TEAM #5

TEAM LIST:
Kathleen Archer
James Bader
Naowarat Cheeptham
Iglika Pavlova

TEAM FACILITATOR:
Carol Hurney

Kathleen Archer
Trinity College, Hartford, CT

Assignment #1: Introductions

1) Describe your teaching responsibilities and the type of student you teach
In the biology major I teach introductory biology courses (we have a 3 semester series), plant physiology, plant diversity, recombinant DNA methods and a seminar in symbiosis. In service to our general education I teach a plant biology courses for non-majors and a first year seminar.

Trinity College is a private, four-year liberal arts college and our students include those from privileged economic backgrounds (the "full-payers") as well as from the other economic levels. Trinity has worked hard to maintain its financial aid percentage, so the portion of our students who receive financial aid is significant Recently we have experienced an increase in the number of international students we attract. Our student body is an interesting mix of well-to-do, first in the family to attend college, and new to the U.S.

2) Describe what you would like to take home as a result of attending the SoTL Institute
I attended ASM-CUE for the first time last year, and made a short Microbrew presentation on group exams - a technique I had tried for the first time and really liked. We know group exams help students self-correct misunderstandings of the material, but what I hope to take away from our meeting in July is a strong plan for collecting and analyzing data on whether group exams improve retention of knowledge. I also hope to connect with other people like me who are interested in how to demonstrate the effectiveness of teaching strategies in a scientific way.

3) Tell us about your interests outside of the classroom and a book that you've read recently
I'm interested in, and intimidated by, the world of art, and to push myself a little I started taking watercolor painting lessons a year and a half ago. It uses a different part of my brain, and I have enjoyed it immensely. I also am an enthusiastic gardener - both perennials and vegetables - and have been busy planting and

seeding. I also like very much to eat, and enjoy cooking and trying out new cuisines.

Since I was a little girl I was lucky to be a fast reader. I read about 20 minutes at bedtime, and that way manage to get through about three books a month for pleasure. Recently I enjoyed reading "Boone: A Biography" by Robert Morgan, and "Affinity" by Sarah Waters. I'm also fond of mysteries and in particular like Robert Parker.

Assignment #2: Reflections

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

I'm interested in whether group exams can improve understanding and/or retention of material compared to exams taken only individually. I have used group exams in the way described by Larry Michaelsen (Michaelsen et al., 1985), where students are divided into small groups of four or five. For an exam, students first take the exam individually and turn it in. Then, each group of students gets the same exam again to take as a group. They must come to consensus about each answer, and in working towards that answer they self-correct misconceptions and errors. Since students receive both an individual grade and a group grade, they are motivated to generate the best group test score. In my experience, group exams were exhilarating to watch - students were vigorously discussing each question and were engaged in the kind of intellectual interaction we always hope for.

If that's all that happens during group exams I'd still be satisfied, but it seems likely that such discussions would not only lead to correcting errors, but to improved understanding and possibly to improved retention. My research problem then, is the question, ***does the participation in a group exam improve student understanding and/or retention of material?***

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

Mattetal writes that Classroom Action Research (CAR) should address questions under the instructor's control, and the questions should be small and feasible. Those are qualities that I think describe the question I'm posing. She also writes about the need to triangulate, to have data from several different sources. I like that idea and agree that it improves the trustworthiness of the conclusions. I've thought of one way to collect data that address my question, and will value suggestions from my co-participants on what other kinds of data might serve in the triangulation. Pat Hutchings also writes about the utility of more than one approach to researching a question, especially in terms of the methods we are familiar with within our own scientific discipline and not familiar with but common outside our discipline. She sees that feedback across disciplinary boundaries is very useful, and I'm interested in how co-participants from different areas of biology might see to approach my question.

3) Based on Pat Hutchings article, what taxonomy would you use to describe your research question and why?

"What works" seems like a good fit with what I'm trying to determine about group exams. I want to know if the group exam technique works to improve understanding and retention, which is a pretty concrete, defined question. The other taxonomic

items strike me as broader and more open-ended - visions of the possible, new conceptual frameworks, description of an approach and its features - none of these seem to describe what I want to address as well.

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

A theme that I see in both the Mattetal and Hutchings is the idea that the scholarship of teaching and learning is somehow different from educational research. The sense I get from these articles is that educational research is viewed as scientifically rigorous and applicable beyond an individual instructor's classroom. Teaching and learning scholarship, or Classroom Action Research (Mattetal) on the other hand, are described in terms that suggest this kind of research may be less universally applicable, but useful for a particular institutional setting or specific class. What I'm a little wary of are the hints I get from these authors that SOTL or CAR may be seen as somehow less rigorous or controlled than educational research. I'm concerned about the idea that one might still draw conclusions from research that is less rigorous - if we don't have the right controls, can we be confident the data is meaningful? I'd like to know a little more about the idea that scholarship in teaching and learning might not meet the standards of educational research, because I'm not sure how we can convince our colleagues in the sciences that a pedagogical tool is worthy if the data are not strong.

