TEACHING AND LEARNING PORTFOLIO

by

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MAY 2007

This portfolio submitted in partial fulfillment of the requirements for the Delta Certificate in Research, Teaching, and Learning.

Delta Program in Research, Teaching, and Learning
University of Wisconsin-Madison

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2007

Teaching and Learning Portfolio

Evidence of an intentional process

Alysa J. Remsburg

May 2007

Portfolio Overview:
Evidence of an intentional teaching and learning process

Communicating my teaching and learning philosophy and reflecting on my experiences helps me develop as a teaching professional and as a lifelong learner. This portfolio summarizes my beliefs and objectives for the teaching and learning process. In addition, it contains a sample collection of my experiences putting my teaching beliefs into practice. This working collection will continue to improve as I gain new insights and experiences. The portfolio begins with an overview of my teaching and mentoring philosophies. The three teaching examples that follow each include a short reflective statement and a document illustrating how I created meaningful learning experiences for students. My central goal is to help students approach learning as an important and intentional process, and not as a passive experience.

Portfolio Contents

Statement of Teaching and Learning Philosophy

My undergraduate advisor's memorable enthusiasm for both the material and the art of teaching was the spark that prompted my interest in teaching. When lecturing, Dr. Lewis asked students to form hypotheses, help explain graphs, and relate course material to our own research projects. The inquiry-based teaching style that he modeled is central to my own teaching philosophy because it encourages students to learn for the sake of discovery and problem solving. I still have the notes that I began taking as a sophomore undergraduate student when I was consciously analyzing how to improve student learning in biology courses. Thus my teaching and learning philosophy is a synthesis from eight years of reflecting, journaling, discussing, and practicing how to be an outstanding college teacher. As a course instructor and research mentor, five core techniques help me foster student learning: defining learning objectives, creating an active learning environment, evaluating my own and student progress regularly, communicating effectively, and stimulating enthusiasm.

I identify enduring learning objectives at the earliest stages of planning curricula and teaching approaches. Although I am often anxious to apply some of the proven teaching techniques that I learn about from colleagues or education articles, I realize that specific approaches can only be chosen after I detail the learning objectives and measurable outcomes I hope to achieve. For all students in my classrooms and laboratory, I include practical learning objectives such as critical thinking, collaborating, applying knowledge to new situations, communicating, and conducting the rigorous scientific process of discovery. When I taught data analysis techniques to introductory biology classes, I reviewed common mistakes in previous students' independent projects. Then I provided students with a list of the learning objectives and a sample paper demonstrating my high expectations for their own projects. When students become aware of the learning objectives, they can actively monitor their own progress.

I create interactive classrooms. Small group activities promote preparation outside the classroom and cooperative learning among individuals with diverse backgrounds or learning styles. Active learning forces students to identify misconceptions and to apply new knowledge. While smaller class sizes facilitate shared learning more easily, large lecture formats can still include some activities in which students work together to learn the skills and concepts necessary for a career in biology. I have observed successful assignments in large lecture halls, where students discussed in groups of three which lines of global warming evidence are most convincing and formulated their own predictions based on available data. I will explain to my students why I use a unique combination of lecture and active learning approaches.

The only way for me to know whether my teaching accomplishes the stated objectives is to **evaluate the learning process rigorously and regularly.** My previous assessments of student understanding have included verbal questions directed at small groups of students, carefully constructed homework assignments, group presentations, online prior knowledge surveys, and writing assignments. I also plan to implement brief weekly surveys asking students to identify the most important and most challenging concepts learned. Objective evaluations improve both student and instructor learning. Providing students with frequent feedback on their progress allows them to play an active role in their own learning process. I believe that the best teachers are lifelong learners, not only of their subject material, but also of how to improve their teaching.

Effective communication is fundamental to teaching and learning, so I aim to explain concepts clearly and to listen to student needs. I present conceptually difficult ideas using multiple techniques, such as models, illustrations, metaphors, examples, or different vocabulary. Addressing different learning styles in this way requires patience and creativity, but the variety of approaches can be highly effective in teaching students with diverse backgrounds and abilities. For example, my experimental design lesson for an introductory biology laboratory included working together on a variety of research case studies and talking with small groups of students about their independent research projects. Classroom communication also requires listening to student needs, reactions, previous notions, and interests. I approach teaching and learning as a dialogue rather than a one-way flow of information, so I am not afraid to adapt my teaching plans as needed.

Finally**, enthusiasm is a contagious emotion that can greatly facilitate learning**. Curiosity and interest in real-world applications are better primers for lasting learning than exam grades, so I consciously share with students my fascination for biology's interconnectedness. I saw and encouraged genuine curiosity about the thermoregulation problems I presented to an Introductory Zoology class when students stayed late to discuss hypotheses after long laboratory sections. By making myself available, using approachable body language, and showing interest, I promote questions of all kinds. I plan to foster enthusiasm by enabling students to apply course concepts to topics of interest or current relevance. As an undergraduate, I appreciated an introductory biology semester-long assignment to collect biological newspaper articles and my own responses to these current biological applications. In addition to the teaching strategies that I have learned, I believe my honest enjoyment of both the material and the learning process makes me an exceptional teacher.

