TEACHING AND LEARNING PORTFOLIO

by

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The Delta Program in Research, Teaching, and Learning is a project of the Center of the Integration of Research, Teaching, and Learning (CIRTL—Grant No. 0227592). CIRTL is a National Science Foundation sponsored initiative committed to developing and supporting a learning community of STEM faculty, post-docs, graduate students, and staff who are dedicated to implementing and advancing effective teaching practices for diverse student audiences. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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About the Delta Program

The Delta Program is a National Science Foundation-funded program dedicated to helping future faculty become better teachers. Three core ideas, each interacting with one another, make up the "pillars" on which Delta is built:

Teaching-as-Research:
"By applying research methods - idea, experiment, observation, analysis, improvement - to the challenge of teaching, Delta participants bring the skills of research faculty to the ongoing investigation of student learning, promote innovation in teaching and measurement of student learning, and advance the role of instructors in the ongoing improvement of teaching practices."

Learning Communities:
"Learning Communities bring people together for shared learning, discovery, and the generation of knowledge. Within a learning community, all participants take responsibility for achieving the learning goals."

Learning Through Diversity:
"Delta seeks to contribute to this goal by enabling present and future science, technology, engineering, and mathematics faculty to enhance the learning of all students whom they teach irrespective of, but not limited to, preferred learning styles, race, ethnicity and culture, gender, sexual orientation, disabilities, religion, age or socio-demographic backgrounds."

This portfolio represents a partial fulfillment of my candidacy for a Delta Program Teaching Certificate. In addition, I have attended courses, been an active part of the Delta teaching and learning community, and have completed an internship in which I applied quantitative techniques from my research training to my teaching methods.

The Delta Program has had a tremendous impact on how I reflect on, engage in, and assess the process of teaching and learning, and has made me realize the kind of teacher that I want to be. I give tremendous thanks to the Delta Program for all of their aid and support along the way as I continue to work every day to improve my ability to guide students through the learning process.

Teaching Philosophy

A student approached me some time ago, a bit frustrated with a classroom exercise. I had given the class an assignment to defend stakeholder positions during a debate on a contentious issue—whether to remove dams along the Lower Snake River to benefit endangered species of salmon. This student was assigned to represent the point of view of commercial fisheries, and she was having some difficulty because she couldn't find information about the positions taken by those companies. I suggested one way to proceed was to identify some of the key fisheries, contact them on the phone, and ask to talk to their public relations representative. Her eyes suddenly became very wide, and she said "I didn't realize that people were really working on these issues that we're debating in class!" She did a phenomenal job in the ensuing debate, and I was happy to see that I had connected a hypothetical classroom exercise to actual conservation issues on the ground.

I view teaching as an interactive process in which teachers and learners exchange experiences, viewpoints, and skills in a mutually beneficial manner. My philosophy of teaching is that I am a guide—I can't actually force students to learn material, but I can provide information on new subjects and points of view in an accessible and interesting format, and help students rapidly familiarize themselves with challenging or unfamiliar concepts. As I teach in ecology and biology, I focus my courses on current environmental events and threats to the Earth's biodiversity, and engage students by illustrating the connection between abstract course topics and real-world biological research and conservation efforts. Environmental, ecological, and conservation issues are frequently quite complex and require students to understand multiple factors, both biological and social, sometimes acting in opposition to one another. I use approaches that focus explicitly on learners, combined with hands-on exercises and real world experiences, to help students conceptualize these complicated issues and investigate workable solutions and compromises. My teaching is focused on three key core concepts—engagement, experiential and contextual learning, and inclusivity.

Engaging students with course material is one of the biggest challenges for any instructor. I have a genuine passion for the natural world and biological sciences, and I am always enthusiastic when describing key course concepts. I use humor and a casual classroom atmosphere so that discussion and debate can take place in a safe, welcoming environment. As an example, when teaching lessons about endangered species, I begin by having each student research a threatened or endangered species located in or near their hometown, and present this material to the class. This exercise has three benefits: it helps the students engage by relating the topic directly to them, it enables them to polish their presentation skills, and it gets them talking with one another. In addition, I have experience working with interactive teaching technology such as "clicker" type devices that allow for immediate student assessment and feedback. These tools can often be a way to keep the students engaged and interested in the material, especially in large science courses. However, no lecture can ever engage students as fully as direct experience using scientific principles, and that's why I always strongly encourage students to become directly involved in biological research, conservation science, outdoor activities, and ecological projects as part of any course that I teach. There is no substitute for hands-on experience.

Experiential learning is a great way for students to not only retain course material, but also attain skills valuable for future careers or graduate school. When teaching courses in biology, I create assignments that require students to go out and gather real data in natural systems whenever possible. In addition, I've worked in both Colorado and Wisconsin to partner with local resource agencies to create internships for students in my classes. Some students have ended up with part- or full-time employment as a result of these internships, and virtually all have reported that these experiences are hugely beneficial to them. My own research focuses largely on urban ecosystems, and this makes it very easy for me to take students into the "field" (sometimes the campus itself) to illustrate the complex ecological interactions that can occur in an urban environment and contrast these to the dynamics of natural systems. Many college students come from urban backgrounds, and teaching them about urban wildlife species that they are accustomed to often helps connect theoretical biological concepts to concrete examples. In addition, I focus course materials around timely and interesting topic areas when possible, to put classroom learning in a proper context. When I taught a senior-level capstone course at the University of Wisconsin, the class culminated in the students drafting conservation plans in groups for the endangered Kirtland's Warbler, a species recently discovered to be nesting in Wisconsin. These plans were based on hard science and research into biological, demographic and social factors, and were reviewed by the Wisconsin Department of Natural Resources to assess their utility as a baseline for actual conservation plans in the future.

While teaching, I always make a particular effort to help students become better writers. Writing skills are sorely needed for careers in science, whether they be academic, technical, or informal, but are often neglected for undergraduate students. In particular, many students complete a degree without ever having been made to edit their own writing. In contrast, the process of drafting reports in a job, or a manuscript for publication, involves spending a tremendous amount of time reviewing, editing and reformatting your own work. When giving writing assignments, I arrange for students to peer review one another's papers as well as receiving reviews from me on their work, and have them revise and resubmit papers for higher grades. These policies do create quite a bit of additional work—both for me, and for the students. However, writing skills are so essential to careers in science (and, indeed, in many careers) that I find this added input of time to be quite worthwhile.

Learning goals cannot be effectively reached unless the students feel they are in a safe, welcoming, and inclusive environment. This requires maintaining a positive, relaxed attitude while lecturing, but it also means respecting that students are diverse, varying in terms of gender, age, ethnicity, economic background, political and religious background, and in numerous other ways, and each have important perspectives and experiences that can improve everyone's learning. As I teach courses on environmental issues, where facts are often not nearly as important as value judgments regarding our natural resources, it is particularly important to be inclusive of students with different points of view. There are no right or wrong answers related to the relative importance of wild places. To help students understand this important principle and learn through diversity, I assign numerous debate and stakeholder roleplaying exercises on contentious environmental issues designed to help them empathize with people who hold differing points of view. These assignments help students to understand and often appreciate viewpoints of people who may come from quite different walks of life.

Improving one's pedagogy is an ongoing, adaptive process. I use the quantitative and analytical skills that I honed as a researcher to assess and improve on my teaching abilities. As a certificate candidate with the Delta Program for Teaching, Learning, and Research, I have taken classes and seminars on teaching and pedagogical theory, developed a successful research project to assess my teaching strategies, and have been an active member of the UW-Madison teaching and learning community. In the future, I will continue to use qualitative and quantitative assessments, including mid-course surveys, experimental teaching exercises, and ongoing self-assessment, to determine the efficacy of my instructional methods, and continuously adapt to incorporate more active and inquiry-based teaching modules. While I still have a lot to learn about teaching, I am excited by the opportunity to apply the teaching techniques and tools I use to new courses in the future.

Overview- Reflections

1) Reflective Statement- Engagement
    1. Student engagement with course materials is critical
    2. I use field studies, real world examples, analytical techniques, and enthusiasm to help my students connect with course materials
    3. Communication with students about my expectations and the intended outcome of each teaching exercise is essential
    4. I use empirical methods and student feedback to assess whether engagement is achieved, and modify teaching techniques if needed
2) Reflective Statement- Experiential Learning
    1. I feel hands-on experience with course materials is essential to student learning
    2. Student writing is a key example of this, and I create numerous and varied writing projects for my students
    3. Inquiry-based group projects have also worked well, particularly when each student is given a task based on a skill or area of interest
    4. I provide additional examples involving teaching students to use Geographic Information System (GIS) software and mathematical modeling
3) Reflective Statement- Contextual Learning
    1. I find that students learn more quickly, retain knowledge more efficiently, and connect classroom learning to existing knowledge when course topics are placed in a proper context
    2. I frequently connect teaching exercises to current events to achieve this goal
    3. I also find it useful to assign projects that relate directly to the individual students and their interests
    4. As added benefits, teaching in this way keeps me connected with my students, and up-to-date on recent advances and topics in my field
4) Reflective Statement- Inclusivity
    1. Creating a classroom environment where all students feel comfortable and free to express their diverse opinions and viewpoints is essential
    2. This is doubly important in courses on environmental issues, where frequently value judgments are just as important as facts, and often there are no right or wrong answers
    3. I use debate and role-playing exercises to help my students to empathize with and understand the viewpoints of all the stakeholders when teaching about contentious topics
    4. I have also invited guest speakers with numerous and varied backgrounds to share their points of view with my students

Overview- Skills and Tools

1) Specific Classroom Experience
    1. Lead Instructor: Conservation of Endangered Species on Private Lands (Fall 2007, 2008, 2009, University of Wisconsin)
    2. Co-Instructor: Skills for the Conservation Professional (Spring 2009, University of Wisconsin)
    3. Teaching Assistant: Behavioral Ecology and Conservation Biology, Principles of Vertebrate Management, Conservation Biology, Introduction to Environmental Studies
2) Novel Approaches to Teaching
    1. Through the University of Wisconsin's Delta Program on Teaching, Research, and Learning, I've applied analytical skills to my teaching, collecting empirical data on student learning and adapting pedagogy based on the results.
    2. I view classrooms as interactive learning communities where all students and the instructor collectively take responsibility for meeting learning goals.
    3. I use the diverse skillsets and viewpoints of my students to enrich the learning experience for all participants, an example of learning-through-diversity.
3) Technology and Methodology
    1. Instructed students on Geographic Information Systems methodology
    2. Provided workshops on mathematical population modeling
    3. Have coordinated the use of interactive teaching remotes (sometimes called 'clickers') for a large (300 students) science class
    4. Gave detailed feedback on Microsoft PowerPoint and Excel applications
    5. Assisted students with repeated revisions of written work, and also coordinated student peer reviews of essays.
4) Educational Outreach
    1. I have tremendous experience with independent study students, having mentored over 30 such students during my academic career
    2. Through partnerships with local natural resource agencies, I've coordinated student internships, some of which have resulted in full-time employment.
    3. I have also served on a graduate committee for a Master's student
5) Evaluations

    The average values from 2007 and 2008 data from my Conservation of Endangered Species course, on a 5 point scale where 5 indicates "strongly agree":
    1. 4.75 for the statement "You would rank the instructor as excellent on overall teaching ability compared with all other instructors you have had on campus"
    2. 4.81 for the statement "You would recommend this course to another person".
    3. 4.75 for the statement "You would like to take another course from this same instructor"

Delta Program Internship- Evaluating the effectiveness of learner-centric approaches in a senior-level capstone on endangered species habitat management

Dr. Seth Magle
Teaching Partner: Dr. Nancy Mathews

ABSTRACT
We used student self-assessment to quantify the effectiveness of a learner-centric capstone course on Endangered Species management. We found that students reported learning within all measured categories, and reported very high levels of learning in most categories. In addition, we demonstrate which of 3 distinct learning modules produce significant learning gains within 6 categories. Student writing skills are identified as an area for future emphasis. On reflection, we believe the class experience could have been improved if student feedback was more actively incorporated throughout the course in an adaptive format, rather than assessed at the end of the class. As the activities designed to address multiple learning styles that were incorporated in the class appear to be achieving different goals, at this time we recommend that they all be retained while further data are collected.