Assignment #4: Annotations

My research problem is to determine if group exams improve retention of knowledge compared to individually taken exams. I'm also interested in knowing whether group exams improve understanding, but I'm less confident I can test for that. I looked for resources that studied the use of group exams and the effect of group discussion, and papers that offered ideas on how to design my own study. As a side note, I just looked ahead at our last assignment and found that one of my favorite papers on my list (Smith et al, 2009) is assigned reading for our first evening of the workshop.

Smith, M.K., Wood, W.B., Aedams, W.K. Wieman, C., Knight, J.K. Guild, N., Sue, T.T., (2009). Why Peer Discussion Improves Student Performance on In-class Concept Questions. Science 323, 122-124.

This study came out in January of this year and I was very impressed with it. It looks at the effect of small groups discussing in-class questions. It asks whether students who initially got a question wrong get it right after group discussion purely due to the influence of more knowledgeable teammates, or because they gained in actual understanding, and they conclude that actual understanding accounts for the improvement in student performance. Although the vehicle (in-class questions) is different from group exams, both have student discussion with peers in common. Also, in their methodology the authors used the idea of isomorphic questions - questions that address a concept in similar ways but are different - to look at improvement in understanding over the course of a semester. Isomorphic questions are likely to be something I will need to use, and their online supplementary material gives a number of examples.

Giuliodori, M.J., Lujan, H.L., DiCarlo, S.E., (2008). Collaborative group testing benefits high- and low-performing students. Adv. Physiol. Educ. 32, 274-278. doi: 10.1152/advan.00101.2007.

The authors wanted to test the hypothesis that all students, both strong and weak, benefit from collaborative group testing. They tested 65 students individually, then immediately after students answered the same questions in groups of two. The individual and group scores were compared, with students identified as high or low performers based on their individual scores. They found that group exam scores were significantly higher (mean of 70.2% correct) than individual scores (mean of 58.7% correct). Furthermore, high performing students improved their scores by a mean of 3%, while low performing students improved by a mean of 20%. Earlier studies have demonstrated that mean student scores improve with group exams, but this study dissects whether both strong and weak students show improvement, and demonstrates that they do. Their data provide good arguments to convince strong students about the value of collaborative exams even to them - although the increase might seem small, most students are keen to increase their point totals by even the smallest amount. The authors also determine the effect size of group exams - effect size is a new concept to me and is something I may need to consider for my own study.

Lusk, M., Conklin, L., (2000). Collaborative Testing to Promote Learning. J. Nursing Education 42(3):121-124.

These authors define collaborative testing as “a method of cooperative learning in which students work together but then turn in their own work.” This is a little bit different wrinkle on the group exam idea, which usually takes the form of a single exam representing group consensus on the answers. Lusk and Conklin tested for differences in retention between students who tested collaboratively as they defined it, and those who tested individually on exams during the semester by testing them again (individually) on the same concepts during the final exam. They found no difference on final exam scores between the two groups, and concluded that collaborative testing makes no difference in comprehension or retention. This study is directly relates to the question I’m asking, and it will be important for me to think about why they found the results they did, especially in light of the next article on my list.

Cortright, R.N., Collins, H.L., Rodenbaugh, D.W., DiCarlo, S.E., (2003). Student Retention of Course Content is Improved by Collaborative-Group Testing. Adv. Physiol. Edu. 27(3), 102-108.

Cortright et al., wanted to know if collaborative testing improved student retention of knowledge, so this study is directly relevant to my own question. Their design is an example of a randomized crossover study, an experimental design method that is new to me. They used 2 student groups (Group A and Group B) of 19 each; all were given exam 1 individually, then Group A was given a subset of questions to answer in teams of 2 or 3 students. A month later, both groups were given exam 2 plus the same subset of questions from exam 1 used for the collaboratively tested group. For exam 2, Group B then received a subset of exam 2 questions to answer collaboratively. Finally, for exam 3 both groups took the exam individually, with the exam 2 group question subset included. They found that student retention when asked the same questions later in time was improved when students worked on questions in groups, raising the percent of questions answered correctly from 46.0% (questions answered only individually) to 52.9% (questions discussed in groups), a difference of 6.9%. They note a limitation of their design is that the students given the group questions have additional exposure time to those questions that the non-

group test students did not receive, and one could argue that the improved retention is due to this extended exposure, not to the group discussion of the question.

Kapitanoff, S.H.,(2009). Collaborative Testing: Cognitive and Interpersonal Processes Related to Enhanced Test Performance. Active Learning in Higher Education 10(1), 56-70. doi: 10.1177/1469787408100195.

