TEAM #4

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Teri Balser
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Assignment #1: Introductions

1) Describe your teaching responsibilities and the type of student you teach
I am an Associate Professor at the University of Wisconsin, Madison. This is the end of my 7th year at Madison. My tenure home is in the Soil Science Department, and I am an affiliate with the Nelson Institute for Environmental Studies, the Microbial Doctoral Training Program, and the Office of Human Resource Development. I am a Soil Microbiologist/Ecosystem Ecologist by training.

I teach several classes. Undergraduate level: Upper level Soil Biology (40 students mostly juniors-seniors), I team-teach in the honors biology track (75 students, mostly juniors), and I teach Intro Environmental Studies (150-200 students, non-science majors, freshman through seniors). At the graduate level: I offer a Teaching Large Classes Seminar, a Microbial Communities and Global Change Seminar, I team teach a class on Women and Leadership in Science, Medicine and Engineering, and I teach a short course on Workplace Skills for graduate students in the Institute for Environmental Studies and the Agroecology program. Finally I am active in outreach teaching, bringing soil ecology workshops and presentations to local community groups and Wisconsin farmers.

2) Describe what you would like to take home as a result of attending the institute
As a result of the SoTL institute I would like to have a clearer idea of how I can assess the efficacy of the various teaching methods I try (group projects, active learning, journals and reflection, interested in team testing). I would also like to learn how I can best support faculty development and biology education on my campus.

3) Tell us about your interests outside of the classroom and a book that you've read recently
I supervise a large research lab and spend most of my non-teaching time reviewing papers. However, I love to ride bicycles, play music and read. I play early music and

saxophones for weddings and in local big band jazz ensembles. Recently I read (and loved) Richard Light's 'College Students Speak Their Minds', and am currently enjoying Fred Pearce's book about climate change called "With Speed and Violence". However, when I read purely for mindless pleasure I tend to read science-fiction and fantasy, and I will confess to owning a Playstation2 and really want a Nintendo Wii!

Assignment #2: Reflections

1) How would you describe your "research problem(s)" to the Research Scholars group?

I enjoyed the articles quite a bit. In particular I benefitted from re-reading the Bass article (I was assigned it last summer, but it sunk in better this year), and considering the larger nature of my teaching 'problem' or interests. My overarching teaching problem is creating lifelong learners – engaging them with the material and having them understand what it means to be a learner. I work to address this problem in my classroom in four ways:

1. Connecting classroom learning with their lives, experiences and goals
2. Engaging them so they are motivated to learn
3. Making learning strategies transparent and accessible so they see how they can best learn new things
4. Helping them develop awareness of themselves as learners – encouraging reflective practice in my classes

Specifically, my Biology Scholars project will address these by assessing the use of groups and group discussion to engage the students, help them connect the classroom and their lives, and by asking them to keep a learning journal during the semester. I tried a pilot of this in class this past year, and I am eager to carry it further, and in a slightly new direction based on the previous results.

2) What theme(s) based on your readings, resonate with your "problem" and/or your proposed approach to address your problem?

The themes that resonated for me most were the ideas related to going beyond the content of a course – how do we teach to the larger goals? I also really enjoyed considering the analogies between my own research and my research about teaching that were themes in the Bass and Benson articles.

3) Which of the 12 properties of SoTL in microbiology education proposed by S. Benson's article are particularly relevant to your project at this stage?

The properties most relevant at this stage seem to be 1, 4, 10, 11 and 12. As I am developing the project, I need to be reflective (1), engaged in teaching (or at least thoughts about teaching) (10), and seek what has already been done so that I can build on it (4). In addition, I will benefit from engagement with my colleagues in this and other disciplines (11) as I design the project. Ultimately, the project should maintain fidelity throughout (12).

4) Do you have any questions/concerns/comments that have evolved from your reading?

I had a question about the Figure in the Benson article – I would love to see/discuss examples of each scenario in the figure.

5) What do you see as tangible products to be developed as a result of your Scholars experience within the next 12 months?

Products: an article about learning in a broadly multidisciplinary classroom, for sure. A revised syllabus. A topic for graduate seminar course on teaching.

6) What do you see yourself presenting at the follow-up session at ASMCUE 2009?
I see myself presenting results from the study – and discussing challenges and strategies associated with creating learners in the classroom.

7) What will you need to develop these products?
What I need? Time. Career stability. IRB approval. Relevant literature to read and build from. I would like to learn more about ways that I can assess student learning gains and more specifically, student awareness of their own learning. Survey instruments are new to me, as are most qualitative research techniques.

Assignment #3: Annotations

My interests this year are centered on the use of groups and digital collaboration to foster problem solving and environmental literacy in my large introductory environmental studies class. My goal is to track students' development in problem solving and their comfort with increasingly complex (increasing 'shades of gray') during the semester. Below is a selection of papers that have been useful at this point:

1. King, P. M., & Kitchener, K. S. (1992). Assessing Reasoning Skills. In Developing Reflective Judgment - Understanding and promoting intellectual growth and critical thinking in adolescents and adults (pp. 75-98). San Francisco: Jossey-Bass.