INTRODUCTION
This study addressed the effectiveness of various learner-centric approaches to the course "Habitat Management for Endangered Species on Private Lands", taught by Seth Magle in the Fall of 2008. This is an interdisciplinary, project-based senior-level capstone course with an enrollment of 20 students, which has been previously taught by Nancy Mathews (from 2002-2006), and by Seth Magle (in 2007). While the course materials and exercises have changed greatly over the past 7 years, the effectiveness of various course modules had never been quantitatively assessed.

In our modern, changing world, environmental education is essential if citizens are to understand the complex nature of the interactions between humans, other species, and the planet (Stapp 1969, Duvall and Zint 2007). Because of the complex, interdisciplinary nature of environmental problems, courses on this subject must also include aspects of disciplines as diverse as biology, engineering, chemistry, sociology, economics, and political science (Foster 1999, Schug 2000, Schelhas and Lassoie 2001, Broussard et al. 2007). Perhaps partly as a result of this complexity, students that study environmental issues have been shown to have improved critical thinking skills (Ernst and Monroe 2004). Engaging students in these complex, interdisciplinary topics is difficult (Disinger 2001, Hart 2003) and is often best achieved through learner-focused, guided inquiry processes such as project-based learning (Seago 1992, Schneider et al. 2002, Brody 2005, Wingfield and Black 2005, Meyers 2006). These experiential methods have a particularly powerful effect when students can be engaged as problem solvers for environmental crises or issues (Alvarez and Rodgers 2006, Walsh et al. 2005, Eves et al. 2007), because involvement with a local issue of genuine importance makes students aware of the applications of skills taught in the classroom, as well as increases student engagement with learning materials (Meyers 2006). The interdisciplinary nature of environmental problems means that problem-solving is best performed by teams of students with disparate skillsets and experiences, and classes in this area can thus directly benefit from student diversity (Domask 2007). Students who have gained experiential knowledge of ecosystems frequently communicate this knowledge to others in formal and informal contexts (Duvall and Zint 2007, Jordan 2007), thus propagating knowledge. However, quantitative research on teaching environmental concepts in higher education is scarce, and suffers from small sample sizes

(Meyers 2006, Domask 2007). Most studies have used pre- and post- classroom surveys of early undergraduate students as a metric for self-assessment of student knowledge and comfort with materials (Meyers 2006, Walsh et al. 2005), but some authors suggest upper-level students may benefit even more fully from interdisciplinary, experiential learning because they have more skills to draw upon as a member of a team (Walsh et al. 2005).

Skills in scientific writing are essential for careers in science and the environment (Rice 1998, Krest and Carle 1999). Thus, this course assigned several writing assignments with clearly defined rubrics. Although writing assignments are assigned fairly commonly as part of an undergraduate education, students are rarely made to edit or review their work, despite the fact that research and professional careers often involve repeated revision of one's own work. In addition, students rarely obtain practice in peer reviewing one another's work, although these experience usually lead to better writing and learning (Langan et al. 2008). We provided students with the opportunity to re-write their essays for higher scores, and also to peer review one another's assignments for extra credit. We then surveyed the students for self-assessed gains in scientific writing ability.

Similarly, while information in science is often presented in oral presentations, students are rarely called upon to present scientific information to their peers in a classroom setting. Oral communication skills are often cited by graduate schools and employers as among the most critical for college graduates (Pittenger et al. 2004). Student presentations are an active learning strategy that improves comprehension, scientific literacy and communication (Farnsworth 2008. Sterling 2008). We assigned numerous student presentations throughout the class, both for single students and in groups, and measured self-assessed gains in presentation skills.

To improve student learning and communication of complex environmental topics, as well as student writing and presentation skills, we evaluated the effectiveness of an active, learner-based teaching model for a capstone course on endangered species management offered at the University of Wisconsin-Madison's Gaylord Nelson Institute for Environmental Studies. Materials were developed by Nancy Mathews and Seth Magle as instructors of the course. The course design includes a significant amount of student presentation, scientific writing, and editing, and was roughly divided into three modules, each designed around a distinct learning style. The first part of the class was largely comprised of instructor and student presentations, designed for students who prefer a passive style of learning, to give students experience presenting information, and to ease the students in to the less traditional portions of the course. The second course module focused on a debate on a contentious environmental issue, with numerous student group investigations and presentations used to gather information before the debate. This portion of the course was intended to appeal to students who learn best by empathizing with parties in a dispute, who are good at investigating topics independently, and who enjoy conflict meditation and resolution. The third module was centered on a large group project in which group members with clearly defined roles created a habitat conservation plan for an endangered species impacted by a hypothetical private development; the groups also provided a lengthy presentation outlining their proposed action. This third module was tailored to students who work well in groups, who have specific talents related to the course materials that they can share, and who learn well by completing lengthy and detailed projects.

Because environmental topics are normative (value-based), many different attitudes and opinions towards endangered species are a normal and healthy part of classroom discussions and were encouraged during debates and structured exercises. As one example of planned inclusivity, when students were assigned to debate groups, efforts were made to place students in the role of stakeholders who held different opinions from the students' own views, to encourage empathy with opposing positions. In addition, because these topics are complex and interdisciplinary, students with backgrounds in non-biological sciences had a tremendous opportunity to contribute. During the group exercise, students with backgrounds in disciplines such as construction, GIS, architecture, engineering, political science, sociology, or mathematics (specialties the instructor does not share) were given an opportunity to use those skills as part of the final habitat conservation plan and helped educate other class members. Final project teams were comprised of small groups of students from different backgrounds and skill sets and were encouraged to continuously reflect on their learning and to provide feedback and communication with one another and the instructor, functioning within and among groups as learning communities.

We used student evaluation questionnaires to assess the relative impact of each component of the course on self-assessed student understanding and improvement of key skills. The specific aims of the study were to: 1) Investigate the relative impact of three teaching modules on student self-assessed comprehension of and comfort with complex course topics related to endangered species issues; 2) Determine the relative impact of the three teaching modules on key student skills such as scientific writing and oral presentation. Self-assessment is a critical skill for college graduates that enhances lifelong learning and development, and correlates with retention and understanding (Hoover & Carroll 1987).

METHODS

Course instruction and assessment took place during Fall of 2008. Students were given surveys to complete on the first day of classes and after each module of the class (4 in total), on September 3, October 1, October 29, and December 10, 2008. Survey completion was required. All surveys had identifying information removed before analysis, and results were averaged for each quantitative question. Surveys self-assessed student knowledge, both before class and as a result of the class, within 6 categories: endangered species topics, the Endangered Species Act of 1973, scientific writing skills, oral presentation skills, understanding of the complexity of environmental issues, and ability to synthesize knowledge from different disciplines. The second and third surveys were identical, but the first and final surveys differed (Appendix 1). The initial survey collected only data on pre-course knowledge levels, while the final survey also explicitly asked students to assess learning on each of the 6 categories as a result of each class module. Each survey asked students to address pre-course knowledge, answers varied to a surprising degree between surveys. Thus, we used the grand mean from all four surveys to assess pre-course knowledge for each category. Questions asked on multiple surveys were compared between each survey using analysis of variance (ANOVA) with Tukey's Honest Significant Difference Test. We used the same analysis method to compare learning as a result of each module, assessed with the final questionnaire. Alpha levels of 0.05 were considered significant throughout, with alpha levels between 0.05 and 0.10 indicating a potential trend in the data that is not conclusive.

RESULTS

Sample size varied from 20 for the initial survey to 15 for the second survey. For the initial analysis, students were asked to assess their pre-course and course-resultant knowledge of course topics on a 5 point scale, where 5 represented very advanced understanding and 1 represented no understanding (Appendix 1). Pre-course values for the 6 questions ranged from averages of 2.5 to 3.75, while responses from the final assessment ranged from 4.125 to 4.5, indicating that students reported improved understanding in every topic.

The first question assessed student knowledge of endangered species issues. Students reported improved understanding compared to pre-course levels following the first ($T = 1.29$, $p < 0.001$), second ($T = 1.31$, $p < 0.001$), and third ($T = 0.95$, $p < 0.001$) modules of the course, but no difference between different portions of the course (Figure 1). Similarly, when reporting knowledge of the endangered species act, students had much higher self-assessed understanding after all three course modules (respectively, $T = 1.94$, $p < 0.001$, $T = 2.55$, $p < 0.001$, and $T = 2.32$, $p < 0.001$) than pre-course levels, but showed no significant differences within course modules (Figure 2). Students believed their writing skills were improved at the end of the course ($T = 0.58$, $p = 0.021$) and after the first third of the course ($T = 1.38$, $p = 0.043$, Figure 3), compared to pre-course levels. Students felt they understood complexity more clearly at the end of the course ($T = 0.75$, $p < 0.001$), and after the second module ($T = 0.63$, $p = 0.001$), than at their pre-course levels (Figure 4). The relationship was identical for student comfort with synthesizing knowledge from different disciplines, with higher values given at the end of the course ($T = 0.614$, $p = 0.009$) and after the second module ($T = 0.485$, $p = 0.049$) than those representing understanding before the class (Figure 5). Students also indicated that they believed presentation skills were improved at the end of class ($T = 1.26$, $p < 0.001$), and after the second module ($T = 1.07$, $p < 0.001$), compared to pre-course levels. Additionally, presentation skills were given higher values at the end of the course compared to values after the first module ($T = 0.86$, $p = 0.024$, Figure 6).

In addition to self-assessing comprehension after each section of the course, at the end of the class we included questions about how much students felt they learned as a result of each course module. These questions were on a 5 point scale, with 5 indicating a tremendous amount of learning, 3 indicating a small amount of learning, and 1 indicating increased confusion. Average responses to all topics and all modules ranged from values of 3.06 to 4.88, indicating that the students reported learning gains. On endangered species issues, there was an apparent trend towards students reporting more learning as a result of the first module than the third ($T = 0.437$, $p = 0.092$), though this was not significant at a 0.05 level (Figure 7). Students reported learning more about the Endangered Species Act from the first module than the second ($T = 1.437$, $p < 0.001$) or third ($T = 1.312$, $p < 0.001$) modules (Figure 8). Students felt that they learned more about scientific writing from the third module compared to the second ($T = 1.647$, $p = 0.007$, Figure 9). There was a slight trend for students to report learning more about the complexity of environmental issues from the final module than the first ($T = 0.562$, $p = 0.059$, Figure 10). Self-assessed learning gains in synthesizing knowledge from different fields was also higher for the final module than the first module ($T = 0.625$, $p = 0.046$, Figure 11). There were no significant differences between modules in student reported improvement in oral presentation skills (all $p > 0.2$, Figure 12).

DISCUSSION

Although this class was designed using learner-centric methods and a variety of teaching styles, its efficacy has never been quantitatively evaluated. Evaluating the course is somewhat difficult because the goals of the course are not simple retention of facts and methods, but rather to build essential scientific skills like scientific writing and presentation, and to help students grasp the complexity of environmental problem solving in a world of limited resources. Self-assessment of student confidence and understanding is likely one of the more effective means of evaluating these goals. Stepping back for a moment from the statistical comparisons, broad analysis of the trends in the data can provide some evidence of the student's perspective of how effective the class is at achieving its aims.

We found that students reported learning within all measured categories, and reported very high levels of learning in most categories. In response to statements indicating that students felt knowledgeable about endangered species and the Endangered Species Act (ESA), average student responses representing pre-course attitudes were 3.14, and 2.5, respectively, where a 2 was defined as "Disagree" and a 3 represented "Neither agree nor disagree". By the end of the class students assessed their understanding of both topics between a 4 and a 5, where a 4 indicates "Agree" and a 5 indicates "Strongly agree". Thus, students clearly increased their comfort level with these topics during the class. Higher initial values for endangered species generally may indicate that the students were initially generally scientifically literate but lacked knowledge about specifics of the ESA. Students were more initially confident in their writing skills, where average scores pre-course were 3.41, but still improved slightly to an average score of 3.88 by the end of the class. This may be an area for future emphasis in this class. Students had a fairly low initial opinion of their presentation skills, giving themselves an average score of 2.87. By the end of the class this had improved to a 3.94. Students were initially the most confident in their understanding of the complexity of environmental issues and their ability to synthesize knowledge across disciplines, on average rating themselves 3.75 and 3.57, respectively. By the end of the class these ratings improved to 4.50 and 4.18. For the most part, students seemed to feel that the course met its goals, and reported improved ability in all six of the measured categories.