Kapitanoff was interested to know how collaborative testing works to improve student test scores. She proposed that it might work in several ways, including through cognitive processes, interpersonal interactions, and reduced test anxiety. She took a group of 33 participating students and 16 non-participating students and gave them a pre-test questionnaire about test anxiety, confidence, etc. and a week later administered the exam. All students took the exam as individuals, and immediately following the participators answered a subset of the exam questions in small groups. Kapitanoff found that students performed better on the group test portion than on their individually taken exam, with a mean gain of 8.4%. Subsequent to the exam students filled out a follow-up questionnaire. Kapitanoff bases her conclusions about how group tests improve test performance on what students self-reported about themselves and their attitudes in this follow-up. Drawing conclusions based on student self-perceptions seems to tell us more about why students **think** it works than about how it actually does work.

James Bader
University of Wisconsin, Madison, Madison, WI

Assignment #1: Introductions

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

I am a lecturer in the Department of Biology at Case Western Reserve University in Cleveland, and Director of the Center for Science and Mathematics Education. My current teaching responsibilities are upper level aquatic biology lecture and lab courses in the fall, a microbiology laboratory in the spring, and one of our introductory core courses in the summer. In the past I have taught a variety of introductory level courses as well as lecture courses in ecology and microbiology.

In theory, I am half time in biology and half time with the Center for Science and Mathematics Education - the Center coordinates K-12 STEM offerings across campus and runs 10 programs directly. We recently completed an NSF-funded Math and Science Partnership program together with the Cleveland Municipal School District, John Carroll University, Cleveland St University, and EDC, and we have a state funded MSP that is finishing up this summer. As a consequence, one of the populations of students I work with extensively are in-service high school and middle school science teachers.

Legend has it that if you throw a computer out the window on our campus, it is likely to land on a biology major or a biomedical engineering major. It is true that these are the two biggest undergraduate majors at CWRU and a huge percentage of our students are pre-med, pre-dent, or pre-something else medical. As a result, I teach freshman who are convinced they are going to medical school, juniors who are still hanging on to that hope, and seniors who have either realized the dream or are looking reality square in the face.

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

I am one of several faculty in the biology department who cleverly call ourselves the biology teaching group because we come together on a regular basis to talk about teaching, particularly in the introductory core classes. Several of our faculty have participated in the summer institutes at Wisconsin and have been working hard to integrate active learning into our large lecture courses (300+ students). My personal interest is in developing the skills to address classroom based questions in a more rigorous way and specifically, to investigate some interesting observations I have made when students are engaged in cooperative learning situations.

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

Outside of the classroom, I have no life, mostly because I have six children, ranging in age from 25-13. In true modern American fashion, all of those children are still living under our roof which makes life interesting on a daily basis. When I get the chance, I am a big Cleveland sports fan (Go Cavs!) and my wife and I like to travel, but rarely get the chance. I am currently trying to work my way through "Team of Rivals", but I confess progress is slow.

Assignment #2: Reflections

1) How would you describe your "research problem(s)" to the Research Scholars group?
Just when I think I have narrowed the focus of my research problem, I observe something else happening in the classroom that gets me thinking in a different direction. I am currently teaching a 5 week intensive summer course in introductory biology. It is extremely challenging for a variety of reasons (accelerated pace, summer, etc.). At the beginning of the course, I was struck by how heterogenous the student population is this summer. There are a significant number of students who withdrew from the same course this spring, some who are retaking the course for a better grade (they hope), some who have graduated and are prepping for the MCAT, a whole bunch of engineers of all sorts, and some students who haven't had biology since high school.

My inititial interest was in the impact of cooperative learning in an upper level elective, but now I am very interested to see if cooperative learning can level the playing field in a heterogenous population of students in an accelerated summer course. I have heard that both high achieving and struggling students can benefit from this arrangement, but I don't know the specifics of the literature or what else I need to do to facilitate this. I have some preliminary data collected with clickers, but clearly need more sophisticated methods to learn more about what is really going on in these groups.

2) What theme(s) based on your readings, resonate with your "problem" and/or your proposed approach to address your problem?
One of the things I really liked about the CAR paper was the personal nature of the work. It was clear you don't have to know the literature inside and out and it is ok if your work replicates what others have already done. I want to know what works for me and my students, even if others have already done it. It is new for me and that is ok.

I have been exposed to more and more formal experimental education research through the Math and Science Partnership program, and I have struggled with how to replicate those kinds of studies at my university. It makes sense to start small and work your way to something more formal. I am looking forward to triangulating data, and maybe someday will get to participate in a randomized control trial.