This chapter discusses reflective thinking and how it can be measured. The authors first propose a list of desirable features in a measure f reflective thinking, and examine and evaluate a suite of existing measures. I found their description of well- versus ill-structured problems useful in honing my thinking about the nature of environmental problems. They discuss reflective and critical thinking, and evaluate two tools for assessing critical thinking skills (Watson-Glaser Critical Thinking Appraisal and the Cornell Critical Thinking Test). Finally they describe four models for development of reasoning. I found the chapter very useful as a way of framing the developmental stages my 1st-5th year's students may undergo, as well as a starting point in considering how to assess their reasoning skills.

2. Anderson, W. L., Mitchell, S. M., & Osgood, M. P. (2008). Guaging the gaps in student problem-solving skills: assessment of individual and group use of problem solving strategies using online discussions. Cell Biology Education-Life Sciences Education, 7, 254-262.

This paper describes a tracking method developed at the University of New Mexico to monitor student use of problem-solving strategies in a large introductory biology class. For the past three years the instructors have been using interactive online Problem-Based Learning case discussions. Because of the challenge in a large class of monitoring student learning and progress, they developed a tracking method to monitor individual and group problem solving strategies. They present their assessment rubric and discuss the problem solving roles the students take-on. They

found that students became rapidly facile in the use of the discussion boards and they report that their tracking system allowed them to identify groups in need of intervention.

3. Morse, D., & Jutras, F. (2008). Implementing concept-based learning in a large undergraduate classroom. Cell Biology Education-Life Sciences Education, 7, 243-253.

This paper reports results from an experiment explicitly introducing learning strategies to a large first-year undergraduate cell biology course. The authors wished to see if awareness and explicit use of strategies had a measurable impact on student performance. They evaluated student concept maps produced pre- and post-instruction in the concept mapping strategy. They evaluate student effective use of concept maps and find that many students are unable to produce an adequate concept map both before and after instruction. They discuss the importance of providing feedback to students about the validity of their use of the strategy. They report the use of groups and generating a consensus map to provide feedback and improve student concept mapping.

4. Nelson, C. (1989). Skewered on the unicorn's horn: The illusion of tragic trade-off between content and critical thinking in the teaching of science. In Enhancing critical thinking in the sciences (pp. 17-27). Washington DC: Society of College Science Teachers.

This paper discusses the Perry's model for the development of thinking modes and seeks to reconcile it with a model of scientific reasoning. The author then uses Perry's scheme to divide critical thinking tasks and the teaching choices that facilitate them into four groups. Each group is accessible to students at a different Perry 'level'. 1) Fostering precise thinking; 2) Fostering the recognition of fundamental uncertainty; 3) Fostering an understanding of theory selection; 4) Fostering an understanding of the roles of values. Within each of these groups is a task, for example "delineate the fundamental problem" falls within group 2.

5. Klymkowsky, M. W., & Garvin-Doxas, K. (2003). Bioliteracy and teaching efficacy: what biologists can learn from physicists. Cell Biology Education-Life Sciences Education, 2, 155-161.

In this paper the authors describe the Force Inventory Concept and the development of the analogous Biology Concept Inventory (BCI). They discuss the definition and importance of bioliteracy for society. They argue the utility of a consensus Inventory for biology education. Much as the inventory did for physics, they argue, the BCI will allow for the standardization necessary to produce "bioliterate" citizens.

Christopher Burke
University of Tasmania, Launceston, Australia

Assignment #1: Introductions

1) Describe your teaching responsibilities and the type of student you teach

I am a senior lecturer at the University of Tasmania. My teaching currently involves first year aquatic ecology and second year microbiology courses to environmental science and aquaculture majors. I've been at UTas for 18 years and so am pretty well rusted onto the building. Recently, my class sizes have been small (<30), but we are in the middle of a major administrative and academic restructure which has an aim (as always) to attract large numbers of undergrads, so my future teaching is not yet settled beyond the end of the year.

2) Describe what you would like to take home as a result of attending the institute

The major driver for my teaching is to make it student learning as much as possible, and to achieve this I am using an enquiry-based learning approach among other means to increase student participation in lesson activities. My wants from the workshop are twofold: first to develop my understanding and skills in evaluating the effectiveness of different approaches to teaching and learning. And secondly, to become part of an ongoing discourse on T&L with like-interested colleagues. I have tried this in various ways before with only a modicum of success, so you may appreciate the importance of a discussion group to me as I feel compelled to travel 20,000 km to achieve this, despite being surrounded by academics in my office!

3) Tell us about your interests outside of the classroom and a book that you've read recently

Outside of the office I like to run, and am looking forward to enjoying the sights in Washington whilst pounding the pavement. It'll be my first visit. An occasional beer or glass of wine in convivial company is always pleasant. I am also interested in history and that is reflected in my recent reading – on two battles – Trafalgar and Stalingrad. What I liked about these books was that they were largely written from first person accounts of many different participants and so gave a really 3-dimensional appreciation of what happened.

Assignment #2: Reflections

1) How would you describe your "research problem(s)" to the Research Scholars group?