My commitment to being an outstanding teacher makes this teaching and learning philosophy the most important document of my science career. Although my specific emphases and beliefs about teaching have changed and will continue to improve, I will always focus on how students learn most effectively rather than on how I think I should teach. I will continue to review and revise this teaching and learning philosophy during each semester of teaching so that my beliefs continue to define my actions, and my experiences continue to refine my philosophy.

Statement of Mentoring Philosophy

I view the process of entering mentoring as one of the most valuable aspects of my graduate education. As an effective mentor, I have had opportunities to assist students toward career goals and to practice communicating the context and motivation for my own research. Guiding and getting to know 11 undergraduate researchers offered me numerous opportunities to establish, evaluate, and improve my mentoring approach. I include in this list of mentees four hired students who did not register for guided research credits. Instead of treating these summer workers as mere employees or means to data collection, I served as a mentor, demonstrating and discussing with these students how to pursue a rewarding science career. To me, mentoring means developing an open relationship and helping someone become a successful professional. I believe that an effective mentor discusses clear and realistic expectations, encourages questions, and frequently reevaluates his or her approach.

A detailed discussion of both the mentor's and mentee's expectations for the mentoring relationship sets the foundation for a productive experience. I generally initiate this kind of focused discussion at the first interview and again at the early stages of the mentoring experience. I describe realistic objectives for the mentee, such as learning the anatomical vocabulary in a dichotomous key, understanding insect taxonomy, and developing dissection microscope proficiency. Practicing how to conduct literature searches, reading primary literature with specific goals in mind, preparing a research paper, and recognizing potential career pathways are also among the goals I describe for my mentees. Importantly, I explain the reciprocal nature of the mentoring opportunity by describing what I hope to gain from the experience. With my most recent mentee, this included help with identifying emergent dragonfly skins (exuvia) from 20 research sites, a second opinion on some laboratory approaches, an audience for me to practice research talks, and reminders for me to consider the bigger picture of my research.

Asking questions enables a student to be most productive and to learn to think as a scientist. I welcome constructive criticism, scientific skepticism, general curiosity, repeated requests for details, and even personal questions. I demonstrate patience. I once implied that a mentee could have found the answer to her question by reading the papers I had previously suggested. Afterward, I realized that such a response would only discourage her from approaching me with future questions. As I recalled the importance of an open and accessible mentoring relationship, I decided to never again make a student feel guilty about asking a question rather than looking it up. This does not preclude me from pointing students gently in the direction of other resources, but a tone of openness for my mentoring relationships.

As in teaching and research, a mentor needs to gather evidence of whether or not the methods used are effective. Student researchers have a wide diversity of experiences, learning styles, skills, and cultural norms. As such, I find it valuable to discuss frequently with individuals the progress of our mentoring relationship. Some students have indicated that they learn best when I show outlines of broader context and illustrate concepts with contrasting specimens or sketches. I learned that other students were particularly motivated by conservation biology topics, so I helped them develop applied ecology research hypotheses. I have sometimes had to reevaluate the scope of a research project because we were progressing too slowly, or the student became interested in a different aspect. I teach students that modifying plans is a normal aspect of scientific research. Upon giving my mentees a survey to evaluate their guided research experience a few months after its completion, I was surprised at some of the responses. Although I had feared that I left a student working on her own too long at data analyses, she remarked in the evaluation that I had provided her with the right level of independence for the procedure we discussed to make sense to her. Rather than waiting until the final research paper (or even its drafts) to test whether students have understood my explanations, I often ask them to explain their project back to me or to another undergraduate in the lab. I also investigate the accuracy of student work frequently by spot-checking their results.

All of my mentoring beliefs also apply to my classroom teaching and learning philosophy. The main difference with teaching through mentored research is that it enables me to customize my approach to the individual. Mentoring partnerships provide invaluable opportunities for learning from others' experiences or ideas, as well as from the process of teaching. Thus I believe that a whole department should strive to function as a network of effective mentors.

Statement of Commitment to Learning Through Diversity

My appreciation of diversity has developed through experiences in which I interacted with people for long enough to get to know the individuals' beliefs, backgrounds, and strengths. While working and living with colleagues at remote field research stations (in Wyoming, South Dakota, Michigan, and northern Wisconsin), I had opportunities to develop relationships with students and professors who had diverse interests and cultural backgrounds. In housing, classroom, and mentoring situations, I often learned the most from groups whose members were not homogeneous in ethnicity, age, socio-economic level, and educational goals. The unique perspectives I gained from diverse groups arose not from racial differences per se, but from the differences in experiences, knowledge, values, and assumptions that accompany cultural differences. Based on my own appreciation of learning from many forms of human diversity, I am committed to promoting classroom interactions of diverse individuals.

As with species diversity in ecosystems, human **diversity often creates the most productive environments.** When professors, mentors, and peers foster interaction and engagement of all students, irrespective of race or socio-economic background, we maximize learning and research success (e.g., Turner 2000, Milem 2001, Antonio 2002). Thus the relatively high attrition of minority students in biology majors documented by the National Science Board (2002) demonstrates a critical challenge: accommodating student diversity in biology classrooms. Learning objectives should not only include specific biological concepts, but also creative problem solving, teamwork, and effective communication to diverse audiences. The ten students who I mentored in dragonfly research projects represented three different ethnic groups and a wide variety of skills and interests. I always encouraged these independent research students to spend time in the lab in pairs so that they could learn from each other. I witnessed these students benefiting from different communication or learning approaches taken by their colleagues.