3) Based on Pat Hutchings article, what taxonomy would you use to describe your research question and why?
I believe my question falls into the what is category. I am very interested to see what impact cooperative learning has in these mixed groups of students. From there, I can envision moving into more ambitious work, but first things first.

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

Assignment #4: Annotations

My research question focuses on the conditions that maximize group performance and individual learning in cooperative learning settings. This includes considerations of both group composition and the role the instructor plays in group facilitation.

There is a large and robust body of research on cooperative learning lead by the works of Cohen and Johnson and Johnson that clearly demonstrates the positive impact of cooperative learning on student understanding. However there are several key areas where results to date have been inconclusive and are worthy of further study.

For instance, there have been several studies on the performance of individual students working in homogeneous groups of like ability, gender, experience, etc as compared to students working in heterogeneous groups. I am interested in how heterogeneity is defined and accounted for because I just completed a summer course that I believe was very heterogeneous. I anticipate exploring alternative ways to define heterogeneity and investigating the impacts of various grouping arrangements.

Saleh, M., Lazonder, A.W., and De Jong, T. "Effects of within-class ability grouping on social interaction, achievement, and motivation" *Instructional Science* 33:105-119, 2005.

This study grouped 104 fourth grade students in Kuwait according to their ability level (low, medium, and high) based on their performance on a standardized test. Students scoring in the top or bottom 25% were identified as high and low ability respectively, and the group in the middle 50% were identified as medium ability. Heterogeneous groups consisting of one high, one medium, and one low ability student were established and as well as homogeneous groups of only high, medium, or low ability students. Groups were asked to complete tasks related to plant biology and but then individuals completed and were scored on quizzes and pre- and post-tests.

The data indicates that low ability students achieved more in heterogeneous groups, average ability students performed better in homogeneous groups, and high ability students performed comparably in both homogeneous and heterogeneous groups. These results are consistent with those of Lou et al. (1996), and Webb (1991, 1995) and establishes a baseline of sorts for my research. It should be noted that work with high ability students has yielded inconsistent results, with some studies concluding high ability students perform best in homogeneous groups and others in heterogeneous groups.

Webb, N., Nemer, K.M., and Chizhik, A.W. "Equity issues in collaborative group assessment : Group composition and performance" *American Education Research Journal* 35(4):607-651, Winter 1998.

According to these authors, the literature on group composition and student achievement is sparse. They cited only one study (Pomplun 1996) that has investigated this component of cooperative learning. Pomplun showed that the presence of a special education student did not negatively impact the group's performance, but the study did not look at the sub-structure of groups that were composed of only regular education students.

Webb et al. (1998) investigated the impact of group ability (rather than individual ability) on group performance. Webb et al were investigating the hypothesis that group performance often correlates with the average ability of the group or the highest ability level in the group. In this study of 7^{th} and 8^{th} grade science students, all students were given a verbal and non-verbal pre test (Phase 1), and a hands on

and written test following instruction on electricity and circuits (Phase 2). The results of these assessments were used to group students in a variety of configurations for Phase 3, which was a re-taking a month later of the hands on and written tests on circuits, but this time in a group setting.

Working with above average students helped low and medium ability students. They had more correct answers and they demonstrated a higher level of scientific discourse (make/defend suggestions, ask questions, paraphrase thoughts of other students). High ability students worked better in homogeneous groups, but it appears that participation in heterogeneous groups was not significantly detrimental to their learning.

The authors pose an interesting problem that I hope to be able to investigate further: Based on these results, it appears the performance of high and low ability students can not be optimized at the same time.

Armstrong, N., Chang, S., and Brickman, M. “Cooperative learning in industrial-sized biology classes’, *CBE-Life Sciences Education* 6:163-171, Summer 2007.

My primary interest in this article are the ways the authors measured student achievement in a large biology class as well as how they defined heterogeneity. Interestingly, students were randomly assigned to groups and they were given no instructions on how to interact within the groups. They used student scores on individual tests and the final exam to measure achievement. They measured learning gains by the percentage difference on a pre-test and the final exam. They also categorized their multiple choice questions according to Bloom’s taxonomy and investigated the ability of students to master both factual recall and conceptual understanding.

To measure heterogeneity in the student population, they collected data on self reported GPA, the number of previous science courses, gender, and scores on a pre-test exam. Relationships between student performance and self-reported GPA and the number of previous science courses were investigated using the non-parametric Kruskal-Wallis test, between student performance and gender with logistic regression, and between student performance and pre-test scores with an ANOVA.

Tanner, K., Chatman, L.S., and Allen, D. “Approaches to cell biology teaching : Cooperative learning in the science classroom – beyond students working in groups”, *Cell Biology Education* 2:1-5, Spring 2003.

