instructors) really flourished. Students seemed to learn as much about themselves and their interactions within and between groups as they did about the project. Awareness of the value of the wetland areas also increased. This was evidenced through students becoming quite protective of the habitats and concerned about the potential impacts of littering and campus construction on the health of the wetlands.

Reflection

There was a lot of learning that occurred during this class, both for the students and certainly for the instructors. Following the end of any course, once the dust has had time to settle a little, reflection can occur in earnest to develop ways to improve the course for the future. If given the opportunity to run this course again, one change to implement would be creating a “contract of participation”. Continuing along the lines of “buy-in”, that is one thing that could have been strengthened from the start, as opposed to having to reel them in when effort was not being put in uniformly. If the students were charged with creating

the contract as a group, agreeing upon it, and then everyone signing it, it would be more meaningful and potentially lead to them holding each other accountable, vs. relying on instructors solely for that. A contract also increases transparency of the course expectations and confirms that everyone is starting off in the same place. The growth of leadership and responsibility was again a wonderfully unexpected result of the course, so ways to further enhance that would be beneficial.

There is also an opportunity to reflect on what unexpected impacts the course may have had on the students, the campus community, and the instructors. One of the most unexpected impacts of the course was the continued interest by several of the students to extend their experiences through independent field research. Three of the students decided to work with the course instructors to further develop and conduct field research projects in subsequent semesters. One of the students was so inspired by the class, that she approached her town’s conservation commission to get approval to complete an extensive wildlife assessment of a town-owned wetland. This student has recently enrolled in the master’s in biology program at USJ and is interested in continuing her wetland assessment work as part of her thesis project. Interestingly, for two of these students, their work and projects were in fields of biology that had not been their primary interest, as one is now starting pharmacy school and the other is applying to Physician’s Assistant programs. This speaks volumes about the applicability of the course and further emphasizes the importance of providing students exposure to a broad array of topics in order to increase environmental literacy. If we, biology programs, strive to make well rounded students and well-informed citizens, then comprehensive capstone courses in a biology curriculum are key steppingstones for undergraduate careers. Hopefully, other instructors are inspired by the information provided in this case study to try a similar teamwork style of implementing a PBL, project based, service-learning course curriculum that revolves around a singular community serving focus for their own courses.

Acknowledgements

We would like to thank our biology faculty colleagues for their support, as well as Dr. Charles Morgan, Dr. Rhona Free, Andy Levesque, Dr. Kaitlin Walsh, Dr. Melissa Marcucci, and Dr. Raouf Boules for their crucial involvement as stakeholders.

We especially want to thank the hard-working students who took this course: Olivia Anderson, Wendy Cotto, Mabintou Darboe, Sara Delgado, Nina Dicioccio, McKenna Driscoll, Lauren Held, Tessa Kwarciany, Maria Lopez, Sophia Marler, Bianca Pappacoda, Tamara Rodriguez, and Darla Watson.

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