Students assessed understanding of endangered species, and of the Endangered Species Act, rose sharply after the first class module, which focused largely on instructor and student presentations to present material. For these topics, many of the key concepts must simply be learned and memorized, and these passive methods that students may be more familiar with were reported as effective. Students reported only very slight gains following this initial portion of the class.

By contrast, the skills we hoped to teach the students reported much more varied gains. Only in the later portion of the class, when students were working on complex debate topics and particularly on group projects, did they report significant gains in scientific writing skills. Oral presentation skills showed significant self-reported gains throughout the class, with particularly strong scores in the final evaluation after the group projects. Gains in writing and oral presentation skills were somewhat low compared to other areas and these may be areas for future assessment and evaluation. Self-reported learning goals on these topics were highest during the final portion of the course when group projects were completed. These projects did require a significant amount of writing and public speaking.

Understanding complexity, and ability to synthesize knowledge from different disciplines also showed steady gains throughout the course, and especially seemed to increase following the second portion of the course, in which students took on the roles of stakeholders debating salmon conservation issues. During these debate exercises, students represented stakeholders with wildly varying opinions and were asked to research various points of view to best support their assigned position. In addition, they were asked to come up with consensus solutions to complex, controversial environmental topics while acknowledging limited resources. It seems likely that this daunting task led them to a greater understanding of complexity and perhaps forced them to use different aspects of their education than they had previously. It was somewhat surprising to us that students did not report more significant gains in synthesizing information as a result of the final project. This project is designed to combine students in teams with disparate skillsets so that they learn how to integrate different fields of learning. In the future, more emphasis may need to be placed on communicating and emphasizing this essential facet of the project. It is possible that students were uncertain what was meant by synthesis of knowledge and this should also be better explained.

The effects of all modules are somewhat confounded by issues of timing. As overall understanding is cumulative, it is difficult to tease out the relative impacts of each module since they happen in sequence. We attempted to do so by surveying the students after each module, and by asking them explicitly on the final evaluation how each module contributed to learning. It is possible that the assessment given on the first day yielded somewhat disparate or misleading results, because students were unfamiliar with the instructor and the course format, and may not have had a good grasp of their true knowledge levels. However, those results were only averaged with all four assessments of pre-course knowledge that were used to determine a grand mean, and thus should not be dominating the analysis. Written feedback on the course was largely positive. Four of 16 students indicated concern that the second module seemed rushed, and as high learning gains were reported following that section it should perhaps be expanded in future semesters. Overall, however, the varied methods were appreciated and every student indicated that they would recommend the course to a friend.

CONCLUSION AND LESSONS LEARNED

We provide baseline data that indicates students believe they are learning a tremendous amount from the IES 600 capstone course. In addition, we demonstrate which of three distinct learning modules produce the most significant learning gains within 6 categories. In the future, we will attempt to increase the focus on scientific writing, as this area shows the weakest overall improvement. In addition, we believe the class experience could have been improved if student feedback was more actively incorporated throughout the course in an adaptive format, rather than assessed at the end of the class. As the multiple learning styles incorporated in the class appear to be achieving different goals, we recommend that they all be retained.

Literature Cited

Alibrandi, M. 1998. GIS as a tool in interdisciplinary environmental studies: student, teacher, and community perspectives. Meridian 3:1.

Alvarez, A. and J. Rodgers. 2006. Going “out there”: learning about sustainability in place. International Journal of Sustainability in Higher Education 7: 176-188.

Brody, M. 2005. Learning in nature. Environmental Education Research 11: 603-621.

Broussard, S.R., J. Mick La Lopa, and A. Ross-Davis. 2007. Synergistic knowledge development in interdisciplinary teams. Journal of Natural Resources and Life Sciences Education 36: 129-133.

Disinger, J. 2001. K-12 education and the environment: perspectives, expectations, and practice. Journal of Environmental Education 33:4-11.

Domask, J.J. 2007. Achieving goals in higher education: an experiential approach to sustainability studies. International Journal of Sustainability in Higher Education 8: 53-68.

Duvall, J. and M. Zint. 2007. A review of research on the effectiveness of environmental education in promoting intergenerational learning. The Journal of Environmental Education 38: 14-24.

Ernst, J.A. and M. Monroe. 2004. The effects of environment-based education on students’ critical thinking skills and disposition towards critical thinking. Environmental Education Research 10: 507-522.

Eves, R.L., L.E. Davis, D.G. Brown and W.L. Lamberts. 2007. Integration of field studies and undergraduate research into an interdisciplinary course. Journal of College Science Teaching 36: 22-27.

Farnsworth, D.L. 2008. Student presentations in the classroom. International Journal of Mathematical Education in Science and Technology 39: 692-697.

Foster, J. 1999. What price interdisciplinarity?: crossing the curriculum in environmental higher education. Journal of Geography in Higher Education 23: 358-366.

Hart, P. 2003. Reflections on reviewing educational research:(re)searching for value in environmental education. Environmental Education Research 9: 241-256.

Hoover, N.L., and R.G. Carroll. 1987. Self-assessment of classroom instruction: an effective approach to in service education. Teaching and Teacher Education 3: 179-191.

Jordan, R. 2007. Nudging academic science into the public sphere. Academe 93: 52-54.

Krest, M. and D.O. Carle. 1999. Teaching scientific writing: a model for integrating research, writing, and critical thinking. The American Biology Teacher 61:223-227.

Langan, A.M., D.M. Shuker, W.R. Cullen, D. Penney, R.F. Preziosi, and C.P. Wheater. 2008. Relationships between student characteristics and self-, peer and tutor evaluations of oral presentations. Assessment & Evaluation in Higher Education 33: 179-190.

Meyers, R.B. 2006. Environmental learning: reflections on practice, research, and theory. Environmental Education Research 12: 459-470.

Pittenger, K.K.S., M.C. Miller and J. Mott. 2004. Using real-world standards to enhance students' presentation skills. Business Communication Quarterly 67: 327-336.

Rice, R.E. 1998. "Scientific writing"—a course to improve the writing of science students; stressing the English language component of scientific writing. Journal of College Science Teaching 27: 267-272.

Schelhas, J., and J.P. Lassoie. 2001. Learning conservation and sustainable development: an interdisciplinary approach. Journal of Natural Resources and Life Sciences Education 30: 111-119.

Schneider, R.M., J. Krajcik, R.W. Marx, and E. Soloway. Performance of students in project-based science classrooms on a national measure of science achievement. Journal of Research in Science Teaching 39: 410-422.

Schugg, M.C. 2000. What does economics contribute to environmental education? Social Studies 91: 53-57.

Seago, J.L. Jr. 1992. The role of research in undergraduate instruction. The American Biology Teacher 54: 401-405.

Stapp, W.B. 1969. The concept of environmental education. The Journal of Environmental Education 1: 30-31.

Sterling, D.R. 2008. Assessing student presentations from 3 perspectives. Science Scope 31: 34-37.

Walsh, M., D. Jenkins, K. Powell, and K. Rusch. 2005. The campus lake learning community: promoting a multidisciplinary approach to environmental problem solving. Journal of College Science Teaching 34: 24-27.

Wingfield, S.S. and G. Black. 2005. Active vs. passive course designs: the impact on student outcomes. Journal of Education for Business 81: 119-123.

Figure Legends

Figure 1. Student self-assessment of understanding of endangered species issues, on a five-point scale, where 5 represents "strongly agree" and 1 represents "strongly disagree" with a statement that the student feels knowledgeable about the topic, before the course and after each course module. Error bars represent one standard error. Sample size is 58 for pre-course understanding (grand mean), 15 after module 1, 17 after module 2, and 16 for the final assessment. Bars associated with different letters were significantly different at the 0.05 level.

Figure 2. Student self-assessment of understanding of the Endangered Species Act of 1973, on a five-point scale, where 5 represents "strongly agree" and 1 represents "strongly disagree" with a statement that the student feels knowledgeable about the topic, before the course and after each course module. Error bars represent one standard error. Sample size is 58 for pre-course understanding (grand mean), 15 after module 1, 17 after module 2, and 16 for the final assessment. Bars associated with different letters were significantly different at the 0.05 level.

Figure 3. Student self-assessment of scientific writing skills, on a five-point scale, where 5 represents "strongly agree" and 1 represents "strongly disagree" with a statement that the student feels knowledgeable about the topic, before the course and after each course module. Error bars represent one standard error. Sample size is 58 for pre-course understanding (grand mean), 15 after module 1, 17 after module 2, and 16 for the final assessment. Bars associated with different letters were significantly different at the 0.05 level.

Figure 4. Student self-assessment of understanding of complexity of environmental topics, on a five-point scale where 5 represents "strongly agree" and 1 represents "strongly disagree" with a statement that the student feels knowledgeable about the topic,, before the course and after each course module. Error bars represent one standard error. Sample size is 58 for pre-course understanding (grand mean), 15 after module 1, 17 after module 2, and 16 for the final assessment. Bars associated with different letters were significantly different at the 0.05 level.

Figure 5. Student self-assessment of ability to synthesize knowledge from different disciplines to solve environmental problems, on a five-point scale where 5 represents "strongly agree" and 1 represents "strongly disagree" with a statement that the student feels knowledgeable about the topic,, before the course and after each course module. Error bars represent one standard error. Sample size is 58 for pre-course understanding (grand mean), 15 after module 1, 17 after module 2, and 16 for the final assessment. Bars associated with different letters were significantly different at the 0.05 level.

Figure 6. Student self-assessment of oral presentation skills, on a five-point scale where 5 represents "strongly agree" and 1 represents "strongly disagree" with a statement that the student feels knowledgeable about the topic,, before the course and after each course module. Error bars represent one standard error. Sample size is 58 for pre-course understanding (grand mean), 15 after module 1, 17 after module 2, and 16 for the final assessment. Bars associated with different letters were significantly different at the 0.05 level.

Figure 7. Student self-assessment of learning gains on endangered species issues, on a five-point scale where 5 represents "learning a tremendous amount" and 1 represents "if anything, it only confused me more", as a result of each course module. Error bars represent one standard error.

Sample size is 15 after module 1, 17 after module 2, and 16 for module 3. Bars associated with different letters were significantly different at the 0.05 level.

Figure 8. Student self-assessment of learning gains on the Endangered Species Act of 1973, on a five-point scale where 5 represents “learning a tremendous amount” and 1 represents “if anything, it only confused me more”, as a result of each course module. Error bars represent one standard error. Sample size is 15 after module 1, 17 after module 2, and 16 for module 3. Bars associated with different letters were significantly different at the 0.05 level.