The story described by Randy Bass particularly resonates with me, as I have gone through a similar process of identifying teaching problems; using various methods to supposedly fix them; having my eyes opened about the nature of learning and then fundamentally altering my approach to teaching. Concomitantly, I deliberately chose to spend a lot of time and effort in developing my understanding of teaching and learning, and how both can be evaluated in terms of the effectiveness of the learning that occurs. So, although the first problems that I recognised were the lack of scientific and critical thinking in students, together with their poor retention of the fundamentals of microbiology, I rapidly became aware of the urgency of developing my abilities of evaluating my teaching. From this, I now think that the big problem is

what is the question – i.e. what am I trying to achieve with each component of the teaching and learning nexus?

2) What theme(s) based on your readings, resonate with your "problem" and/or your proposed approach to address your problem?
Craig Nelson wrote about the biases that we and our students bring to class. In a slightly different context I found one of the most useful aspects of my undertaking formal learning in pedagogy is that it placed me front and centre as student, with all the usual ignorance and lack of confidence that students have. So now I starting to consider my teaching from the perspective of the student and what they are likely to bring to the class, in order to acknowledge the real starting point and build upon it. Teaching and learning can be seen as a complement to the research process in which an aim is defined, research (learning) carried out, peer evaluated (e.g. the exam) and then disseminated (hopefully, via the students' future activities). Reading the JMBE guidelines was interesting, because to me it identified good research and publication in education as being the same as good research and publication in my discipline of science – and probably any other discipline as well. Viewing it like this, helps me overcome the block that I currently have allowed to develop about publishing in education, when I have a reasonable publication record in science. However, the real plus for me here was to read the example paper that is on the website – this provided clear examples to illustrate all the points. Following on from this, of Spencer Benson's 12 points, I would identify the need to disseminate / publish as particularly relevant to me. And I would hope that my efforts do stimulate some intellectual exchange, for I think the biggest problem facing teachers is the vacuum in which we work.

3) Which of the 12 properties of SoTL in microbiology education proposed by S. Benson's article are particularly relevant to your project at this stage?
Although I agree with Spencer's 12 points, I am not sure that I would place such emphasis on the importance of the actual discipline for education in that discipline. I tend to see science as a mining down to fundamentals, whereby one answer generates another question and often this question can only be answered by understanding a concept from another discipline. I would emphasise the links within and between disciplines for student learning. My concern, however, is that I think that I have a long way to go in developing a sound understanding of pedagogy, and its evaluation, in order to develop curricula and teaching activities that engender good learning. So where does that leave the students that I am currently teaching?

4) Do you have any questions/concerns/comments that have evolved from your reading?

5) What do you see as tangible products to be developed as a result of your Scholars experience within the next 12 months?
For me the prospect of a network of like-interested colleagues to discuss and critique teaching and learning practices and research into education is the most important outcome of the workshop. The network provides the opportunity for peer review, which I would find very helpful, particularly to achieve my aim of publishing my research into the effectiveness of enquiry-based learning in microbiology.

6) What do you see yourself presenting at the follow-up session at ASMCUE 2009?

I will present this at ASMCUE 2009 as a paper tentatively entitled: Is it microbiology, or should it be science?

7) What will you need to develop these products?
To achieve these, the most important component will be time on task. It will be vital for me to not allow other aspects of my job to distract me (all too easy to do) from interacting with colleagues and getting on with preparing a publication.

Assignment #3: Annotations

I have for a long time been concerned about the level of conceptual change that occurs in students during my microbiology classes. It has seemed to me that, while students may be good at memorising information, they do not retain this well. Nor have they been particularly good at applying their knowledge to new problems after finishing my courses. Thus, I want my students to increase their level of understanding about microbiology as a science, so that they can use their knowledge profitably later on in their lives. To achieve this I am moving my lecture classes more to an enquiry-based learning approach. To be precise I should say to a "not didactic lecturing approach" as I am incorporating a range of active learning activities to engender more student-centred learning via a constructivist approach. From my initial learning about pedagogy I realise that I need to think about several issues. It is these issues that I have chosen to collate into my annotated bibliography to focus my thinking.

What are the alternatives to didactic teaching?

1. Udovic, D., Morris, D., Dickman, A., Postlethwait, J. and Wetherwax, P., 2002. Workshop biology: demonstrating the effectiveness of active learning in an introductory biology course. Bioscience 52, 272 – 81.

This paper was one of the first that I read when starting to reconsider how I might change my teaching in order to improve student learning outcomes. What I get from this paper is the realisation that large science classes are not necessarily a barrier to student-centred active learning. Secondly, it gives me some ideas to consider for my own classes (for example challenging misconceptions, introducing students to thinking in a scientific manner). Thirdly, it uses quantitative data such as comparisons of pre- and post-testing of biology concepts in classes taught in the workshop format versus classes taught didactically. These are data that I could recognise despite them being in a fundamentally different discipline. Concomitantly, the paper introduced me to an alternative form of data: qualitative data that examined student reflections on their own learning. And finally, they demonstrated that the workshop biology approach of modelling the scientific method produced better learning outcomes for students than did didactic lecturing. I was sold.