This article was helpful in that it provided a very brief but fundamental review of the major elements of cooperative learning as defined by Cohen and Johnson and Johnson. In this paper, the authors quote Johnson (1991, pg 18), “Putting students into groups to learn is not the same thing as structuring cooperation among students.” That statement effectively summarizes my experience and was a large part of my motivation for pursuing the Research Residency.

The paper goes on to summarize the five essential elements for effective cooperative learning and offers some suggestions on how they might look in the classroom. The five essential elements are (1) positive interdependence, (2) face-to-face promotive interaction, (3) individual and group accountability, (4) interpersonal and small group skills, and (5) group processing. There are several elements that I have not

considered in my own work with groups, and this paper is a nice introduction to the challenges of putting together high quality and productive groups.

Staples, M.E. “Promoting student collaboration in a detracked, heterogeneous secondary mathematics classroom” *Journal of Mathematics Teacher Education* 11:349-371, 2008.

I really enjoyed this paper because to me, it is the second half of the equation. Assuming we can get students into groups that make sense, what happens next? This is the only paper I found that explored the mechanics of facilitating groups, but I’m guessing/hoping there are more out there.

The author observed a high school geometry class and collected a wealth of data to process and analyze (direct observation, video of whole class and group interactions, interviews, etc). The author argues that when analyzing teacher interactions with groups, direct cause and effect is insufficient to effectively capture what is really going on. Instead, she draws on the work of Davis and Simmt (2003) and what they call complexity science. The basic assumption here is that student collaboration is an emergent property of the classroom system and requires an alternative form of analysis.

The author identified four categories she felt are critical to understanding the teacher’s role (1) promoting individual and group accountability, (2) promoting positive sentiment among group members, (3) supporting student-student exchanges with tools and resources, and (4) supporting student inquiry in direct interactions with groups.

I have found this paper to be extremely interesting, particularly some of the strategies the teacher uses to promote accountability in groups, a problem that I have noticed in my classroom.

Naowarat Cheeptham
Thompson Rivers University, Kamloops, BC

Assignment #1: Introductions

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

Originally from Thailand now a Canadian, I have been working as an Assistant Professor of microbiology at Thompson Rivers University (TRU) for the past six years. TRU is a one of a kind university, in the last 20 years, it has transformed from a community college to an innovative university-college, and now to a full provincial university with a unique mandate. TRU offers combinations of traditional degree programs, diploma, certificate program, and degrees through distance education (TRU British Columbia Open Learning University).

When I was hired in 2002, I was the only microbiologist (we have two now) in the department. Together with a couple of colleagues, I oversaw curriculum development for Department's new major in Cellular, Molecular, and Microbial Biology (CMMB). I was enthusiastic about the new program which is now the most popular program in the Department. We have seen the number of enrolled students growing every year. My contributions to this program include creating and teaching courses on Introductory Microbiology I and II, Molecular Evolution, Industrial Microbiology, Advanced Microbiology Techniques, and Bioremediation. I have revised and reorganized the lab component of the Introductory Microbiology courses with the help of two lab faculty members so that we have a more updated series of exercises that aims to make microbiology fun, and more meaningful to students as well as complement the lectures. Additionally, to enhance student learning, I have been supervising a number of students on their research projects for both the Directed study and Honours program.

My teaching responsibilities and the type of student in our program.

Current teaching responsibilities for the academic year

Course	Level	# of students	Type of students
BIOL 210	2nd	90	Microbiology major (Introductory Microbiology I and lab component, alternately teaching in the Fall semester)
BIOL 220	2nd	80	Microbiology major (Introductory Microbiology II and lab component, alternately teaching in the Winter semester)
BIOL 411	4th	12	Microbiology major (Advanced Microbiology Techniques, Winter semester)

BIOL 449	4th	30	Microbiology major

(Special Topics in Biology: Industrial Microbiology and Bioremediation, alternately offered in Winter semester)

BIOL 448	4th	up to 2	Microbiology major

(Directed Study in Biology)

BIOL 499	4th	up to 2	Microbiology major

(Honours Thesis in Biological Sciences)

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

Though in my 6th year of teaching here, I continue to find myself learning how to improve my teaching and to assess student learning so that the courses can be made more effective and interactive. The Biology Scholars Research Residency program will expand my repertoire of pedagogical approaches in teaching microbiology at an undergraduate level. This program presents an opportunity to further my own learning as a microbiology educator, to develop a network with other teaching colleagues, and to learn the tools needed to evaluate student learning. By joining this program, I also hope to develop strategies to enhance student-student interaction and to make learning more active. Finally, the information obtained via this proposed project will be disseminated through ASMCUE, Microbiology Education and other journals for pedagogical excellence such as the Journal of Scholarship of Teaching and Learning. All in all, this will benefit not only TRU students, myself, TRU colleagues, and the Biology Scholars Research Residency program Listserv community, but in science education community as a whole.