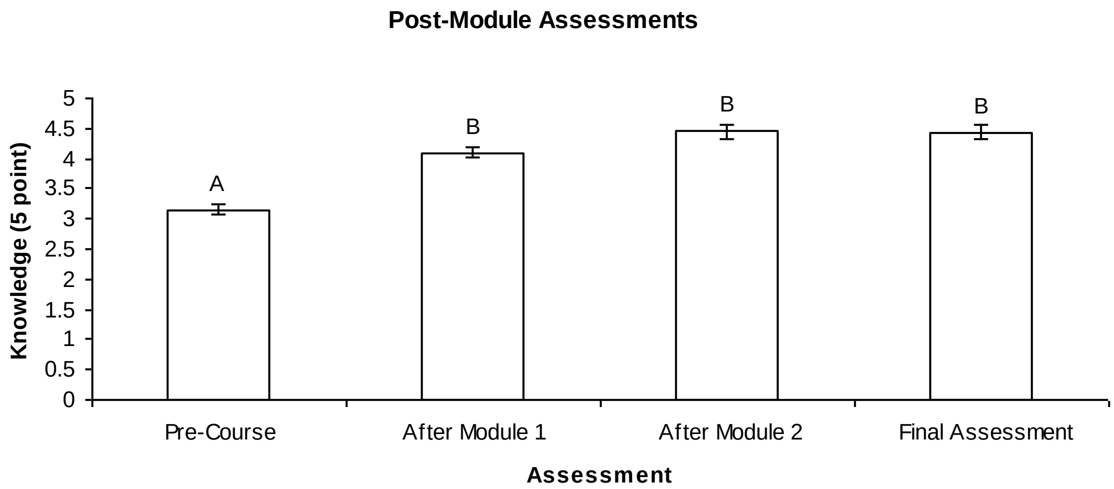
Figure 9. Student self-assessment of learning gains in scientific writing, on a five-point scale where 5 represents “learning a tremendous amount” and 1 represents “if anything, it only confused me more”, as a result of each course module. Error bars represent one standard error. Sample size is 15 after module 1, 17 after module 2, and 16 for module 3. Bars associated with different letters were significantly different at the 0.05 level.

Figure 10. Student self-assessment of learning gains on the complexity of environmental topics, on a five-point scale where 5 represents “learning a tremendous amount” and 1 represents “if anything, it only confused me more”, as a result of each course module. Error bars represent one standard error. Sample size is 15 after module 1, 17 after module 2, and 16 for module 3. Bars associated with different letters were significantly different at the 0.05 level.

Figure 11. Student self-assessment of learning gains on synthesizing knowledge from different fields, on a five-point scale where 5 represents “learning a tremendous amount” and 1 represents “if anything, it only confused me more”, as a result of each course module. Error bars represent one standard error. Sample size is 15 after module 1, 17 after module 2, and 16 for module 3. Bars associated with different letters were significantly different at the 0.05 level.

Figure 12. Student self-assessment of learning gains on oral presentation skills, on a five-point scale where 5 represents “learning a tremendous amount” and 1 represents “if anything, it only confused me more”, as a result of each course module. Error bars represent one standard error. Sample size is 15 after module 1, 17 after module 2, and 16 for module 3. Bars associated with different letters were significantly different at the 0.05 level.

Figure 1.



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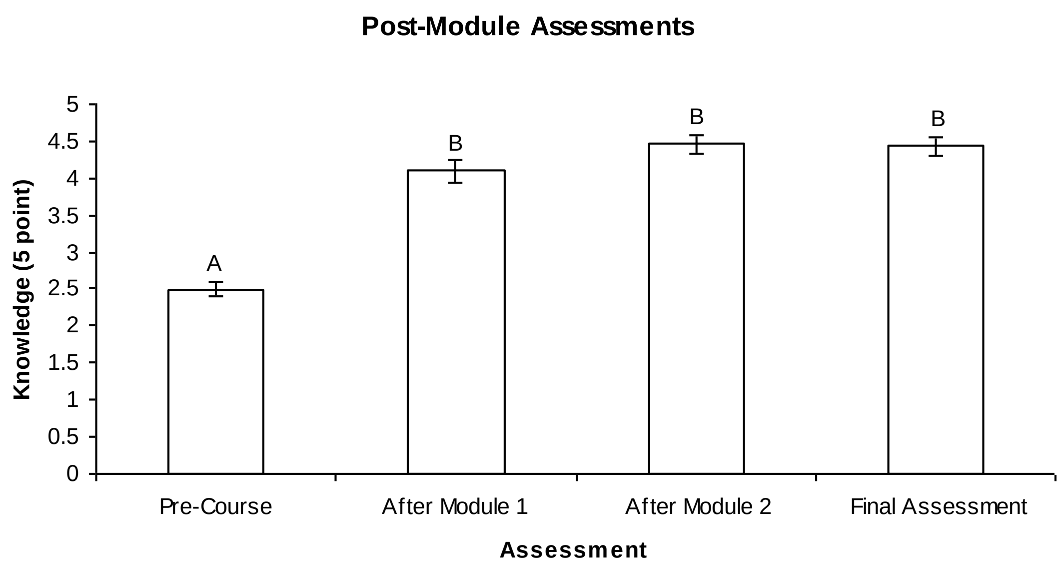

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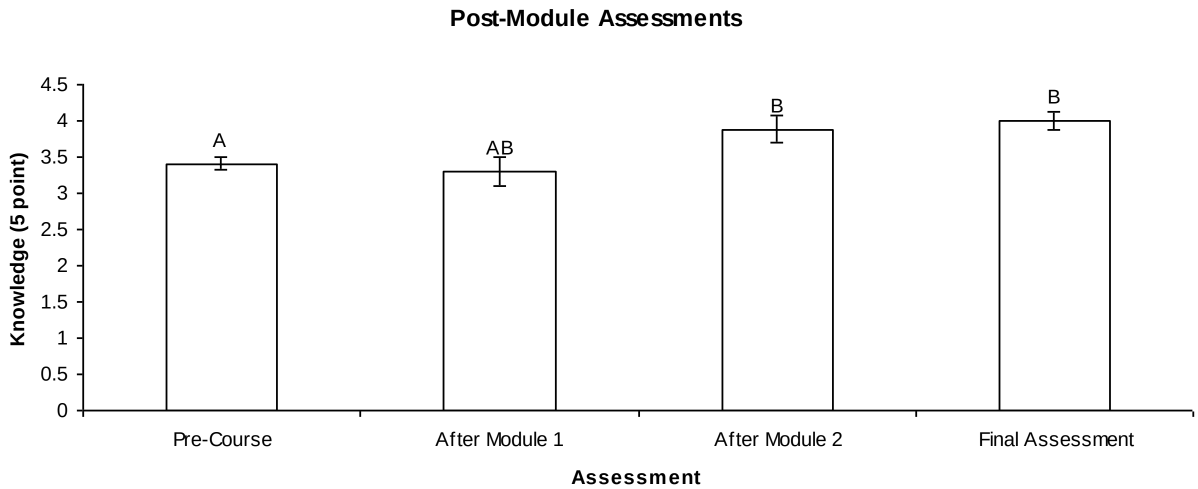

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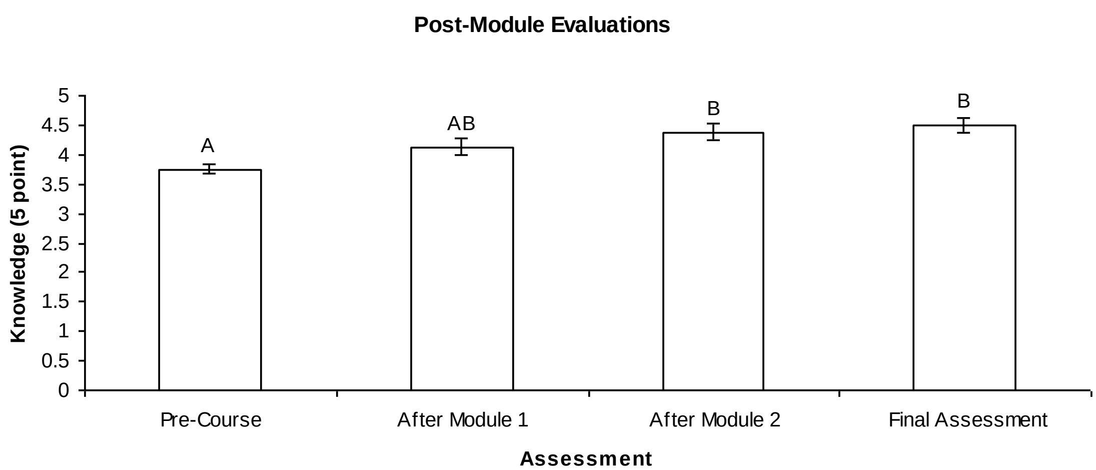

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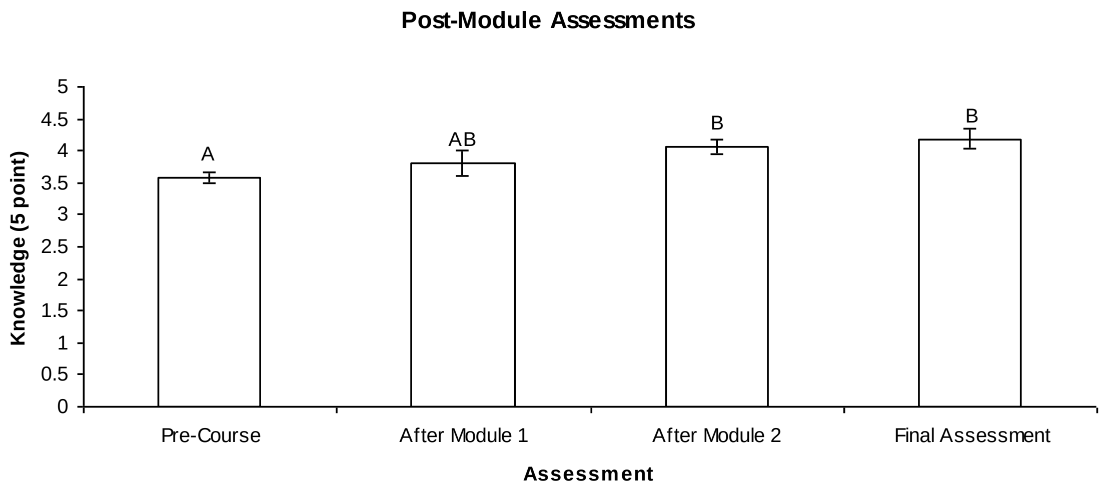

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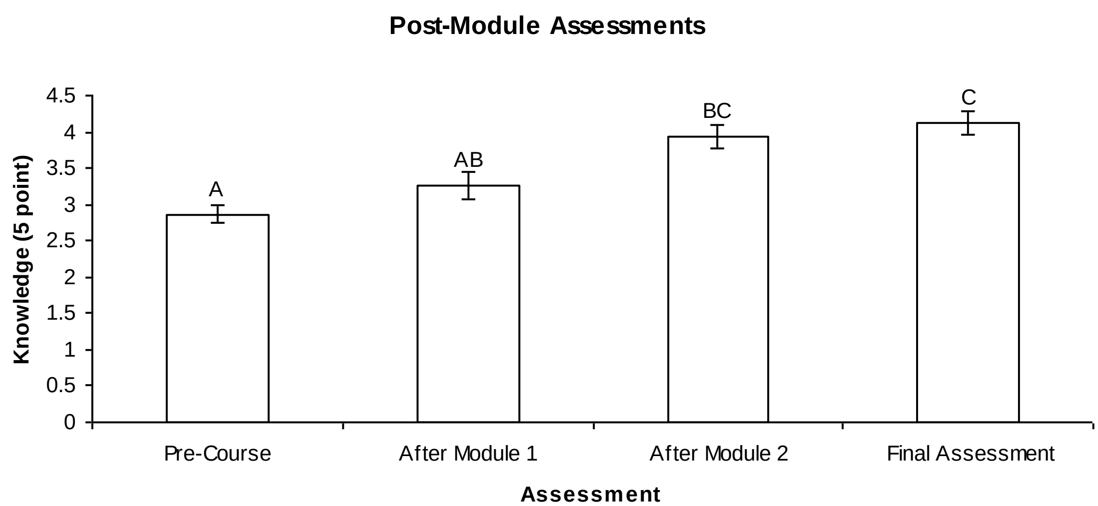