Evidence suggests that **promoting curiosity and problem solving in introductory biology classes can improve the diversity of students pursuing Biology** because students feel involved rather than competitive (National Research Council 2003, Tobias 1990). I have therefore developed laboratory activities that challenge students to solve problems as a team. Small group activities can promote preparation outside the classroom and cooperative learning among individuals with diverse backgrounds or learning styles. Working in small groups enables more students to participate in the classroom than just the few who are very vocal and confident. This kind of active learning forces students to identify learning challenges and to apply knowledge.

Although the array of learning styles may be as numerous as the number of students in the class, incorporating a variety of proven teaching methods enhances the learning of a diverse student body (Coffield et al. 2004, Handelsman et al. 2007). By using activities that require all group members to contribute, examples that involve researchers with different ethnicities, and a variety of approaches for explaining difficult concepts, I act on my commitment to learning through diversity. As students collaborate with each other in my classes and in field research, I hope to enhance their appreciation of ethnic and cultural diversity.

References:

Antonio, A. 2002. Faculty of color reconsidered: Reassessing contributions to scholarship. Journal of Higher Education 73: 582-602.

Coffield, F., D. Moseley, E. Hall, and K. Ecclestone. 2004. Learning Styles and Pedagogy in Post-16 Learning: A Systematic and Critical Review. London: Learning and Skills Research Centre.

Handelsman, J., S. Miller, and C. Pfund. 2007. Scientific Teaching. New York: W.H. Freeman and Company.

Milem, J.F. 2001. Increasing diversity benefits: How campus climate and teaching methods affect student outcomes. In Diversity Challenged: Evidences on the Impact of Affirmative Action. G. Orfield, ed. Cambridge, MA: Harvard Education Publishing Group.

National Research Council. 2003. Bio2010: Transforming Undergraduate Education for Future Research Biologists. Committee on Undergraduate Biology Education to Prepare Research Sceintists for the 21st Century, Board on Life Sciences, Division on Earth and Life Studies, Washigton, DC: National Academy Press.

National Science Board. 2002. Science and Engineering Indicators. Arlington, VA: National Science Foundation.

Tobias, S. 1990. They're Not Dumb, They're Different: Stalking the Second Tier. Tucson, AZ: Research Corporation.

Turner, C.S.V. 2000. New faces, new knowledge. Academe 36:34-37.

Part A Reflection: Defining Learning Objectives for a Biology Statistics Unit

The outline of learning objectives on page 9 exemplifies the detailed, learning-centered planning that precedes my decisions about how to teach or evaluate students. The Biology Core Curriculum (advanced introductory biology) statistics unit included two hours of classroom instruction per lab section. I had to select carefully the statistical concepts that would be most useful and attainable for the students because this was the only time allotted to teaching data analysis. I aimed to list reasonable learning objectives that could be readily tested, a goal that required numerous revisions of the highest-priority learning concepts. For every lesson that I create, I prepare documents similar to this outline.

My teaching preparation follows the "backward design" structure[1]. In "backward design," articulation of learning objectives leads to determining evidence for learning and then finally to designing teaching activities. This approach enables me to appraise how I can best help students achieve the learning objectives. Although I initially had several ideas for different active learning techniques that I wanted to try for the statistics lab unit, completing the list of learning objectives ultimately guided me in selecting appropriate teaching activities. I made the learning objectives transparent to students. Referring frequently to this list made rubrics to grade their research projects and test answers surprisingly simple to design.

I view surveys and consideration of students' pre-existing misconceptions as important steps in defining learning objectives. Lasting learning takes place when we adjust existing mental models to accommodate new experiences[2]. I therefore used a pre-teaching survey and discussions with students and past instructors to assimilate a list of common student misconceptions about data analysis. Unfortunately, teaching time did not permit me to address all of the misconceptions I listed. However, bearing these misconceptions in mind helped me to explain answers to individual students' questions. Student attention and retention seemed to be greater when I acknowledged common misunderstandings.

1. Wiggins, G. and J. McTighe. 1998. Understanding by Design. 2nd edition. Alexandria, VA: Association for Supervision and Curriculum Development.
2. Ausubel, D. 2000. The Acquisition and Retention of Knowledge: A Cognitive View. Boston: Kluwer Academic Publishers.

Part A Evidence: Learning Objectives for Biology Core Curriculum Data Analysis

Students should Know:

1. What ANOVAs, t-tests, and paired t-tests can accomplish.
2. That statistics provides critical tools for biological and social research because it quantifies variability in the data.
3. Each statistical test requires checking specific assumptions about the data distributions.

Students should Understand:

4. How sample size affects the signal-to-noise ratio and the conclusions that can be made about hypotheses.
5. What null hypotheses, t-scores, and p-values mean.
6. How an alternative hypothesis determines whether to use a one or two-tailed rejection criteria, and which is the more conservative choice.

Students should be able to:

7. Judge whether an experiment truly tested the hypothesis. If it does, they should be able to:
    - Conduct independent and paired t-tests (using Excel) to analyze lab data.
    - Use statistical results to support or reject the experimental hypothesis
8. Present results in the format of a published scientific paper.