2. Powell, L., 2004. NRES: Wildlife Ecology and Management. Viewed on July 1 at http://www.courseportfolio.org/peer/pages/index.jsp?what=portfolioObjectD&portfolioObjectId=169

Course portfolios such as Larkin Powell's are a good way to get ideas on how teachers review their courses and how they reflect on what they learn about how their students learn. As it was easy for me to associate with the subject matter, I could judge this portfolio more easily than if it concerned the pedagogy of a different

discipline. In this sense the discipline does matter, for I could compare my ideas of what students should be able to achieve in scientific learning with Powell's. There is a clear picture of the class, its aims and syllabus, who was in it, and how the students were assessed, together with outcomes of the teaching and learning activities. Powell provides examples of assessment and of student responses to the assessment along with his comments. The course portfolio enables more examples of student achievement than is likely to be possible in a journal article. I have been evaluating student responses to exams in my classes. In particular I have looked at the level of thinking required by assessment in order to see if a sequential increase in how students perform occurs. Powell found that the whether or not students had the prerequisite subject significantly affected student achievement in his course. This is clear evidence of the role of prior learning and its impact on student learning and is further recognition of the students as individuals.

Evaluating learning

3. Nazario, G., Burrowes, P.A. and Rodriguez, J, 2002. Persisting misconceptions: using pre- and post-testing to identify biological misconceptions. J. College Science Teaching 31, 292 – 6.

This paper is interesting for its use of pre- and post- testing to identify conceptual misconceptions that students have. While pre- and post-testing is a well known means for determining the effectiveness of teaching and learning activities, this paper took a further step. Nazario et al (2002) developed a misconception index to find out which concepts were difficult for students to get correctly. Persistent misconceptions are similar in nature to the problem of troublesome knowledge as described by Perkins (1999). The misconception index identified the most frequent incorrect answer in a multiple choice question and thus gives the teacher an idea of where to spend more time and effort. I have used analysis of MCQ answers in my courses, but not so much to identify misconceptions, but rather to identify effective questions. Thus, this paper has provided me with another tool to use in analysing student learning outcomes. However, from my perspective there was one misconception in which I thought that the students were hard done by!

4. Perkins, D., 1999. The Many Faces of Constructivism. Educational Leadership 57(3): 6 – 11

Student approaches to learning

5. Minbashian, A., Huon, G.F. and Bird, K.D., 2004. Approaches to studying and academic performance in short-essay exams. Higher Education 47: 161–176, 2004.

Minbashian et al (2004) examined the effect of the approach that students took to learning (deep or surface) in relation to their performance in short-essay exams that required either reproduction of knowledge or understanding. They controlled for student motivation and intelligence and found that the quality of student answers (understanding) increased with a deep approach to learning, but the detail in the answers was maximal with a moderate deep approach and declined with high levels of deep approach. Thus, student exam marks were not improved with a high level of a deep approach to learning, because although the conceptual quality was good, the level of detail was not. I found this paper interesting because of the methods used: learning, motivation and intelligence surveys and analysis of the quality of student answers with the SOLO taxonomy (described in Biggs, 2003 – which incidentally I

think is a very well written text for learning the pedagogy of higher education). It addresses one of the concerns that I have with how I am changing my teaching practice, and that is, does a constructivist approach to learning result in better learning outcomes. Minbashian et al (2004) could not demonstrate a clear relationship and concluded that this could have been because of the nature of the assessment, which were 4 short essays in 60 minutes. I would agree with them, that time constraints on the students may well have led those taking a deep approach to sacrifice detail in order to demonstrate their understanding. To date, I have used the Learning and Study Questionnaire (ETL Project, 2002) to encourage students to think about their approach to learning, but have found it difficult to use quantitatively because of small class sizes. Also, I have used the SOLO taxonomy to guide the construction of exam questions to require higher cognitive levels from students, but could now start to use it to analyse student responses. Minbashian et al (2004) give a framework for considering these questions and some of the potentially confounding influences.

6. Biggs, J., 2003. *Teaching for Quality Learning at University*. 2nd edition The Society for Research into Higher education and Open University Press Maidenhead, UK 309pp.

7. ETL Project, 2002. *Learning and Study Questionnaire*. Economic and Social Research Council Teaching and Learning Research Programme. Viewed 09/02/05 http://www.ed.ac.uk/etl/questionnaires/LSQ.pdf

Content versus process?

1. Sweller, J., 1993. Some cognitive processes and their consequences for the organisation and presentation of information. Australian Journal of Psychology 45, 1 - 8.

This paper by Sweller (1993) is my first attempt at grappling with the effects of enquiry-based learning on the difficulty for students to learn the discipline whilst concomitantly learning how to think about the discipline. Sweller describes cognitive load theory wherein if the total cognitive load (TCL) of a lesson is too high, then little learning may result. This occurs because, whereas the long term memory is very large, the human working memory is relatively small. Thus we have limited processing capacity to manage new material and we learn by developing schema of how to think in the discipline and by automating actions. Both are the domain of the long term memory. The use of schema and automation underpin the difference between the expert and the novice. TCL is made up of the intrinsic cognitive load (ICL), which is defined by the inherent level of difficulty of the subject, plus the extrinsic cognitive load (ECL)determined by the structure of how the material is presented. Little can be done to decrease the ICL where several pieces of information must be integrated in order to achieve a learning outcome. However, structuring a lesson such that most processing capacity can be directed to learning the content and away from interpreting it will decrease the ECL. Sweller (1993) suggests using goal-free problems, to prevent students from trying to work backwards from the goal, because although this is efficient, it has a high cognitive demand. Thus students focus on the content and learn schema for long term memory. Secondly, using worked examples, especially if they avoid splitting student attention between different sources of information and lack redundant information. So what I have taken from this is a starting appreciation of what students have to do mentally in order to learn something. And as I am emphasising understanding of how to think,

then clearly developing appropriate learning structures becomes vitally important and my initial impulse to change all is more sober and reflective.