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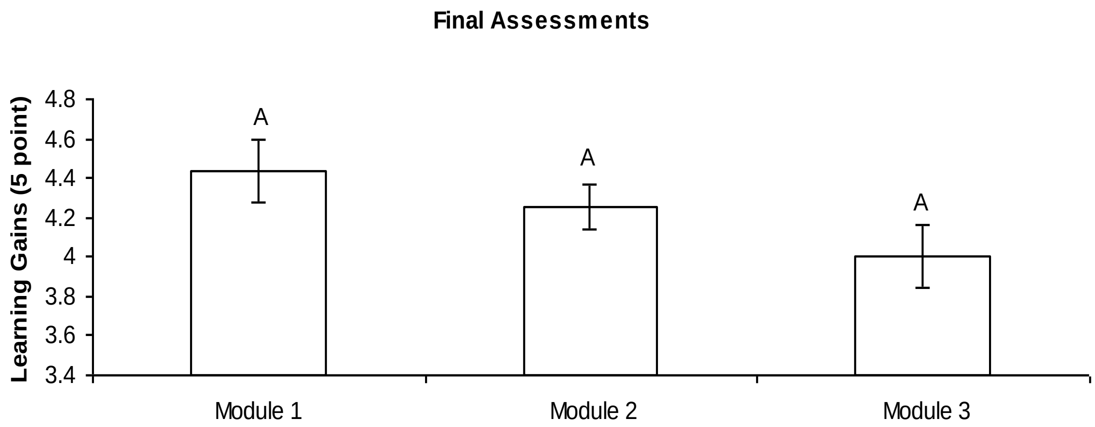

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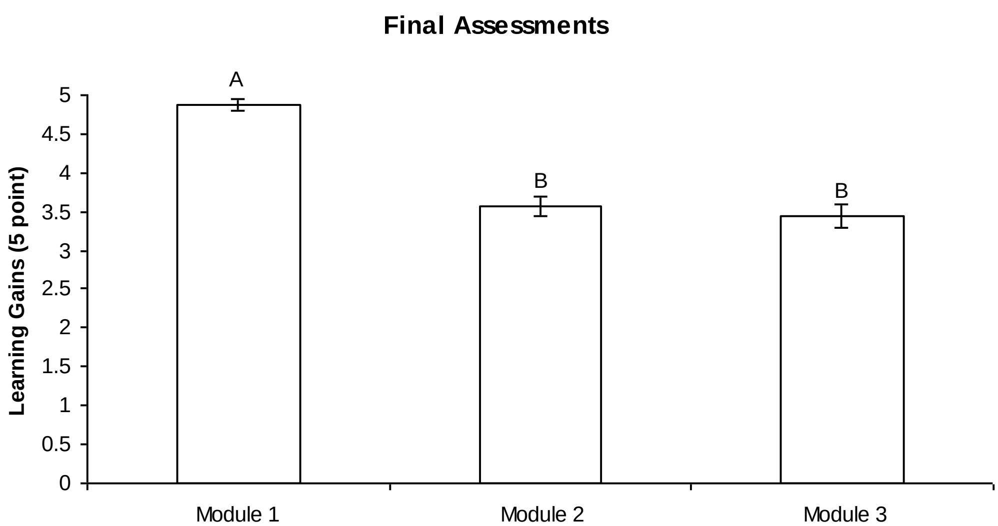

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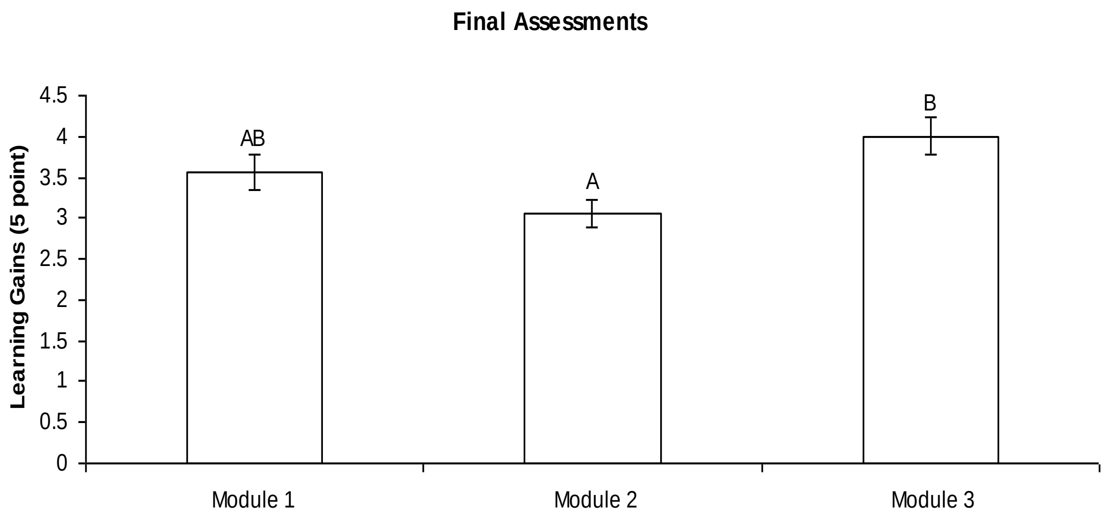

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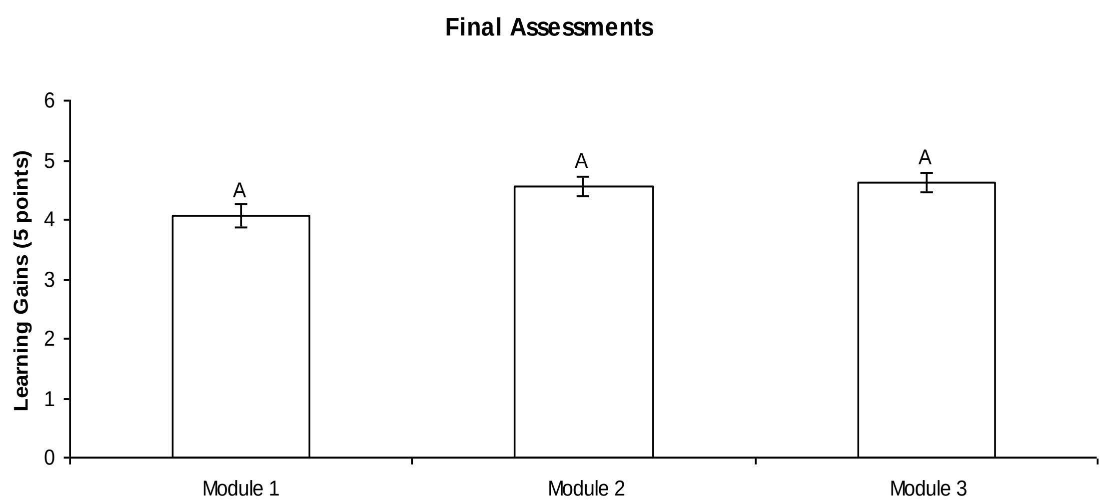

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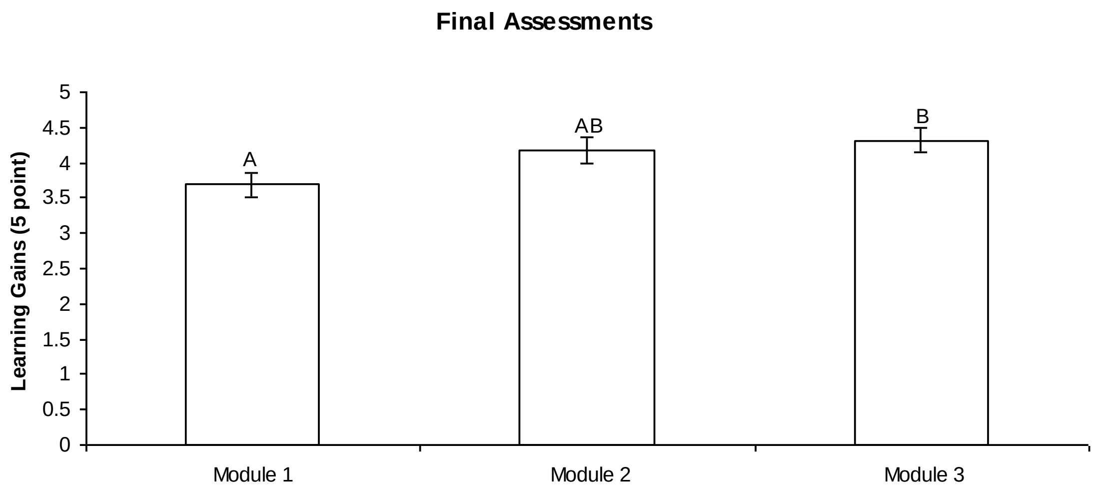

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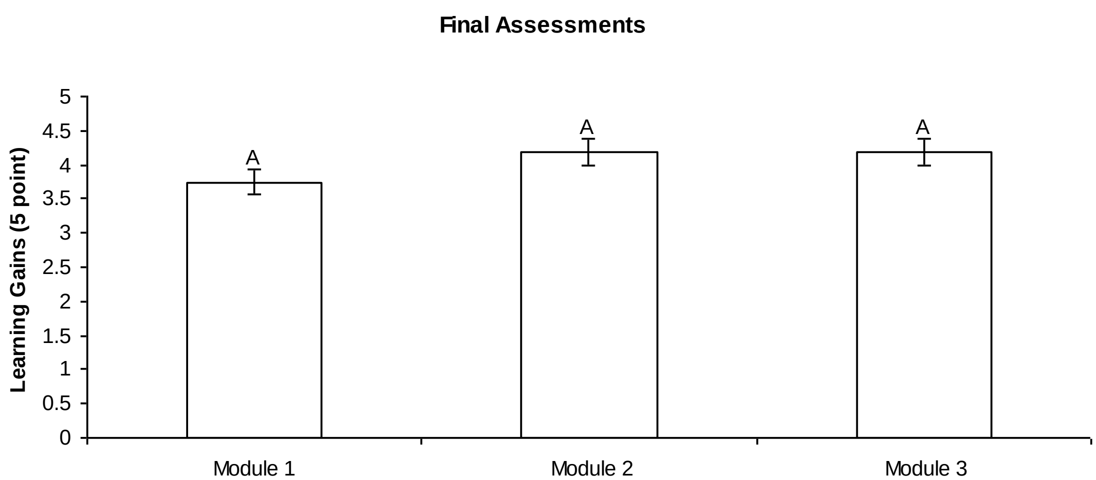


Reflective Statement- Engagement

It's hard to describe exactly what causes students to engage with course material. In a way it's like art—you know it when you see it. Even more unmistakable is when you've failed to create a sense of engagement in the classroom. Blank-eyed stares and yawns are pretty good indications that your students couldn't care less about whatever critically important (to you) point you're trying to convey. I remember sitting in a particularly bad economics class when I was an undergraduate. The instructor droned on and on without illustrating any of his points, repeating them if there was confusion, or even answering questions when students raised their hands. After receiving some negative feedback on a mid-course evaluation, he told us; "I am here to provide you with information, and that's all. You all seem to have the misapprehension that I am here to entertain you." Sitting at my desk, I recall thinking; "No, but you are here to show us why these materials are interesting and useful." That professor devoted his life to the study of economics; surely he must have found it a fascinating subject. Somehow, however, he failed to help us engage with the material around which he built his life's work.

In some ways, I'm quite lucky compared to that economics professor. His subject was by its very nature theoretical and that can make it difficult to engage students. I study biology, and specifically I work in ecology and environmental systems. Thus, it's comparatively easy for me to bring my students out of the classroom and into the real world. Specifically, my research projects focus on the ecology of urban areas, so it's quite easy for me to bring the students to my research sites—sometimes the college campus itself—and show them the diverse ecological interactions that are always happening around us. In addition, I can use the analytical methods I hone as a scientist in the field to quantify the effectiveness of my teaching and modify my lessons as a result. I find that illustrating classroom concepts with real-world examples can pique a students' interest quite effectively. It also doesn't hurt that I'm quite a bit more enthusiastic when I teach than my economics professor was. My subject endlessly fascinates me, and I see no reason not to help my students develop a sense of wonder about biology. Species conservation is a critical issue in our society, and students are easily excited and engaged in this topic, especially when they are given hands-on demonstrations and exercises.

When students are engaged, they go above and beyond to improve their understanding and build new skills. This was made very apparent to me through the final projects my students have completed for my courses. For example, when I assigned a project to create a conservation plan for a small plot of land in Jackson County, Wisconsin, I expected my students to investigate census data and demographics, research the local biology, and provide plans sufficient for protection of species. My students surprised me by going above and beyond my expectations, including visiting the site, taking careful inventory of the species that were present, contacting local officials, and tracking down grant sources for their proposed projects (Figure 13). Even without receiving feedback from them, their willingness to perform well beyond the simple project description showed me that I had succeeded in engaging them with the materials…for that project, at any rate!