Expected Prior Knowledge:

1. Ability to make bar graphs and scatter plots (with error bars) using Excel.
2. Knowledge and application skills of standard error, standard deviation, mean, and median.
3. Enough biological knowledge about the study system under investigation to formulate a reasonable hypothesis and experiment.

Common Student Misconceptions → ways I could address these

1. P-values are magic cutoffs to identify whether your hypothesis is "right" or "wrong." → describe experiments with different cutoffs, and how that affected results. Also use examples from different areas of scientific study to make this point. E.g., elephant biologists have much lower sample sizes than bacteriologists, and so often use very different rejection criteria.
2. Statistics allow you to prove something. → Analyze wording in sample papers, then discuss this (and scientific method) in small groups.
3. Small sample sizes can provide adequate evidence for a hypothesis → show graphs of an experiment with multiple sample sizes; show how n affects t-statistic calculation
4. Graphing +/- 1SE around the mean illustrates a 95% confidence interval → use published papers to show how researchers choose different ways to illustrate variability (CI, ± 1SE, ± 2 SE, SD)
5. Graphs alone can be used for data analysis → discuss results sections of published papers; show effects of altering figure scales and error bars.
6. Statistics are only for this class, or only for math-oriented people.→ discuss results sections of published papers (in science or media or odds in everyday life).
7. The statistics presented in this class are the only options. → look at the dichotomous key with other data analysis options.
8. It is always better to use non-parametric tests because you don't have to meet assumptions. → try both with a sample dataset to show how p-values can be less significant
9. A test is not valid if the results are not significant. → discuss results of published papers

Part B. Reflection: Active Learning Classroom Debate

The following document describes an activity that I designed and led for fellow students/instructors in our Instructional Materials Development class. The classroom consisted of post-doctoral researchers, graduate students, and academic staff. Although the students in this class had far different experiences from the undergraduate students that I normally teach, I believe that the debate forum can provide an effective active learning approach for many types of classrooms.

After calling for respect of each individual's real or assigned viewpoint, I initiated the debate as outlined on the next page. At the bottom of the document are notes that I took as we concluded the classroom debate. Most participants resolved that active learning can be highly effective for certain learning objectives and audiences, but only when its purpose is clearly explained at the outset. One-minute (anonymous) reflection essays that I assigned as a follow-up to the debate showed that 8 of the 11 participants felt that the class debate sufficiently covered the most important components of our reading assignment on active learning. The three less-satisfied students each explained that they viewed different aspects of the reading as the critical learning objectives. Discussing learning objectives with students prior to a teaching activity can generally prevent complaints, but unanimous agreement on the set of learning objectives remains difficult. With this knowledge, I frequently review learning objectives, as described in the "backward design" of example A (page 8).

Debates and role-playing require students to empathize, critique, collaborate, synthesize, and articulate arguments. I recognize that debates are only suitable for classroom topics with reasonable arguments on two or more distinct sides. In the case of whether or not (or when) to incorporate active group learning into college classrooms, it became clear me that many instructors and students have conflicting opinions. A debate was therefore an appropriate classroom activity to help the class appreciate several different but valid arguments.

Forms of active learning other than role-playing include brainstorming, one-minute essays, creating physical models of concepts, multiple choice or True/False questions where students place stickers to indicate their anonymous answers, case-study decision making, and concept mapping. I have incorporated several of these approaches into my teaching, but also continue to focus on my traditional lecturing skills.

Part B Evidence: Debate on Active Learning

Learning Objective: Participants will consider when active learning is and is not appropriate.

Debate Topic Statement:
"In preparation for a biology course, an instructor should focus more on developing and applying active learning techniques rather than lectures."

Classroom instructions:
The class will be split randomly into two groups, with one group taking an affirmative viewpoint and the other group taking an opposing viewpoint on the statement printed above. Each group will work together to develop arguments based on the assigned readings and experiences of the group with examples where appropriate. The group will designate one member to record the arguments, another member to present the arguments to the entire class, and another member to provide closing or summative statements.

Timeline:
Small groups meet: 15 minutes.
Groups present arguments to entire class: 3 minutes for each side.
Clarification/Rebuttal/Reaction to arguments: 8 minutes, with equal time for each side.
Closing statements: 1 minute for each side.
Class discussion and wrap-up: 5 minutes.
Students write "one-minute essays" in response to the following question: 'How well did the debate address the most important or challenging aspect of the assigned reading?' : 2 minutes

Arguments For Active Learning:
-lets students get to know each other and feel worthwhile to group success
-requires that students do work ahead of time (because classmates hold them accountable)
-activities can serve as a way to evaluate students; quickly combat student misconceptions
-takes equal time to plan (if you've never done the lecture before) ? -takes pressure off instructor
-easier and more frequent student assessments
-facilitate learning by students with diverse needs and learning styles (e.g., ADD, visually impaired)
-helps students apply new information so that it is more memorable and meaningful
-requires students to take responsibility for their own learning; engagement can promote enthusiasm
- Addresses professional skills learning objectives.

→Response to con side's argument: Students don't always appreciate what they've learned from active learning. Have them record what they learned (e.g., with one-minute essays). Introductory students need to be forced place concepts into applied contexts.