Anne-Marie Hoskinson
Minnesota State University, Mankato, MN

Assignment #1: Introductions

1) Describe your teaching responsibilities and the type of student you teach

Unlike the rest of you, I am in transition this summer. I'm finishing two years as a biology instructor at Georgia Tech and jumping on the tenure track at Minnesota State – Mankato starting in August. Today is my last day of classes ever at Tech. I'm one of those crazy quantitative biologists. At MNSU, I will teach biology to non-majors and lab experiences for elementary teachers (really jazzed about that!). More, certainly, to develop.

2) Describe what you would like to take home as a result of attending the institute

I would like to take home two things from our working time this summer: the generalized principles that will allow me to design SoTL studies; and a re-invigoration of my passion for teaching biology. I'm specifically targeting design of a study that will define collaboration and measure its efficacy as a long-term teaching strategy and learning tool.

3) Tell us about your interests outside of the classroom and a book that you've read recently

Outside the classroom I spend lots of time, umm, outside. I hike, bike, camp and fish with my two puppy-dog boys. They are better at fishing, and I am better at biking. I am also a photographer (of nature – what else!). I have been making my way through Alan Weisman's The World Without Us since winter break. Gee, I sound really boring. Like a couple of you have mentioned, I like beer and gardening, too. Also beer gardens. I will be coming to DC a couple of days early to check out the Smithsonian(s) and a monument or two.

Assignment #2: Reflections

1) How would you describe your "research problem(s)" to the Research Scholars group?

The problems we face – as scholars, researchers, educators, and citizens – span such scales of time, space, and expertise to require intra- and inter-disciplinary collaboration. Yet this set of skills is not generally taught – in fact, many students find it difficult to reconcile the traditionally-competitive model of education with the collaboration that work and citizenship require. Our students aren't (generally) learning how to form habits of asking questions and collaborating. Collaboration itself isn't well-defined and is rarely distinguished from other cooperative teaching and learning practices. Without recognizing it, I demonstrated the very deficits I identified as my BRS research problems.

I hypothesize that the skills and processes of collaboration can be taught, that effective instruction methods correlate positively with long-term (≥ 12 mo) skill and practice retention, and that collaboration as an instructional and learning activity produces greater retention for longer durations than traditional teacher-based methods (lecture-then-exam cycles). (Null hypothesis = no effect of collaboration on

any measured learning outcome.) My objectives are to develop and refine the most effective tools for teaching classroom and real-world collaboration to biology undergraduates, and to distribute the instructional tools to my colleagues within and among our disciplines. To accomplish these goals, I must design an experiment that will test whether, and to what extent, the methods I use are effective at generating collaboration in my students, whether that effect persists beyond the classroom experience for my students, and if it persists, for what duration.
I define a collaborative group as distinct from a cooperative group. While both require cooperation among group members working toward a common goal, I use the term "collaborative groups" to refer to higher-performing groups that solve more complex tasks. Unlike cooperative groups, collaborative group members understand that the common goal cannot be achieved by any one group member alone, nor by group members taking a "divide and conquer" approach. Because of their commitment foremost to a common goal, collaborative group members guide their learning responsibly. While this distinction is rare (absent) from the SoTL literature, I use it to distinguish my objectives, teaching philosophies, and my goals for this program from merely studying "group work."

2) What theme(s) based on your readings, resonate with your "problem" and/or your proposed approach to address your problem?
As I read the articles by Bass, Benson, and Nelson, I was struck first by how manifest their theses were to me. In fact, I thought I was missing something. Of course we must consider problems in the scholarship of teaching and learning the same way we consider our 'hard science' problems, I thought. They are interesting questions, hypotheses waiting to be articulated and tested. What is the purpose of such obvious declarations? Was I missing something?

Well, yes. It didn't occur to me that not everyone sees questions in the scholarship of teaching (and learning) as research problems best engaged with scientific inquiry. Biology is a quantitative, emergent science.

3) Which of the 12 properties of SoTL in microbiology education proposed by S. Benson's article are particularly relevant to your project at this stage?

4) Do you have any questions/concerns/comments that have evolved from your reading?

5) What do you see as tangible products to be developed as a result of your Scholars experience within the next 12 months?
I anticipate the following products:

1. An operational definition of collaboration as a skill and practice within life sciences teaching and learning;
2. Data analysis of past collaborative-learning (CL) outcomes;
3. Design of a new experiment to test my questions, above, and;
4. Strategies and heuristics for turning traditional and/or lecture-based activities into problems that foster collaboration and concept development.

I currently have four data sets of student-reported outcomes from four semesters of a CL class in mathematical-biological modeling that I designed and taught at Georgia Tech. I need to analyze these data to determine whether there was a treatment effect (i.e. whether designing this course and its problems from the objectives backward had the intended outcome). Next, I will use meta-analyses of CL problems

I've developed and compare them to existing best-practices to generate heuristics for designing CL problems.