Figure 13. Photograph taken by student during a site visit to proposed development location

I've used a few other strategies for engaging learners that have worked well. On one occasion I had an idea for a teaching exercise that I wasn't sure would achieve its learning goals. I pitched the idea to my advisor, while indicating to her that I'd need to make sure the students didn't realize I was unsure about how well it would work. After all, I wanted to appear to be a confident teacher. She looked very surprised, and said; "Of course you should tell them you're uncertain. Make sure they know that it's an experimental teaching exercise, and tell them exactly what you're trying to accomplish and how your idea will help accomplish that. If they buy in to the process, you'll be much more likely to reach them." After that conversation, I completely reversed my vision of a good teacher, from someone who simply provided knowledge in an expert fashion, to someone who engages with students to create a collaborative learning community. In the end, I did tell my students what I was trying to do and why, as well as my uncertainty about it, and the exercise worked even better than I had hoped.

In general I have benefited from very high levels of student engagement simply by maintaining lines of communication between myself and my students. Some steps are as simple as outlining specific learning goals for each section of a course and providing carefully worded rubrics. Often, I have had success anticipating student difficulties with assignments. I find that if, as I assign a difficult project, I let the students know that they probably will experience confusion or frustration, and that those processes are part of the learning process, the result is far more willingness on the part of students to persevere through challenging tasks. Of course, I also inform my students that I am always available to provide additional help and guidance whenever they need it.

Figure 14. All comments from 2007 and 2008 course evaluations that regard student engagement.

- "Dr. Magle has been an extremely encouraging and helpful professor. His lectures are thorough and interesting, and he provides excellent feedback on assignments. He is always available for questions and advice. I have greatly enjoyed the focus and intensity of this course…Overall, this has been one of the most challenging yet rewarding classes of my undergraduate career."
- "This class has been one of the most interesting and useful courses I have taken at the UW. Everything that we have done is potentially applicable to a possible career in wildlife biology. Writing a Habitat Conservation Plan was such a valuable experience, and even though it was a difficult assignment, everything we did in the class led up to it and in the end it was completely doable. We got great comments on our papers including a lot of advice on how to be better writers but also a lot of positive comments. Seth was a great professor and I'm so glad I took this class!"
- "I thoroughly enjoyed this class"
- "Seth is one of the best professors I have had at this university. The course was a wonderful finish to a great college career here, and it gave me a new career path!"
- "I learned a ton from this course, more than any other Environmental Studies course I have taken. I loved it, and Seth was great!"

Once lines of communication are open, I've found students are much more likely to remain engaged if they feel that their input actually matters. When I schedule my class periods, I like to keep a few class sessions, or portions of class sessions, open. I use these periods to focus in on topics of relevance to the students, and to go back over topics or concepts that remain confusing. I also solicit feedback on student teaching and learning frequently, and ensure that I acknowledge student concerns and, when possible, modify my lesson plans as a result. Feedback from my students indicates that they have high levels of engagement in my classes, partly as a result of this adaptive approach (Figure 14, Appendix 2).

My involvement with the teaching and learning community at UW-Madison has made me realize that I can apply the empirical methods I use in my research to assessments of my teaching, an example of teaching-as-research. In this way I can obtain hard data on the outcome of my teaching and learn how to improve and adapt my pedagogical strategies. For my Delta Program internship, I engaged my students in repeated self-assessment of their learning gains, and summarized the results of this analysis as a function of each module of the course. The input that I received from these self-assessments helped me to tailor the remainder of the class, providing better learning for the students. Though this course has been taught for many years, this is the first quantitative assessment of the efficacy of the different components of the course. While teaching methods will of course change to adapt to each new cohort of students, all of which are unique, these baseline data will be invaluable to future instructors. More importantly, my assessments of student learning throughout the semester, and my explanations of why these assessments were used, demonstrated that I was committed to student learning. The students, in turn, were thereafter more willing to engage with the course material and with the instructor.

There are countless ways to connect with students and to increase student engagement. I have spent this reflection discussing a few that have worked for me, but my eyes are always open for new methods and techniques that will keep my students interested and learning. In the future, I intend to be more explicit about asking my students, in surveys and course evaluations, which aspects of the course engaged them directly, and how I can improve their connection to course activities. In addition, I plan to be more adaptive, using feedback from students and my observations to immediately make small alterations and adjustments to my teaching style. Though it can be difficult to reach a high level of student engagement, it's usually quite apparent when you do, so I think the key is to try new things, remain attentive, and maintain lines of communication with your students.

Reflective Statement- Experiential Learning

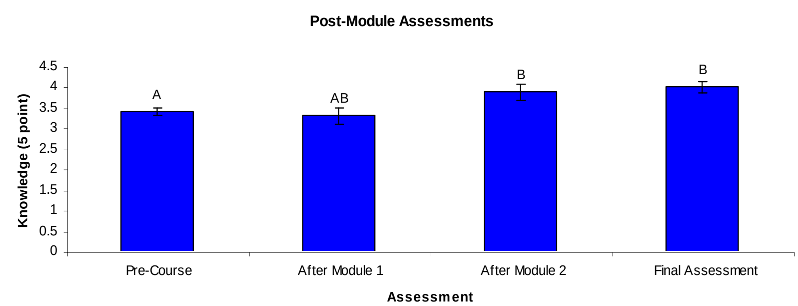
When you work in wildlife science, people tend to show an interest in what you do. After I gave a lecture on my research to a group of educators and scientists at the Denver Zoo, a zoo employee approached me. She ran the zoo's "Teens for Science" program and asked me if I would be interested in helping some high school students to gain experience with wildlife field biology. I was a little taken aback, and I told her that, while I was very interested, she should be aware that most of what I know about doing field science I picked up on my own, largely through trial and error. She smiled and said; "Then I bet you're good at it!"

Figure 15. Photograph taken by Denver Zoo volunteer of prairie dog colony in Denver, Colorado

Those students from the zoo gained hands-on experience with urban ecosystems (Figure 15), as well as providing me with a lot of valuable data. I came to realize that I only valued knowledge when I used it directly and could understand its application. Although it was many years before I taught in front of a classroom, I never forgot that important point, and that's why I always give my students an opportunity to practice the skills we learn in class. Not only does this aid retention, but it helps the students realize that what we learn is applicable to their future careers.

Writing is a key area where experiential learning is necessary. Virtually every profession requires some degree of writing ability. However, because classes are large and grading essays is difficult, instructors often decline to assign writing exercises to their students. The past two years I have taught a senior-level capstone course at the Nelson Institute for Environmental Studies, where most of my students are preparing for graduate school or future careers. To assess the efficacy of my teaching, I performed an internship project through the Delta Program to assess student confidence with course topics and how each improved as a result of the components of my course. This internship revealed that the vast majority of my students self-report relatively low confidence in their writing ability when they come into my class. Fortunately, their confidence levels gradually improve throughout the course as they continue to complete writing assignments (Figure 16).

Figure 16. Graph from Delta Internship project depicting student self-assessed writing skills on a 5 point scale, where 5 represents "strongly agree" and 1 represents "strongly disagree" with a statement that the student feels knowledgeable about the topic, before the course and after each course module. Error bars represent one standard error. Sample size is 58 for pre-course understanding (grand mean), 15 after module 1, 17 after module 2, and 16 for the final assessment. Bars associated with different letters were significantly different at the 0.05 level.



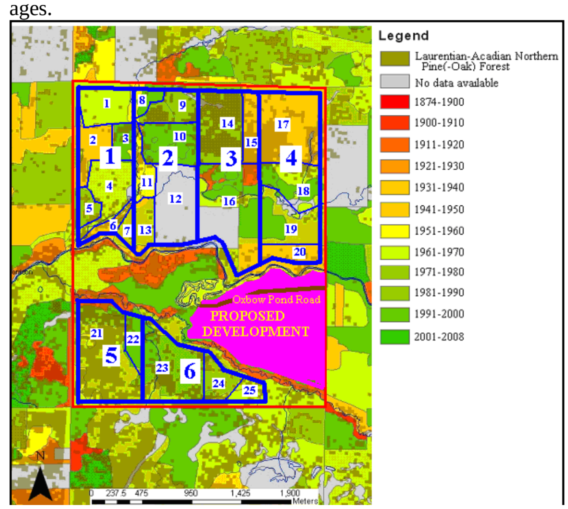
I assign numerous written assignments in my classes, with at least some written "in-class" (and thus with a time constraint) and others written at home, to maximize the different types of writing experiences for my students. Both to allay anxiety over subjective grading of written work and to give the students experience with the editing process, I allow my students one "re-write" of each essay after they receive comments back from me. In addition, I have the students peer review one another's work, and I evaluate them based on their review, and their resulting revisions. Along with writing assignments, I always provide a carefully worded rubric

(Appendix 3). This clearly defines measures of success for the students, gives clear expectations for grading and provides guidelines for student appeals of their evaluations. Obviously, these policies create quite a bit of additional work for me, and for the students. However, writing skills are so essential for careers in environmental science that I find these exercises to be quite beneficial, and my students do as well—usually after some early grumbling!

Although it makes a pretty good example, hands-on learning doesn't end with writing. Using inquiry-based group project assignments, I help my students to gain a whole variety of skills and tools that will be enormously valuable to them in their careers. In my capstone course, in the final third of the course the students work in teams to create a management plan for an endangered species. As part of this plan, they investigate a plot of land that I select, and then propose a development project that could take place on that site. They use their biological expertise to draft a conservation plan that will protect the endangered and threatened species that reside on that property. The students are given specific jobs within their groups which are determined based on their interest. I work closely with the groups to try to make sure each student is communicating well with one another and with the instructor, and that everyone's voice is heard. It is essential that the entire group takes joint responsibility, along with me, for their learning. In this way, the classroom becomes an inclusive learning community. I also make sure each group contains a diverse mix of students, to encourage learning-through-diversity within groups. For example, my students vary in background, ethnicity, economic status and in many important ways, but they also differ in their valuation of endangered species, which is the very topic of the course. My role as an instructor is to make sure that each student feels welcome to express their opinion in a safe, non-threatening environment. In a course like mine there are very few wrong answers, and we all gain a richer understanding of the political realities of conserving species when we hear a diversity of opinions. The conservation plans students draft are lengthy and include analysis of not only species biology, but human sociology and economics, geology, hydrology, and land use history. Many students use their plans as components of research portfolios, and they have also been reviewed by local agencies to assess their utility in real-world conservation scenarios. Students gain skills in numerous areas as part of this project, but for the remainder of this reflection, I'll focus on a few complex and challenging skills where my students have showed tremendous improvement.

Geographic Information Systems (GIS) are complex mapping software packages that can be used for mapmaking and spatial analysis. Digital maps are rapidly replacing paper ones, and people who are skilled at using these programs are highly sought after among employers and academic research teams. In my own research I have substantial experience using GIS programs and methodology, and I use these skills when instructing my students. After I collect surveys to identify the members of my class who have an interest in learning about GIS techniques, I assign them as land use specialists tasked with making maps as part of their final projects. I then provide multiple workshops where I demonstrate GIS techniques and work closely with the students through every step of the process including data acquisition, learning how to extract information from spatial data, spatial analysis, and map building. Many of my students have done outstanding work on these maps (Figure 17) and some have gone on

Figure 17. Map created by student using GIS methodology. This map depicts spatial locations of development and forest stand ages.



to full-time employment using the skills they learned.

Typically, students don't get into conservation or biological science because they want to do math. However, tracking and estimating the populations of endangered species really boils down to some fairly complex and rigorous mathematics, and therefore my students' projects include population dynamics modeling. I sometimes find that part of the process tedious, which made me initially reticent about teaching it. After some careful thought, I realized that my frustration with the material might actually make me a better teacher, as I could understand my students' difficulties and help them work through them. Ultimately, I came up with some novel, plain-language materials and figures that I used to convey the basics of population dynamics to my students. After filling them in on the basics, I encouraged them to experiment further by adding complexity to simple models and investigating additional approaches. The students initially expressed a lot of reluctance to use math, and I wasn't really sure how well I had done, but I was amazed at the elegance and intricacy of their final models (Figure 18). By rolling up my sleeves and helping the students build these mathematical models, I also learned more than a little, and overcame some of my initial hesitation about the topic. Thus, not only has my research helped with my teaching, but the reverse has been true as well.