Arguments Against Active Learning:
-students need as much information as possible; as quickly as possible
-standard lectures prepare them for standardized tests; this approach has worked for centuries
-easier to prepare lectures and subsequent exams
-students are accustomed to lectures and appreciate predictable structure
-students with different learning styles can adapt to traditional lecture mode
-small groups can be biased; learning is not always standardized
-students don't understand what's expected of them; takes a long time to set up

→Consider the audience : If students are already engaged in learning the material (i.e., grad students), then lectures can be more efficient teaching mode.

Based on learning objectives, use both lecture and active learning. Active learning can't be done half-heartedly. Students must consistently be held accountable for learning.

Part C Reflection: Assessing Student Learning of Experimental Design

The research questions and data collection shown on the next page demonstrate how I use the rigor of scientific research to assess student learning. I collaborated with a statistician and the Biology Core Curriculum program directors to create new course materials for reinforcing the most challenging aspects of experimental design. Although I initially wanted to focus all my efforts on designing the actual classroom activities, I realized that documentation of what did and did not succeed in helping students learn would make the process much more useful to students and other instructors. Thus I developed a series of survey and homework questions to collect evidence on how well students achieved the stated learning objectives. I evaluated open-ended questions by adhering strictly to a grading rubric that was based on the learning objectives. Although open-ended questions require students to recall concepts entirely on their own, I learned that these questions may not have provided enough direction to test students on all of the objectives that I had in mind. I have found the ongoing process of conducting research on teaching to be challenging but very interesting.

I assess student learning at multiple times during and after a lesson. Effective teaching calls for repeated assessment of student learning because it increases learning gains and provides feedback to both students and instructors[1]. After evaluation of all surveys and student projects from the experimental design unit, I hope to publish the results in a journal such as CBE Life Sciences Education. However, I also included many less formal assessments of student understanding throughout the teaching activities. These included worksheets, calling on groups to answer aloud, anonymous multiple choice using stickers, research proposal presentations, and asking students to explain concepts to each other. At times, I was disappointed to see that my explanations had not helped students as much as anticipated. Revealing this soon enough allowed me to try a different teaching approach.

1. Handelsman, J., S. Miller, and C. Pfund. 2007. *Scientific Teaching*. Madison, WI: the Board of Regents of the University of Wisconsin System.

Part C Evidence: Assessment of student learning

Outline of teaching-as-research questions, approaches and initial results

1. How did participation in Biocore 302 and the workshop influence student performance in experimental design?

- Approach: I tested mastery of the four learning objectives on an open-ended homework assignment given at the beginning of the next course in the sequence. I used Fisher's exact test for count data to compare proportions of students meeting objectives :
  - a) students who took 302 (n = 71) vs. students who skipped 302 (n = 17)→ no significant differences in application of the objectives (p- values from all four objectives > 0.1)
  - b) students who attended the 302 additional workshop (n = 18) vs. other students who took 302 (n = 71) → Percentages of students correctly applying the objectives were higher for students who took the workshop (except objective ii). However, only objective iii ("experiment provides controlled test of only the variables in the hypothesis"/ use of appropriate dependent variable) showed a significant gain (odds ratio = 0.19, p = 0.013; Fig. 1)

Learning Objectives for Biocore 302 Workshop on Experimental Design:
note: I denoted scores of 2 or 3 as "successful application" of the learning objectives.

Learning objective	Homework question scoring rubric	Homework question
i **Samples** of a population should be selected systematically if a confounding factor is known to influence the dependent variable systematically.	(0) no mention of sample (1) recognize a problem with the sample (2) suggest allocating different variables evenly to different treatments (paired or blocked) (3) suggest "systematic" sampling	1a (identify errors in dog diet experimental scenario)
ii. Valid experimental replicates are **independent** of all other replicates. Replicates should experience equivalent but independently applied experimental conditions.	(0) inaccurate description of "sample size" (1) no doubling of sample size (2) "not independent" (3) explain that the same subject is more likely to respond to the treatment similarly at both times, or that the treatment is not tested separately n times.	1b (what if they recorded response variable on more days for the same subjects?)
iii. Dependent variables measured and reported match those identified in the **hypothesis**.	(0) no critique of dependent variable (1) some discussion of legitimate dependent variable (2) recognition of inconsistency with extra response variables (3) note that the extra variables were not included in the hypothesis	1a (identify errors in scenario)
iv. Complexity of biological systems: The hypothesis and conclusion consider whether the dependent variable measures a **direct or indirect** effect of the independent variable.	(0) no critique of confounding factors (1) consider controls (2) note that dependent var. "could relate to other variables not measured" (3) discuss "indirect effects"	1a (identify errors in scenario)