6) What do you see yourself presenting at the follow-up session at ASMCUE 2009?

7) What will you need to develop these products?

Assignment #3: Annotations

My research asks how best to assess the short-term and long-term effectiveness of collaborative learning, and what instructional tools and methods best develop collaborative learning. In my research and teaching, I am making two key distinctions. The first is between more traditional, competitive learning and cooperative learning. Second, I distinguish between cooperative learning and collaborative learning. For brevity, you may think of collaborative learning as a specialized subset, an enhancement, of many of the practices of cooperative learning. Many SoTL journals, book chapters, proceedings, etc. don't distinguish between these learning models, but it is non-trivial. This is partly what prompted my inquiry, but it is a little startling (as at least one other Scholar pointed out!) to search several databases without arriving at consensus of thought. I am surprised that there is so much variance among simple definitions such as cooperation, collaboration, and effect. My first challenge, then, is to clarify what collaborative learning is. I am also finding very few "hard results," but am unsure yet whether this is because I'm not looking in fertile sources or because I don't know where to look!

1. Smith, K. A. (1995). Cooperative learning: Effective teamwork for engineering classrooms. ASEE/IEEE Frontiers in Education. B. Carlson. Rensselaer Polytechnic Institute. URL: http://fie.engrng.pitt.edu/fie95/2b5/2b54/2b54.htm. Accessed 2 July 2008.

Smith defines cooperative learning along a hierarchy of results based on the degree of teamwork. Pseudo-learning groups are teams in name only – their learning model is still highly competitive. Cooperative learning groups, in contrast: a) work toward a common, shared purpose; b) are responsible and accountable for their work; c) learn from one another as they complete a substantial, common work product; and d) analyze their interactions and results. What Smith calls "high-functioning" cooperative groups include all those characteristics, but "outperforms all reasonable expectations." This is a good beginning to distinguishing collaborative learning. Note than neither Smith nor I are making a value judgment about either learning model. Smith does not specify what this outperformance is.

2. Gokhale, A. (1995). "Collaborative learning enhances critical thinking." Journal of Technology Education 7(1): 22-30.

The author designed a simple experiment to test whether students in a circuit's class performed better after completing a group synthesis exercise than students tested after individual study. However, based on the reported practices, the author's model of a collaborative group is better characterized as a low-functioning cooperative group, because the instruction (the actual learning) is still based on the professor, not the students, and because the group learning process is entirely scripted. Student group members do little to define the process of neither their learning nor

the "rules" for teamwork. None the less, Gokhale found that students who worked in small groups fared better on critical-thinking exam questions (based on Bloom's [1956] taxonomy) than students who worked individually.

3. Rockwood III, H. S. (1995). "Cooperative and collaborative learning." The National Teaching and Learning Forum 4(6): 8-9.

4. Rockwood III, H. S. (1995). "Cooperative and collaborative learning, part 2." The National Teaching and Learning Forum 5(1): 8-10.

Rockwood answers the question, what's the difference between cooperative and collaborative learning? He acknowledges the overlap between the two models – for example, both learning models are student-centered, success occurs when group members fulfill a common goal with complementary roles. However, Rockwood asserts that there are a few key differences, too. Cooperative learning groups are more structured; teamwork, cooperation, and group skills are often explicit curricular goals; and the instructor is still the center of authority and knowledge in the class. In collaborative learning, groups fulfill more complex tasks (corresponding to Bloom's analysis, synthesis, and evaluation levels). Structure arises from autonomous groups themselves, not the instructor, who helps students construct their knowledge bases. Rockwood asserts that the key difference between the two learning models comes down to knowledge and power. Rockwood does a great job of capturing the essential distinctions between two very similar models.

5. Johnson, D. W., R. T. Johnson, et al. (1998). "Cooperative learning returns to college: What evidence is there that it works?" Change (July/August): 27-35.

The authors summarize results from a meta-analysis of academic success, relationship quality, and psychological adjustment of cooperative learners. They reported analyzing 168 studies comparing individual, competitive, and cooperative learning models, using a broad survey of measures – knowledge retention, accuracy, problem-solving, and meta-cognition among many other examples. Their reported effect size for cooperative vs. competitive learning was 0.49, an impressive value. Unfortunately they do not give any methodology, so it is impossible to know how they got there, or how to replicate (or not) their results.

Sherri Morris
Bradley University, Peoria, IL

Assignment #1: Introductions

1) Describe your teaching responsibilities and the type of student you teach

I am an associate professor in the Biology Department at Bradley University, a private comprehensive in central IL. I have taught a number of courses. The ones I teach most often are Ecology, Ecosystems Ecology and an environmental science course entitled Populations, Resources, and Environment. The first two are for majors and ENS course is non-majors upper level general education course. I have also taught organismal biology in our sophomore level series which is a research immersion course designed to encourage independent thought and a comprehensive understanding science as a process. I have also taught some grad level courses in ecology and soil ecology. I enjoy teaching at BU. We encourage undergraduates to participate in our research labs by allowing research for credit. I have an active research lab with undergraduates and masters students.