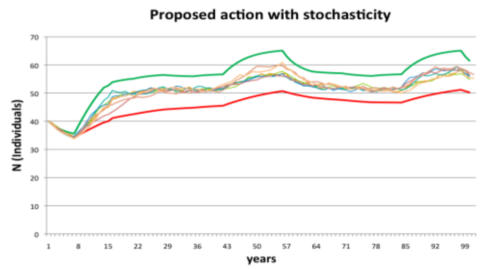


Figure 18. Output of student-generated population dynamics model. This model includes density dependence, multiple model runs, 95% confidence intervals and stochastic effects.

It's a fairly simple observation that students learn best by doing. Often, I find the tricky part is figuring out how to make an interesting exercise for a given topic. Sometimes I've had a brilliant insight, more often I've talked to a colleague about it and received some great ideas. On other occasions, I've asked the students how they think they might best learn a given set of materials and taught based on what they suggest. However, ever since I started thinking about teaching I've been convinced that there's no substitute for hands-on experience. I am going to continue to develop experiential exercises for my students, using examples from the scientific literature, advice from colleagues, and attempting new methods I develop myself. For courses in biology and environmental systems, I'm particularly excited to get students outside, making observations, collecting data, and crafting experiments in natural systems. I'm thrilled that I've been given an opportunity to stretch my brain for new and interesting ways to provide experiences to my students that will help them gain the skills they need to excel.

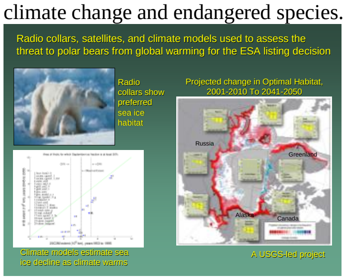
Reflective Statement- Contextual Learning

As I was putting the finishing touches on my syllabus for a class focused around endangered species and the Endangered Species Act of 1973, something unexpected happened. It was only two days before the first class period and I learned that former President Bush had made numerous changes to the Act based around the decision to list polar bears as endangered species. These changes were designed to ensure that the Act could not be used to protect species threatened by climate change.

While this had enormous implications for species conservation in this country, my more immediate reaction was concern about my class. Should I continue ahead with the syllabus I'd worked so hard on, or was it necessary that I make adjustments to ensure that my class learned about these recent events and their implications? Thinking about that question made me ponder the situations in which I best learned, and what type of class I wanted to run. I realized that most of my best teaching and learning happened when subject matter was placed in the proper context, either by relating it to current and ongoing events, or to my own situation or needs. Contextual learning is particularly important in scientific disciplines, as science subjects can rapidly become overly theoretical and disconnected from the students, which often diminishes learning gains. After I made this realization, I knew what I had to do, so I rolled up my sleeves and started changing the syllabus to incorporate these recent events.

Ultimately, I think my changes, though unavoidably last minute, worked well. I was able to find a guest speaker who provided a fascinating lecture on polar bears and how they are impacted by climate change (Figure 19). We had numerous interesting and useful discussions about the changes to the Act, which also helped my students to learn more about its workings. In the end, some of my students even decided to write letters during the public comment period to give their opinion to government officials on the proposed changes (Appendix 4). Many students remarked that learning about the Act with respect to current events made them realize the importance of the subject matter. On reflection, I think the extra time I spent to give my students a contextual learning experience was well worth it.

Figure 19. Title slide from a guest presentation by Dr. Eric DeWeaver on climate change and endangered species.



Contextual teaching and learning isn't always about current events—certainly I'm not always lucky (or unlucky) enough to have a major breakthrough in my discipline a few days before a class starts. Another method I've used to place course materials in context is to relate the topics personally to each student. As an example, when teaching the course mentioned above on endangered species, I usually start by having each student research an endangered species found near their hometown. They then give a presentation to the class outlining the biological needs of the species and why it has become endangered (Figure 20). Making the topic of endangered species somewhat personal to the students in this way helps them to understand the real-world application of endangered species biology and law, and places the subject in the proper context. Giving the topic individual relevance also helps students tap into their existing knowledge of biology, which is frequently more advanced than they realize. In addition, learning where each student comes from and what species are of interest to them gets my students talking with and

Figure 20. Title slide from a representative student presentation on an endangered species found near their hometown.

thinking about one another, an important step towards building the classroom into a vibrant learning community. These connections between students lead to shared discoveries and a welcoming, inclusive environment.

While an instructor can encourage contextual learning by use of examples and anecdotes while lecturing, and these methods certainly help, I also like to use exercises and course modules on current events, or that relate personally to students. In my experience, keeping course materials in the proper context improves student engagement and retention of course materials. It also has the added benefit of keeping the instructor both up to date on current events, and aware of the personal circumstances of his or her students. I am continuing to follow current events in biological and environmental science, and working to tie them into my classroom exercises. Maintaining a good network of cutting-edge researchers who are willing to visit my students to discuss how classroom activities directly relate to real-world science and natural resource conservation will aid as well. I am always continuing to think about the best way to teach course materials so that students can clearly understand how their classroom learning relates to real-world situations, and I feel as though I am getting better all the time.

Reflective Statement- Inclusivity

When I had my first appointment as a teaching assistant, I was excited to review my course evaluations. I had worked hard to ensure I knew the material and could express my knowledge to the course. I was extremely disappointed when I read the first evaluation on top of the pile. While the student acknowledged that my levels of understanding of the subject were high, she noted; "Somewhat aloof and distant. Hard to approach. Difficult to envision him as a peer." The instructor for the course told me not to worry about this assessment, as he felt that presenting the material was more important than engaging directly with the students. After reflection, I decided that I couldn't disagree more. I didn't feel then, and I don't feel now, that students can learn from even the most brilliant lecturer if they don't feel like they are part of a welcoming, inclusive learning community. As I moved on to leading my own classes, I always tried to remember that evaluation. Keeping it in mind helps me ensure my classrooms are open, hospitable environments where the students' analyses and points of view form a part of the larger learning experience.

Teaching courses on environmental issues often leads to discussions of controversial issues. One of my courses focuses on the Endangered Species Act of 1973, and my class has many debates on topics such as; How much land should we set aside for wildlife? When is it permissible to restrict the use of a person's land or property to protect species? Do native people have a right to harvest endangered species for cultural practices? As a society, what other concerns such as economic growth or national security might supersede the right of a non-human species, and how do we decide? The students have a wide range of opinions on these topics, and my job as an instructor is to make sure that we acknowledge that every opinion on these issues is valid. Incorporating everyone's viewpoint and thus learning-through-diversity helps us all to learn about the importance of varying points of view. My courses rarely focus around clear facts like you might encounter in mathematics or physics. Environmental science is often normative (based on values), and this makes it doubly important that the classroom be an inclusive setting where no one feels their viewpoint is invalid.

In one class period, I raised the issue of land use restrictions used to protect a certain bird species. I was hoping to inspire a lively debate about the degree to which the government could intrude on the lives of private people to protect wildlife. Initially I was deeply disappointed because the response was very one-sided. As you might expect in an environmental science course, the students overwhelmingly spoke up and said that the government should do whatever it needs to do to protect wild birds, even if that means restricting the rights of landowners. I found myself on a bit of a precipice—with so much universal agreement, I considered just moving on to the next topic I had planned to discuss. However, after a moment of hesitation I decided to speak up myself and express the opposing view, that private landowners have important rights and have to be respected if species conservation is to succeed. After I finished, a few students who had been quiet began to express similar views, and ultimately we had a very useful and illuminating discussion. After the class one these initially shy students approached me to thank me. They said they'd been feeling outnumbered and didn't want to express their opinion until I acknowledged the validity of both sides of the equation. I realized after that class period that a small amount of input by me could go a long way in making a classroom more inclusive to people from diverse backgrounds and varying perspectives.

To help my students to acknowledge the importance of other points of view, I assign numerous discussions and debate exercises that require the students to research and communicate a whole diversity of opinions (Example given as Appendix 5). When possible I assign students to represent stakeholder groups that hold quite different viewpoints from the students themselves to ensure they are forced to step outside of their own experience. While the students tend to be initially overwhelmed by these assignments, by the end of the section they indicate that their learning gains are tremendous, and often they have learned to better empathize with alternate viewpoints (Figure 21).

Figure 21. Student-created handout in which students are representing the viewpoint of industry groups.

Creating a welcoming and inclusive classroom environment means more than just encouraging different points of view. Diversity in all its forms should be embraced so that students from all backgrounds and walks of life can have their voices heard, and so that all students understand the validity of different ideas and views. Diversity is multi-dimensional and goes far beyond what an instructor can see. This was brought home to me as a student in a seminar on diversity issues, in which the instructor remarked on how unfortunate it was that all the participants in the seminar were Caucasian. After the class ended, one participant approached the instructor and politely commented that he was a little offended by her statement because he was, in fact, full-blooded Cherokee. I'm not sure if that event strongly impacted the instructor of that seminar, but it had a real impact on me, and got me thinking about diversity and how it connects to student learning and an inclusive classroom. I believe a good instructor should never assume his students are the same as he is, or that their views or opinions on controversial issues are any less valid.

It seems to me that because diversity is complex, including factors such as age, race, socioeconomic background, political and religious viewpoints, as well as countless others, the only way an instructor can be sure of being inclusive and welcoming is to be respectful and cognizant of the complexity of variation that exists in any student body, while exposing the students to dissimilar groups and their points of view. Teaching my students about other cultures and opinions isn't something I can always do on my own, since I have only my own background to draw upon. A diverse set of guest speakers can provide a valuable resource for student inclusivity and learning about diversity. As one example, because Native American tribes are heavily involved in environmental conservation in the United States, for the past two years I've invited Dr. Jon Gilbert from the Great Lakes Indian Fish and Wildlife Commission to speak to my classes from a tribal perspective (Figure 22). This and other guest lectures from speakers with a variety of life history and experience have been well received by my students.

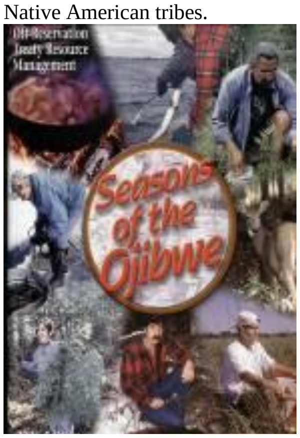


Figure 22. Handout from Dr. Jon Gilbert's lecture on wildlife species and their importance to Native American tribes.

Creating a welcoming and inclusive environment where all my students can learn from their collective diversity is not easy, and I still have a lot of learn. Nevertheless, I feel I've come a long way since I first received that assessment stating that my teaching style was aloof and unapproachable. In the last year ten of my students have asked me to write them letters of recommendation for graduate school, and my evaluations indicate that most students feel relaxed and comfortable within my classroom (Figure 23). In the future, I plan to include questions in mid-term surveys to ask the students how I can improve on the classroom environment, and to make a continuous, concerted effort to understand and address the concerns of students who may feel marginalized or outnumbered. It's particularly important to maintain an inclusive environment throughout so that students in minority groups, or who hold minority opinions, feel comfortable speaking up for themselves. The process of creating a classroom where students are relaxed and willing to express themselves is never-ending, but I'm excited to keep improving as I learn along with my students.

Figure 23. All comments from 2007 and 2008 course evaluations regarding classroom atmosphere and inclusiveness.