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

Outside of the classroom, I enjoy hiking, biking, cross-country and downhill skiing, cooking, dancing, taking pictures, playing squash, travelling, and interacting with my son, Ryder, he is almost two now.

On a different note, I am also volunteering for the CDC, Canadian Diseases Control, on their community program called "A community program for a wiser use of Antibiotics: Do Bugs Need Drugs?". As an educator, I found this initiative very important and vital to our increasing problem of new and emerging resistant bacteria both in the hospitals and communities. That said, I just finished translating the CDC's parental guide for the program into Thai and with my former student, we will help them with Japanese translation later.

To be honest, I have not had lots of time to read for fun for a while with a very active toddler and a full time teaching, it is hard. However, I read whenever I have time:-) The recent book I read and really enjoyed was "The King's last song" by Geoff Ryman. Given that I am originally from Thailand and was in Cambodia in 1997, I developed sympathy and guilt at the same time towards Cambodians of what they have gone through and how little the Thai government did to help them. This book is beautifully written and brings the mixture of contemporary and ancient Cambodia together wonderfully. A must read for those who loves this type of story.

Assignment #2: Reflections

1) How would you describe your "research problem(s)" to the Research Scholars group?
2) What theme(s) based on your readings, resonate with your "problem" and/or your proposed approach to address your problem?
3) Based on Pat Hutchings article, what taxonomy would you use to describe your research question and why?
4) Do you have any questions/concerns/comments that have evolved from your reading?

For our Cellular, Molecular, and Microbial Biology (CMMB) program, I created an elective course on industrial microbiology for third and fourth year major students which I have taught a few times. In this course, the principles of fermentation technology and various factors that have great impacts on the biochemical and physiological basis of fermentation processes that are relevant to the industrial microbiology of selected products are discussed. In addition, different products and fermentation processes are chosen and discussed as case studies. The course has been well-received by both students majoring in CMMB and non-major students.

When the course was first offered, there were just 10 students in the class and it is now capped at 24 students. I assign the students group learning activities and articles to discuss, and ask them to make presentations on specific topics. There are three mandatory field trips arranged for the class: the Armstrong Cheese Factory, the Granite Creek winery, and the Kamloops Beer Brewery. Student evaluations have shown that students learned a great deal on the applications of microorganisms and their metabolites, as well as some possible career paths related to microbiology. Although, I believe that these field trips enhance the students' in-class learning, I have difficulties in assessing these
experiences in more concrete and quantitative ways.

Specifically, I would like to propose a series of questions that will help me evaluate the impacts of field trips on student learning and understanding in an upper-level microbiology course. This information will enhance, first of all, my own curiosity as a teacher, curriculum design, course implementation, and evaluation. The questions I would like to address are:

1) Is it possible to quantify the enhancement of student learning
as a result of field trip activities? Besides, attitudinal survey, is there any approach to assess student learning?

2) How should the attitudinal survey be designed to provide
valuable information on student perceptions of their field trip experiences in the course?

3) What factors serve as facilitators or barriers in the design and
implementation of field trips in the upper-level course?

To date, an attitudinal survey (Lewis and Seymour 2001) was done on students at the end of the course. The results demonstrated that overall students enjoyed the course and that the field trips enhance their learning as a whole (but how and to what extent?). I firmly believe that excellence in teaching and the quality of the learning experience enjoyed by students go hand in hand with the close connection

that is made between its real world experience, and the learning in the classroom. In proposing this project, I hope to gain a clearer and deeper understanding of different pedagogical approaches to assess the impact on student learning in field trip-based courses.

Based on the pre-institute assigned readings, I see this set of questions as an on-going inquiry and a continuous improvement of my own teaching. The questions I am asking now are basically my attempt to try getting where I can say "what works (Pat Hutchings)" in the context of the class I am teaching (and maybe this will lead to other types of questions as well). In a way, I do not think that a starting process of empirical research in one's own discipline is that much different than the approach of the scholarship of teaching and learning. What I am doing now is merely "asking questions" and I strongly believe that researchers and/or teachers need to equip themselves with this to be successful in their own quest. Reading these assignments opened my eyes in numerous ways, it is so hard to believe that (and I quoted from Randy Bass 1999) "teaching is an egocentric profession". Hence, it is difficult to hear at times. At the end of the day, I want to be able to teach what I know in my discipline to my best ability to students. That said, I want to be a teacher who teaches for un"understanding" I mean "deep understanding"). And I will try not to prematurely assume that students understand but I need to have a way to go about to measure that yes, students indeed really understand what I taught.