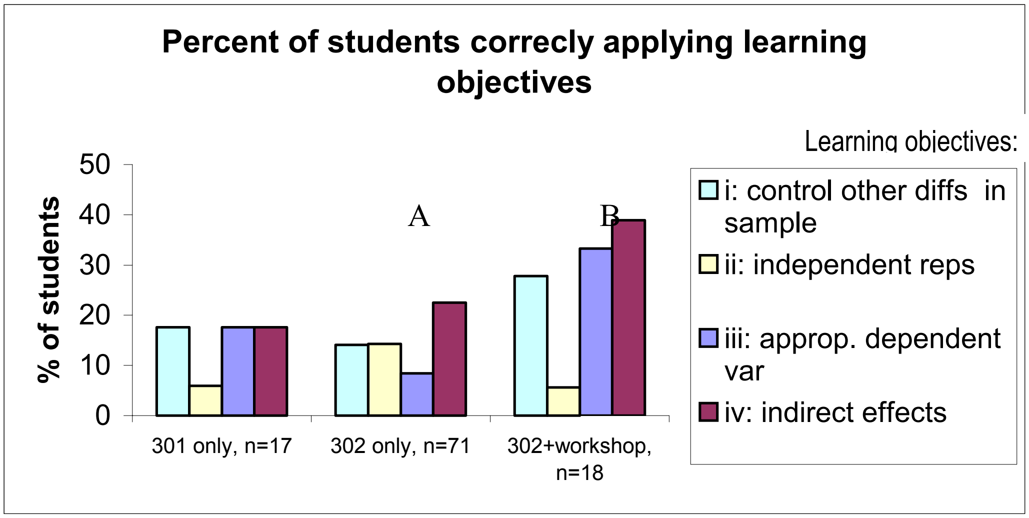

Figure. 1. Percentages of introductory biology students applying the four experimental design learning objectives (summarized in table above and in figure legend) in an un-graded critique of a flawed experiment. 17 students did not complete the course that included an experimental design unit (Biocore 302), while 18 students completed both the course and an optional workshop focusing on experimental design. A significant learning gain for objective iii is denoted by different letters on the figure (Fisher's exact test p <0.05).

2. How did participation in Biocore 302 and 304 influence student confidence in - and appreciation of - experimental design and data analysis?

- Approach: I used permutation tests (paired by student) to compare self-reported skills and plans to take a statistics course from surveys given prior to 302 (n = 101) and again after 304 (n = 103).

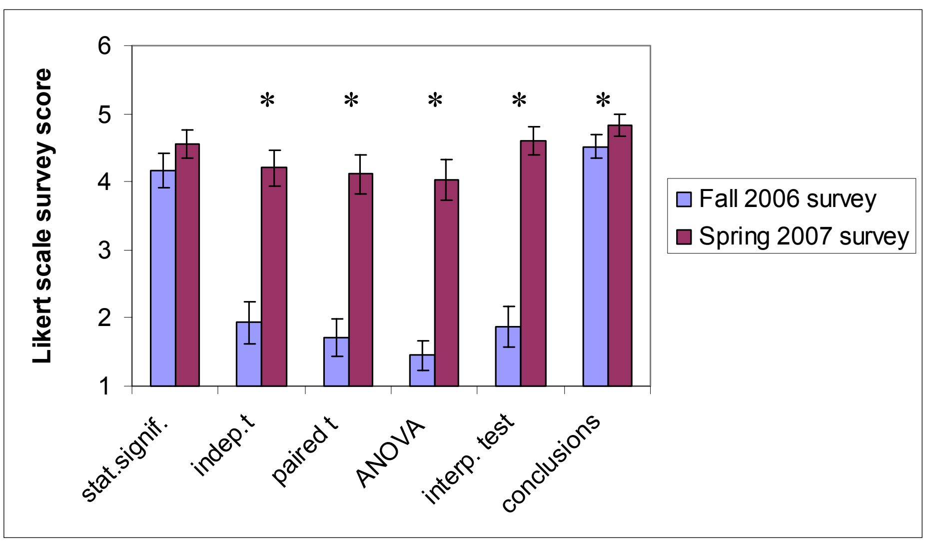

Figure 2. Comparison of pre- and post-instruction self-reported skills at determining statistical significance, conducting independent and paired t-tests, conducting ANOVAs, interpreting statistical results, and drawing conclusions. A Likert scale score of 6 indicated highest confidence. We present mean scores for each learning objective ± 2 standard errors around the mean. Asterisks (*) indicate significant differences (with $p < 0.005$, including Bonferroni-corrections for multiple tests) based on permutation tests paired by individual student.

Appendix A. Curriculum vitae

ALYSA JANE REMSBURG

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EDUCATION

Ph.D. Zoology, University of Wisconsin, Madison: anticipated completion July 2007
"Use of Riparian Plant Structures by Odonata in Habitat Selection"

M.S. Zoology, 2005, University of Wisconsin, Madison
"Amount, Position, and Age of Coarse Wood Influence Litter Decomposition"

B.A. Biology, 2001, Wittenberg University, Springfield, Ohio
summa cum laude, Phi Beta Kappa, Department Honors, Environmental Studies minor

RESEARCH INTERESTS: biology education; biodiversity indicators; effects of plant architecture on animal distributions; human influences on trophic interactions; riparian buffers

RESEARCH EXPERIENCE

2004 – 2007: *North Temperate Lakes Long-Term Ecological Research station, Wisconsin.*
Field experiments testing how lakeshore and aquatic plants affect the distribution of dragonflies and damselflies (order Odonata); Biocomplexity project led by Dr. S. R. Carpenter.

2005 (February – April): *Stellenbosch University, South Africa.*
NSF Graduate Research Fellowship funded travel for field experiments in collaboration with Dr. Michael J. Samways to test how invasive trees affect dragonfly densities.