2) Describe what you would like to take home as a result of attending the institute

As varied as my teaching load has been in the past 8 years I have also taught using a number of different approaches and styles. I have recently become involved with a number of science education activities where we involve education majors in research immersion courses. It has been quite an experience. I feel behind the curve in this arena because the education faculty actively assesses classroom performance and teach action research activities to their students as mechanisms to improve their teaching. I am very interested in assessing the degree to which the different approaches I use in the classroom impact student learning.

3) Tell us about your interests outside of the classroom and a book that you've read recently

I am married, with a 5 year old boy, 2 year old girl and new puppy. Pretty much sums up my free time. I enjoy reading anything with more than 10 words on the page, relatively few pictures and am especially fond of books that don't rhyme. The book I most recently chose of my own free will was Yvonne Baskins Under Ground: how creatures of mud and dirt shape our lives. But am looking forward to reading several recently mentioned on the list.

Assignment #2: Reflections

1) How would you describe your "research problem(s)" to the Research Scholars group?

My research problem focuses on the use of research in the classroom. In majors courses I use student driven novel research projects rather than 3 hour labs. It has been suggested that research in the classroom and across the curriculum aids in cementing the knowledge of science as a process and provides avenues to teach critical thinking, encourages engagement at a higher level than a simple understanding of course content and often provides students context upon which to place content knowledge. I have never challenged my assumption that providing research experience in place of "canned laboratory exercises" actually achieves those

objectives. Furthermore if my use of research does not achieve those objectives how can I change the way I assign, organize, orchestrate, etc. the use of research to achieve those goals?

2) What theme(s) based on your readings, resonate with your "problem" and/or your proposed approach to address your problem?
There was a great deal in the reading that resonated with me. It is sobering to realize that I really should recapture a portion of the blame for student failure. The ""transactional relation" between teaching practice and student performance" should be actively recognized in teaching and utilized to achieve the desired student performance. My experience with majors and especially with non-majors has been that poor performance on exams is often tied to class attendance and failure to utilize available course materials (i.e. actually reading the book they complained about spending so much money on). While I am cynical enough to believe that teaching personal responsibility to ones children is overlooked as a necessity in this country, hence the failure to participate to the full extent of ones capacity (or maybe it is really driven by societal values i.e. it really does seem to be all of the current generation) I do believe I should recapture some blame for not finding a mode of delivery that allows them better access to that which I believe essential to my course. As a new professor it seemed essential to change the things I could and not feel depressed or overburdened by the things I could not change in my courses. In hindsight, it was perhaps a crutch I used that allowed me to explore more comprehensively all of my roles at the university rather than spending what I saw as an inordinate amount of time on a problem (student engagement and learning outcomes) that perhaps had a solution only outside of my control. It is now time to reassert control over my teaching and use the tools that are obviously available to scientists as a scholar of teaching.

3) Which of the 12 properties of SoTL in microbiology education proposed by S. Benson's article are particularly relevant to your project at this stage?
Of Benson's properties, the 1st property that focuses on reflective analysis is most relevant to my project at this stage. I reflected on the course materials used and the reviews from students in the first several years I taught. As the student evaluations improved to a reasonably acceptable level I began to focus on my research program. Student evaluations are a lousy tool for understanding the degree to which ones teaching actually teaches. It is time to begin the process of reflection again but with a much more serious effort elucidating the approaches that best elicit the desired student outcomes using the same systematic approach I use in research. As for concerns, the readings affirmed by developing suspicion that while I may be considered a good educator I am not teaching in a manner that provides the best education to my students or achieves the goals I think I am achieving in the classroom.

4) Do you have any questions/concerns/comments that have evolved from your reading?

5) What do you see as tangible products to be developed as a result of your Scholars experience within the next 12 months?
As a result of m Scholars experience, I believe I can evaluate the effectiveness of specific teaching practices I use in the classroom and begin to put into place a research program that will provide tangible results that can be used to evaluate the effectiveness of specific methods for achieving specific student learning outcomes. In the first 12 months I expect to set up the research design and begin preliminary

data collection. I expect it will be an iterative process over the next few years to get the assessment tools adequate for answering the questions I need answered to evaluate the process of student learning with the objectives needed for my specific problem.

6) What do you see yourself presenting at the follow-up session at ASMCUE 2009?
I don't know that I will have data that supports the use of research on student learning outcomes to present at the follow-up session at ASMCUE 2009but I will certainly have a research plan designed specifically to evaluate this teaching method. The greatest challenge to developing the products for the ASMCUE meeting in 2009, and to investigate my overall problem will be to develop the pre-tests that will allow me to evaluate whether specific outcomes were achieved as a consequence of specific course elements.

7) What will you need to develop these products?
Thoughtful development of assessment tools will be essential and I have little experience in this arena.

Assignment #3: Annotations

My research problem focuses on the use of research in the classroom. In majors courses I use student driven authentic research projects rather than 3 hour labs. It is a tool that allows students to create and test their own hypotheses in a broad somewhat unrestricted manner. It has been suggested that this process used in the classroom and across the curriculum aids in cementing the knowledge of science as a process and provides avenues to teach critical thinking, encourages engagement at a higher level than a simple understanding of course content and often provides students context upon which to place content knowledge. I have never challenged my assumption that providing research experience in place of "canned laboratory exercises" actually achieves those objectives. Furthermore if my use of student driven research does not achieve those objectives how can I change the way I assign, organize, orchestrate, etc. the use of research to achieve those goals? Perhaps as an alternative a more guided set of inquiry activities would be more useful.