- "Seth was great. Very approachable and knowledgeable. Fortunately maintained an open classroom environment conducive to discussion"
- "It was a very familiar and comfortable environment. I thoroughly enjoyed this class and will genuinely miss it"
- "I thought the wide-range of evaluative criteria was beneficial and appropriate. Also it was laid back atmosphere (sic)."
- "Relaxed atmosphere. Interesting material."
- "The professor led the class in a very comfortable manner"
- "I appreciated the relaxed class atmosphere."
- "Relaxed atmosphere."
- "I liked the relaxed environment and the ability to learn by doing research and reading and not just listening to Seth speak…though his lectures were helpful!"
- "Very comfortable. I thoroughly enjoyed this class."

Appendix 1. Questionaires given to students of the IES 600 course to gather data for the Delta Internship Teaching-As-Research project. Questionaire 1 was given on the first day of class, Questionaire 2 was given twice during the course, and Questionaire 3 was given on the final day of the class.

Questionaire 1

Thank you for taking this evaluation. By doing so you are helping to improve the course for the remainder of the semester by providing valuable feedback. In addition, you are contributing to research on teaching methods that will help students in the future.

Please rate your abilities PRIOR TO TAKING THE CLASS using the following scale:

5 - strongly agree
4 - agree
3 - neither agree nor disagree
2 – disagree
1 - strongly disagree

1. I feel knowledgeable about endangered species issues. _______

2. I feel knowledgeable about the Endangered Species Act of 1973 _______

3. I feel confident in my ability to write scientifically _______

4. I feel that I understand the complexity of environmental issues _______

5. I feel capable of combining knowledge from different fields as they relate to environmental issues _______

6. I feel confident in my ability to give oral presentations on scientific topics _______

Appendix 1 cont.

Questionaire 2

Please rate your abilities PRIOR TO TAKING THE CLASS using the following scale:

5 - strongly agree
4 - agree
3 - neither agree nor disagree
2 – disagree
1 - strongly disagree

1. I feel knowledgeable about endangered species issues. ________
2. I feel knowledgeable about the Endangered Species Act of 1973 ________
3. I feel confident in my ability to write scientifically ________
4. I feel that I understand the complexity of environmental issues ________
5. I feel capable of combining knowledge from different fields as they relate to environmental issues ________
6. I feel confident in my ability to give oral presentations on scientific topics ________

Please rate your abilities AS A RESULT OF TAKING THIS COURSE using the following scale:

5 - strongly agree
4 - agree
3 - neither agree nor disagree
2 – disagree
1 - strongly disagree

7. I feel knowledgeable about endangered species issues. ________
8. I feel knowledgeable about the Endangered Species Act of 1973 ________
9. I feel confident in my ability to write scientifically ________
10. I feel that I understand the complexity of environmental issues ________
11. I feel capable of combining knowledge from different fields as they relate to environmental issues ________
12. I feel confident in my ability to give oral presentations on scientific topics ________

Appendix 1 cont.

Questionaire 3 (Final questionnaire).

Please rate your abilities PRIOR TO TAKING THE CLASS using the following scale:

5 - strongly agree
4 - agree
3 - neither agree nor disagree
2 – disagree
1 - strongly disagree

7. I feel knowledgeable about endangered species issues. ________
8. I feel knowledgeable about the Endangered Species Act of 1973 ________
9. I feel confident in my ability to write scientifically ________
10. I feel that I understand the complexity of environmental issues ________
11. I feel capable of combining knowledge from different fields as they relate to environmental issues ________
12. I feel confident in my ability to give oral presentations on scientific topics ________

Please rate your abilities AS A RESULT OF TAKING THIS COURSE using the following scale:

5 - strongly agree
4 - agree
3 - neither agree nor disagree
2 – disagree
1 - strongly disagree

13. I feel knowledgeable about endangered species issues. ________
14. I feel knowledgeable about the Endangered Species Act of 1973 ________
15. I feel confident in my ability to write scientifically ________
16. I feel that I understand the complexity of environmental issues ________
17. I feel capable of combining knowledge from different fields as they relate to environmental issues ________
18. I feel confident in my ability to give oral presentations on scientific topics ________

Appendix 1 cont.

Questionnaire 3 cont.

Please rate your improvement during the course AS A RESULT OF EACH COURSE MODULE using the following scale:

5 – learned a tremendous amount
4 – learned quite a bit
3 – learned a little
2 – not sure I learned anything
1 – if anything, it only confused me more

Module 1: The first third of the course, instructor and student lectures and presentations
Module 2: The middle of the course, debate and research on the interaction of salmon and dams
Module 3: The final portion of the course, drafting HCPs in groups and presenting those HCPs

Topic	Module 1	Module 2	Module 3
I learned about endangered species issues			
I learned about the Endangered Species Act of 1973			
I improved my ability to write scientifically			
I gained an understanding of the complexity of environmental issues			
I gained an ability to combine knowledge from different fields as they relate to environmental issues			
I improved my ability to give oral presentations on scientific topics			

Appendix 2. Unsolicited Letter of Support from a Student

The following is an unsolicited letter on behalf of Dr. Seth Magle:

Habitat Conservation Planning for Endangered Species on Private Lands (IES 600) was one of the most challenging and interesting courses I have taken at UW-Madison. Dr. Magle cultivated a professional atmosphere in which students were able to participate constructively and openly. The curriculum was both thorough and demanding, requiring a diligent work effort. Over the semester, I went from a rudimentary knowledge of the Endangered Species Act to a comprehensive understanding of the intricacy and controversy regarding endangered species management in the United States. In particular, I have gained a detailed understanding of the Section 10 permitting provisions under the Endangered Species Act, including Habitat Conservation Plans, Candidate Conservation Agreements and Safe Harbor Agreements. Furthermore, I am comfortable interpreting and evaluating the strengths and weaknesses of each provision. As a conservation biology major, I feel better prepared to confront the legal and political aspects of a career in environmental science.

In addition to establishing a productive classroom environment, Dr. Magle did wonderful job balancing independent and collaborative requirements. For the first time in my college career, I participated in a group project where everyone contributed equally. Our diverse backgrounds and areas of study were utilized through creative and challenging assignments. We had numerous opportunities to present our opinions to the class, share ideas and ask questions. Throughout the course, Dr. Magle provided superior guidance and feedback for written assignments and presentations. My writing and speaking skills improved noticeably during the course. I feel more confident conducting research, writing scientifically and presenting my findings to a knowledgeable audience. Overall, Dr. Magle utilized an excellent combination of lectures, interactive exercises, outside coursework, case studies, group projects and readings. I am fortunate to have attended such a thorough and well-taught seminar.

Carolyn Robbins[1]
Senior, University of Wisconsin-Madison
cbrobbins@gmail.com
303-981-5315

[1] This student provided consent to include her name in this portfolio.

Appendix 3. Example rubric for writing exercise.

Grading Rubric for IES 600 In-Class Essay Assignment.

Content (Out of 15):

Score	Description
~15	Student provides a detailed description of each relevant section of the Act, including implications of key phrasing, and relevant subsections where appropriate (e.g. 10a1A and 10a1B). Species biology and reasons for endangerment are illuminated clearly and completely. Recovery plans and history of the listing decision are outlined.
~13	Student provides a description of most relevant sections of the Act, getting the main points of major sections all correct. Species biology and reasons for endangerment are discussed. Recovery plans and/or history of listing decision are mentioned, or discussed very briefly.
~10	Student describes sections of the Act, but some details are wrong or sections are confused. Species biology is discussed, but not in relation to endangerment or the Act, or with key omissions. Recovery plans and/or history of listing are omitted, or have errors.

Depth: (Out of 15):

Score	Description
~15	Student demonstrates impressive knowledge of the Endangered Species Act and is able to discuss sections that create controversy, or details that lead to controversy and confusion, and how these sections are typically interpreted. Species biology is outlined in a scientific, thorough manner that indicates familiarity with current research on the species. History of the species, as well as other species potentially impacted by listing decisions, have been clearly researched and presented.
~13	Student demonstrates average knowledge of the Endangered Species Act and is able to discuss one or two key interpretations or controversial sections. Species biology is outlined sufficiently to address the assignment, but no further. History of the species, as well as other species potentially impacted by listing decisions, are mentioned.
~10	Student fails to address some sections of the ESA. Certain aspects of species biology mentioned in the assignment are not addressed. History of the species, as well as other species potentially impacted by listing decisions, are not mentioned or are incorrect.

Organization: (Out of 10):

Score	Description
~10	Essay sections flow clearly from one to the next, with transition sentences connecting paragraphs, and paragraph topics either identified with titles, or clear within the text. Ideas are logically connected.
~8	Essay sections flow fairly clearly from one to the next, but ideas sometimes seem off-topic. Paragraph topics can be discerned. Ideas are mostly logically connected.
~6	Essay sections are not presented in an identifiable order. Paragraph topics cannot be discerned. Ideas do not follow from one another.

Details: (Out of 10):

Score	Description
~10	Language of essay is comprehensible and engaging. At a maximum, only 1 or 2 spelling or grammatical errors detected.
~8	Essay has some spelling and grammatical errors, but they do not detract from the readability of the essay. Language is comprehensible.
~6	Essay has numerous spelling or grammatical errors that make it difficult to read. Language is difficult to follow.

Appendix 4. Representative letter from my students to the Secretary of the Interior in response to proposed changes to the Endangered Species Act of 1973

We are writing this letter to comment on the proposed changes to the ESA. We are students who are learning about this important law, and are concerned about the well-being of species throughout the nation. While we are uncertain whether the ESA provides the appropriate tool to prevent climate change, we are very worried about the proposed changes to Section 7 of the Act. This section provides the only protection for species on federal lands. Making consultation with the Fish and Wildlife Service optional means that numerous agencies with no experience in biology will be forced to guess as to whether their actions could harm species. In many cases, they are bound to guess wrong. We strongly urge you to reconsider this change to the act.

Sincerely,
(Names withheld)

Appendix 5. Example Debate Assignment.

Modified by Seth Magle from original assignment by Dr. Nancy Mathews

Removal of 4 dams in the lower Snake River, Idaho:
Endangered Salmon vs. Hydro-electric power

Background: During the next 3 weeks you will be learning about the endangered salmonid issues in Idaho, Oregon, and Washington. This has become one of the most hotly contested endangered species issues ever faced and will likely continue long into the future. At the heart of the issue is whether we can save the existing runs of salmon and trout that have declined to near extinction. Balanced against this charge, via the Endangered Species Act, we have at least 10 different stake holders with some degree of objection to the most prudent biological measures to save the salmon (e.g., complete removal of the dams).

Assignment: Your assignment is to learn about the issues, obtain facts and information. You will then be given a stakeholder position, and you will use these facts and information and additional research to support your position. You will be given a chance to try to reach a consensus on the issues during a "God Squad" type debate on October 27th. You must become familiar not only with your particular viewpoint, but also with other viewpoints, in order to argue your position.

For your debate preparation, you will first be given some questions to research and present on October 20th. Next, you and your partner will need to conduct intensive internet research to learn about the issues and stance of your particular stakeholder group. You will present your stakeholder positions for the debate next Wednesday the 22nd. You will need to develop a 2-3 page "handout", for use during the debate, which provides other groups with details to support your position. You will also need to state directly who your allies are on each of the stated debate points to assist you in building coalitions during the God Squad debate.

Schedule:

October 13	**Peer review project, Words of Limited Wisdom from Seth, groups form, work day**
October 15	**Guest speaker on salmon issues, work day (Essay #1 optional re-write due)**
October 20	**Presentation on worksheet assignment, work day (Essay #2 due)**
October 22	**Special Interest Group (SIG) Persuasive Presentation, debate preparation**
October 27	**God Squad Debate**
October 29	**Discussion of God Squad Process and Outcomes; Introduction to HCP assignment and guest speakers**

Grading: This case study will culminate in an in-class debate, in the form of a God Squad. Your grade (based on 75 pts) will be based on:

1. **Performance on worksheet presentations (10 points)**
2. **Performance on SIG persuasive presentations (15 points)**
3. **Performance during God Squad Debate (50 points)**

During the God Squad you will be evaluated during a 2 hr period on how well you: 1) understand your special interest group's (SIG) position, and articulate that position during the debate or other class exercises, and 2) how knowledgeable you are of the facts and information supporting your SIG's stance (as demonstrated through debate participation).