Assignment #4: Annotations

My project focuses more on how to assess student learning when new materials and classroom activities are introduced. In 2004, I created an elective course on industrial microbiology for third and fourth year level students and have taught this course since 2005 in the winter semester. Among other activities, there are three mandatory fieldtrips arranged for the class: Armstrong Cheese Factory, Granite Creek Winery, and Kamloops Beer Brewery. Student evaluation, in the students' own words, showed that students learned a great deal on the applications of microorganisms and their metabolites, as well as some possible career paths related to microbiology. Although, I believe that these field trips enhance the students' in-class learning, I have difficulties in assessing these experiences in more concrete and quantitative ways.

Therefore, I would like to be more effective in evaluating the impacts of field trips on student learning in an upper-level microbiology course.

For this pre-institute annotated bibliography assignment, the first challenge I faces was what the appropriate keywords are. "Field trip assessment" did not work at all in any databases, so I switched to "assessment in science teaching" and "approaches in science teaching and learning". The listed references below were what I found that most related on what I would like to learn:

Penwell RA and Padilla MA, "Developing Attitude Surveys for an Advanced Placement Environmental Science Class", Journal of Cognitive Affective Learning, 3(2): 11-17, 2007.

This article concerns the reliability and validity of a survey designed and used for measurement of the attitude of the students their Advanced Placement

Environmental Science (APES) class. To construct the 42 item attitude scale, the authors followed the model developed by Haladyna, Olsen, and Shaughnessy in 1982. The model suggested that there are three variables that contribute significantly to students' attitude towards science. These are student variables, teacher variables, and learning environment variable. In the paper, to measure content validity, reliability, and construct validity of the survey, Cronbach's alpha and item-total correlations were demonstrated from a pilot project's test results. This paper gave me an idea that there is significantly more for me to learn in how to design an attitude survey effectively.

Tanner K and Allen D, "Approaches to Biology teaching and Learning: From Assays to Assessments-On Collecting Evidence in Science Teaching", Cell Biology Education 3: 69-74, 2004.

This paper gave me a chill while reading given the fact that I have always wanted to learn more about classroom assessment techniques. The paper hit me right in the heart of finding and how to embark on my quest of being a more skilful and effective teacher. The paper describes the definitions and classifications of assessment and moves smoothly on to various methods exampling classroom assessment in different scenarios and disciplines. Additionally, as a scientist, it is useful to have it spelled right out what the similarities and contrasts are when it comes to classroom assessment and scientific research. At the end, it introduced resources on classroom assessment to guide the way in (in which the main book it introduced is the one I bought a few months ago and I am looking into the references to get more papers for further readings.)

Note: I kept on seeing Allen and Tanner's works referenced in various papers as well. It seems that they are well-known in scholarly teaching. Also, I am reading a book entitled "Classroom Assessment Techniques: A Handbook for College Teachers" (Jossey Bass Higher and Adult Education Series) by Thomas A. Angelo and K. Patricia Cross (Paperback - Mar 12, 1993) to learn more about assessment techniques.

Phillips AR, Robertson AL, Batzli J, Harris M, and Miller S, "Aligning Goals, Assessments, and Activities: An Approach to Teaching PCR and Gel Electrophoresis", Life Science Education 7: 96-106, 2008.

The authors did a great job of presenting what they did (introducing research oriented exercises) to enhance student learning. As a scientist and an educator, this work was thought provoking for me in terms of understanding how important aligning teaching and learning goals, designing activities appropriately, and in creating appropriate and valid evaluative assessments. This paper demonstrated the combination of "hands-on and minds-on components" and how to make the two processes go well together to promote critical-thinking and analytical skills in students learning. I learned more about ways in cooperating formative and summative assessments, new to me is the retention assessment where the authors survey whether and how much students have knowledge retention five months after the course. At the end of the report, they also gave the address online where we can access supplemental materials. All in all, I am impressed with the thoughts, planning, time, and work that the authors put into publishing this.

Preszler RW, Dawe A, Shuster CB, and Shuster M, "Assessment of the Effects of Students Response Systems on Student Learning and Attitudes over a Broad Range of Biology Courses", Life Science Education 6: 29-41, 2007.

This article demonstrated impacts of cooperative learning method in this case the use of clickers; electronic students response system, on student learning and impression in six biology courses. The results showed that, though disparity in impression of students observed in lower and upper level biology courses, overall the clickers seemed to make lectures (traditional study method) more interesting. Additionally, improvement of attendance and material understanding in students were seen while there was an unclear conclusion on whether the use of clickers in classroom would help with performance in examination.
In this study, a group of biology educators were assigned for the tasks, among them there was a difference in terms of newness to the use of clickers in classes, some of them never used clickers before, whereas others had. So, it would be more interesting to point out whether this quality of professors teaching classes will yield any differences in results or not.