2002 –2004: *Yellowstone National Park, Wyoming.*
Study of how post-fire coarse wood affects leaf litter decomposition rates and spatial patterns of microarthropods at two spatial scales. Principle Investigator: Dr. Monica G. Turner.

2001 (summer): *Research Experience for Undergraduates, Hope College, Michigan.*
Research led by Dr. K. Greg Murray on invasive mechanisms (allelopathy or light competition) of *Vinca minor* and methods for controlling its spread.

2000 (summer): *Huron National Forest internship, Michigan.*
Radio telemetry study of wood turtle (*Glyptemys insculpta)* habitat use with Dr. Tim Lewis.

1999 (fall): *Wittenberg University.* Independent project on visual cues for frog developmental plasticity.

1998 (summer): *Wind Cave National Park, Earthwatch Student Challenge Award* led by Dr. John Moore.
Field and lab work exploring how detrital inputs relate to cave invertebrate biodiversity.

TEACHING EXPERIENCE

2006-2007 (2 semesters) Biology Core Curriculum, Zoology 302-304, UW-Madison.
Internship to redesign statistics curriculum in biology and teach statistics workshops.

2004-2007 (5 semesters) Mentor for 6 students completing independent projects, UW-Madison.
Trained students to identify odonates, develop hypotheses, analyze data, and write manuscripts.

2002-2003 (2 semesters) Intro. to Animal Biology, Zoology 102 Teaching Assistant, UW-Madison.
Lectured, wrote quizzes, graded tests and papers, and assisted students with dissections.

2002 (winter-spring) Environmental Education Intern at Aullwood Audubon Center, Dayton, Ohio.
Daily presentations for visiting school groups and natural history programs for general public.

2000-2001 (3 semesters) Introduction to Biology 100 Laboratory Assistant, Wittenberg University.
Answered student questions and facilitated laboratory investigations.

1999-2001 (4 semesters) Community Service Workshop Facilitator, Wittenberg University.

Planned and led classes for student reflection on learning through community service.
1999 (summer) Camp Counselor, Stony Lake Lutheran Camp, Michigan.
Led high and low ropes challenge courses with junior high students to build teamwork.

GRANTS

2006 "Effects of lakeshore vegetation on dragonfly oviposition site-selection behavior," Animal Behavior Society E.O. Wilson Award for Conservation Research, $1000.
2006 "Effects of lakeshore vegetation on dragonfly diversity," Garden Club of America, Award for Coastal Wetlands Research, $5000.
2003-2006 National Science Foundation Pre-Doctoral Graduate Research Fellowship, $100,000
2001 National Science Foundation Research Experience for Undergraduates grant, $4000

AWARDS

2007 Delta Certificate in Teaching and Learning, UW- Madison
2007 Wisconsin Program for Scientific Teaching H. Hughes Medical Institute Teaching Fellow
2003 McClung Award for Undergraduate Publication, Beta Beta Beta
2002 Emmett Bodenberg Award for Work in Environmental Biology, Wittenberg University
2002 Graduate Research Fellowship Honorable Mention, National Science Foundation
2001 Presidential Award, Wittenberg University
2001 Biology Department Outstanding Junior Award, Wittenberg University
2000 Biology Department Outstanding Sophomore Award, Wittenberg University
1998 Student Challenge Award, Earthwatch Institute

ECOLOGY OUTREACH

2006 Workshop on dragonflies and damselflies for Friends of Lake Wingra, Madison, WI
2005-2006 Insect Ambassador presentations for Madison schools, UW Entomology Department
2002 Public presentations on wildflowers, maple forests, amphibians, Aullwood Center, Ohio
2002 Workshops on amphibian monitoring, Detroit Audubon Society retreat
2001 Workshops on turtles and radio telemetry, Detroit Audubon Society retreat
2000 Presentation on wood turtle research, Boyscouts of Mio, Michigan
1999 Leader of local environmental club, Springfield, Ohio

PROFESSIONAL ACTIVITIES

2006 Peer reviewer, Landscape Ecology journal
2006 Planner of Wisconsin Wetland Association's Annual Science Meeting
2005- Graduate Committee Member, Madison Ecology Group
2005-2006 Planner of 6th Annual Great Lakes Odonata Meeting

PRESENTATIONS (first authored only)

Remsburg, A.J. Lakeshore vegetation structure influences Odonata distribution in Northern Wisconsin. Wisconsin Wetlands Association Annual Science Meeting, Madison WI, Feb. 2006
Remsburg, A.J. and M.G. Turner. Amount and position of post-fire coarse wood influences litter decomposition and microarthropod communities. Annual Meeting of the Ecological Society of America, Montreal Canada, August 2005.
Remsburg, A.J. and M.G. Turner. Effects of post-fire coarse wood on fine litter decomposition and microarthropod distributions. (poster) Annual Meeting of the Ecological Society of America, Portland OR, August 2004.

Darcy, A.J., M. Burkhart, and K.G. Murray. Allelopathic potential of *Vinca minor*, an invasive exotic plant in west Michigan forests. (poster) Pew Undergraduate Research Conference, St. Louis MO, Nov. 2001.