The following will be of use in my endeavor to address the question of whether research in lieu of "laboratory exercises" achieves greater understanding of the processes of science and what it means to be a scientist.

1. Lord, Thomas and Terri Orkwiszewski. (2006) Didactic to Inquiry-Based Instruction in a Science Laboratory. The American Biology Teacher 68 (6): 342-45.

Lord and Orkwiszewski discuss the ramifications of inquiry based science laboratories. They performed a study that compared performance in an inquiry based laboratory compared to a cookbook using several hundred studies. While there results supported the value of inquiry methods the paper was particularly valuable for me because of the tools used for the analysis. Pre and post tests were required of all students participating. Assessment tools will be particularly important to determine the degree to which specific assignments produce specific outcomes. The

weekly testing on comprehension and the amount of time concepts resonated with specific students could also be an important gauge for student learning. Also important is the conclusion from the written comments that students will love or hate any method you give them based on previous experience, what they perceive as reasonable demands and degree of engagement in higher education. Overall a very nicely presented study that provides important data in support of inquiry in college laboratories.

2. Rogers, Meredith A. Park and Sandra K. Abell. (2008) The design, enactment, and experience of inquiry-based instruction in undergraduate science education: A case study. Science Education 92(4): 591-607

The Rogers and Abell paper provides an introduction to inquiry methods and its development over the past forty years including discussion of the terminology used in inquiry based methods. They note that while inquiry has been discussed by science educators since the nineteen sixties there has been little data collected on the outcomes achieved with this specific set of teaching methods. The journal article provided a study on inquiry based instruction for a smaller group of students than the Lord and Orkwiszewski paper. They used a number of assessment tools within the classroom and outside of the classroom that would be useful for collecting data on student learning outcomes and achievement rather than simple course grades. Their focus was on learning for non-majors. Their conclusion was that the experience allowed students to gain a better perspective on the process of science rather than facts of science. Their approach will be helpful when I hone my hypothesis as I teach both majors and non majors using a variety of approaches in each classroom.

3. Basey, John, Loren Sackett, and Natalie Robinson. 2008. Optimal science lab design: Impacts of various components of lab design on students' attitudes towards lab. International Journal for the Scholarship of Teaching and Learning 2(1): 1-15.

This paper does a great job of aligning instructional goals with intended outcome. There are two issues that must be addressed before one can develop a hypothesis regarding the use of a specific technique in the classroom. First is what does one intending the outcome of a specific experience to be and then second are the students achieving that. This requires different tools than are the students engaged in the materials. Effective teaching will require identifying intended outcomes of the use of authentic research in the classroom and designing the assessment tools to determine whether the outcomes were achieved. The paper focuses on research that would allow users to identify "optimal science lab design" based on the student achievement given a specific set of required outcomes. Assessment tools necessary for developing the optimal lab design are described, which will provide a new set of tools that can be evaluated for use in my project.

4. Jenkins, Alan and Mick Healey. 2005. Institutional strategies to link teaching and research. Higher Education Academy, York, United Kingdom. 68 Pp.

The paper presented an argument for integrating research into the educational system. The benefits associated with use of research in the classroom are discussed and the conflicts with institutional assessment of performance are also addressed. The means by which institutions can begin to move towards blending teaching and research and the outcomes of such movement are addressed. The content is

important for introducing the concepts that authentic research will improve the laboratory environment. As with several other papers, it was not the content of the paper that will be helpful with the study but its identifying the source of the material. The Higher Education Academy has a wealth of information on teaching however in this case there are a large number of resources that emphasize the utility of research in the classroom.

5. National Academy of Sciences. Improving undergraduate education in Science, Technology, Engineering and Mathematics: Report of a workshop. National Academy of Sciences. 176 Pp.

The report focuses on the outcome of a workshop wherein educators discussed mechanisms by which undergraduate STEM education could be improved. Each of the chapters has information that is worthwhile with regards to improving classroom experiences and learning outcomes for students. The specific challenges addressed in the document are how to measure learning in undergraduate STEM courses, how to create criteria and benchmarks to assess instruction using these measurements, and how such a framework could be used at the institutional level to bring about change in STEM education. As assessment tools will be important for conducting a study on learning outcomes tools will be important. However as important are the thoughts in this document on organizing your ideas regarding appropriate and achievable outcomes for students and the experiences that others have had in this arena. This report was also important in my investigation for research materials because it led me to the important resources available from the National Academy of Sciences.

6. Cusick, Judy. (2001) Practicing Science: The Investigative Approach in College Science Teaching. An NSTA Press Journals Collection. National Science Teachers Association, Arlington, VA. 71 pp.

While I have not read the entire collection the document provides a wealth of examples of how to bring inquiry to the classroom both with research and other activities. It provides messages on skill development, benefits of specific approaches, pitfalls, and lessons on how to improve content learning in a wide range of classrooms across a wide range of disciplines. The great value of this particular piece is that it lead me to the great resources available thought the NSTA.