Darcy, A.J. and T.L. Lewis. Home ranges of wood turtles (*Glyptemys insculpta)* in northern Michigan. (poster) National Conference of Undergraduate Research, Lexington KY, March 2001.

REFEREED JOURNAL PUBLICATIONS

Remsburg, A.J. and M.G. Turner. 2006. Amount, position, and age of coarse wood influence litter decomposition in post-fire *Pinus contorta* stands. Can. J. of Forest Research 36(9): 2112-2123.

Remsburg, A.J., T.L. Lewis, P.W. Huber, and K.A. Asmus. 2006. Home ranges of wood turtles (*Glyptemys insculpta)* in northern Michigan. Chelonian Conservation and Biology 5(1): 42-47.

Darcy, A.J., M.C. Burkart, and K.G. Murray. 2002. Allelopathic potential of *Vinca minor*, an invasive exotic plant in west Michigan forests. BIOS 73(4): 127-132.

PUBLICATIONS IN PREPARATION

Remsburg, A.J., A.C. Olson, and M.J. Samways. Influence of invasive *Acacia* tree species on South African Odonata distributions. *In review,* Animal Conservation.

Henning, B.M. and A.J. Remsburg. Effects of lakeshore vegetation structure on avian and amphibian abundance in northern Wisconsin. *In review,* Wildlife Research.

Remsburg, A.J. and M.G. Turner. Effects of habitat structure and lakeshore development on Wisconsin Odonata communities. (*80 % of writing complete - June 2007 submission target)*

Remsburg, A.J. and M.G. Turner. Post-fire microsite heterogeneity effects on leaf litter microarthropods. (*60% of writing complete – August 2007 submission target)*

PROFESSIONAL SOCIETIES

2004- Ecological Society of America
2006- Animal Behavior Society
2006- Dragonfly Society of America

Honor Societies: Phi Beta Kappa, Beta Beta Beta (secretary of Wittenberg chapter), Mortar Board, Omicron Delta Kappa, Order of Omega

REFERENCES

Monica Turner, Eugene P. Odum Professor of Ecology
- *M.S. and PhD advisor, P.I. at Yellowstone research station, Adv. Landscape Ecology course instructor*

UW Department of Zoology 608-262-2592
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Claudio Gratton, Assistant Professor of Entomology
- *PhD committee member, faculty mentor for Delta Certificate in Teaching and Learning, instructor for seminars on Trophic Linkages Across Communities and Ecosystem Services Provided by Insects*

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Michelle Harris, Biology Core Curriculum Program Co-director
- *Advisor for teaching internship, instructor for Delta course "Expeditions in Learning"*

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Madison, WI 53706

Appendix B: The Delta Program in Research, Teaching, and Learning

I participated for four years in the Delta Program in Research, Teaching and Learning, a premier learning community for graduate students, post-docs, academic staff, and faculty at the University of Wisconsin[1]. Its purpose is to improve student learning in science fields through professional development for current and future faculty. (http://www.delta.wisc.edu)

I gained firsthand experience with the three central pillars of the Delta program:

Δ **Teaching-as-research**, "The deliberate, systematic, and reflective use of research methods to develop and implement teaching practices that advance the learning experiences and learning outcomes of students and teachers."

Δ **Active learning communities**, "Bringing together groups of people for shared learning, discovery, and the generation of knowledge."

Δ **Learning through diversity**, "Drawing upon the diversity of students to enhance and enrich learning for all."

I earned the Delta **Teaching and Learning Certificate** in May 2007 by completing:

a) <u>Two graduate courses on teaching and learning</u>

- Informal Science Education. I reflected in this course on how to provide learning experiences outside of the classroom and how to share science with the general public. As a final product, I developed a poster describing the ecology of shoreline restoration.
- Instructional Materials Development. This intensive course included readings and discussion on course development, along with teaching practice. Offered through the Wisconsin Program for Scientific Teaching, this course also helped fulfill the prerequisites to become a Howard Hughes Medical Institute Teaching Fellow.

b) <u>Involvement in the Delta Learning Community</u>

- Expeditions in Learning. Through this weekly seminar, I met with a small group of faculty and graduate students to discuss readings, teaching experiences, and our excursions on campus to different types of learning environments.
- Roundtable Discussion Dinners. I attended several presentations and roundtable discussions each year, which addressed a variety of topics related to the three Delta pillars. I participated in stimulating discussions on topics such as Teaching with Technology, Improving Minority Student Retention in the Sciences, and Preparing Students for Science in the Future.
- Meetings with a Delta faculty mentor and advisory panel.

c) <u>Completion of teaching and learning internship</u>

- Over the course of one year, I led a small working group that included a Statistics faculty member, the co-director of the Wisconsin Program for Scientific Teaching, and the directors of an advanced biology program. I redesigned, implemented, and evaluated the statistics instructional materials for two classes. Together with these colleagues, I plan to publish an education paper on our findings and curriculum recommendations.
- I collaborated with other Teaching Fellows in the Wisconsin Program for Scientific Teaching to evaluate my own and other teaching internships.

d) <u>Development and defense of a teaching and learning portfolio</u>

1. Delta is part of the Center for the Integration of Research, Teaching, and Learning (http://www.cirtl.net/) and supported by a $10 million grant from the National Science Foundation.