Flaspohler MR, Rux EM, and Flaspohler JA, “The Annotated Bibliography and Citation Behavior: Enhancing Student Scholarship in an Undergraduate Biology Course” Life Science Education 6: 350-360, 2007.

Though it superficially seems that this work may be of a far distance from the focus of my research, it is actually not. I want to learn more about different ways of assessment of student learning in science at different levels and this paper gave me that edge as well as others.
The authors introduced collaborative teaching (science faculty and librarians) approach that was created to boost “information literacy” in biology students. The authors deigned and employed annotated bibliography and citation assignment in a biology class for their research (term) paper. They used grading rubrics to evaluate the work of students. The results showed that students gained more knowledge in choosing sources of literatures, writing annotated bibliography of their own research, and a reduction in plagiarism. One thing that bothered me after reading the paper was that I did not find where the supplemental materials can be found.

Iglika Pavlova
University of Chicago, Chicago, IL

Assignment #1: Introductions

1) Describe your teaching responsibilities and the type of student you teach
My major interest is in teaching non-biology majors, though I teach bio majors and premeds as well.

I am also concerned about increasing scientific knowledge overall in the population, and teach science courses for Chicago Public School high schoolers.

I enjoy and have taught a variety of courses, including Infectious Disease, Immunology of Infectious Disease, Microbial Diversity, Plants & Society (a combo of botany, plants as food and medicine, and agriculture), Evolution & Intelligent Design (a course that explores the nature of truth and knowledge (epistemology) and teaches fundamental components of reasoning (deductive/inductive arguments, explanations, theories, evidence, probabilistic thinking), and Critical Thinking.

2) Describe what you would like to take home as a result of attending the SoTL Institute
Foremost in my mind are 2 issues: 1) Teaching in a way that everybody, not just some, learn and 2) Teaching in a way that allows you to make the learning a part of your life & belief system - in a way that you can apply to your daily and/or professional life. So, my biggest goal is to design ways to test the effectiveness with regards to goals 1 and 2 of my "brand" of teaching (with numerous variations, depending on course) which combines both 1) Using messy real life complex situations and 2) Using explicit conceptualization and building of an explicit framework.

The second biggest goal is it to bring back the knowledge of research- based education to my department and biology teaching at the U of C. This may involve being in charge of rigorous assessments of teaching in our department.

3) Tell us about your interests outside of the classroom and a book that you've read recently
I love learning about the world, including the economic and sociological aspects, so I read a lot, go to international music performances and films, enjoy ethnic food, and try to interact with a variety of people - and am more and more helped in this by my modest, yet increasing knowledge of Spanish. Also, I try to go to nature as often as I can!

A friend recently gave me Three Cups of Tea, a non-fiction account about the schools built by American Greg Mortensen in remote areas of Pakistan, so I am currently reading that.

Assignment #2: Reflections

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

The framework (justification not presented) that I am currently working from is:
- In a particular setting, the learning goals should be that everyone learns, and learns to an extent of mastery that allows the knowledge to be used outside of the classroom.
- To accomplish these (ambitious) goals, teaching must be such that A) each student can actively engage with his current understanding, build on it and challenge misconceptions, B) each student learns from messy, complex, real-life situations, and has multiple occasions for practice, and C) each student (even novice learners) can go beyond natural ability to higher order reasoning using explicit conceptualization and creating a framework of knowledge.

Having used these approaches in my teaching and started assessments of their effectiveness, my research questions are:
#1 - What are the incoming thoughts and attitudes of students toward A), B), and C) above – especially C)?
#2 - What is the effectiveness of different methods for C)?
#3 - How can one work with the incoming thoughts and attitudes of students to improve the effectiveness of C)?

2) What theme(s) based on your readings, resonate with your "problem" and/or your proposed approach to address your problem?
3) Based on Pat Hutchings article, what taxonomy would you use to describe your research question and why?

The articles made me think more deeply both about the methods I will use and the goals that I have for my research. (And so much more - Thank you for having us read them!)

I find that I am interested in doing research that explores "what works" (my research question #2), but also understanding what are the underlying reasons ("what is", my research question #1), and using the understanding of that to improve learning ("visions of the possible"?, my research question #3?). Especially because of my interest in developing higher-order reasoning, a widely recognized as important, yet developing and open field, ultimately my interest is in formulating a framework that can be translated beyond my classroom (Hutchings 4th reason). And so, I may be interested in going into more formal education research, even with components of sociological or psychological research.

Because of this interest in exploring problems from different perspectives, I will have to seriously think about how I can break the research project down into more manageable pieces to start with, yet in a way that I can build on it to create a more unified work later on.

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

I am very interested in learning more about the different ways (especially methods of collecting evidence) of doing education research, spanning the continuum from CAR to more formal approaches. I hope we have a discussion of both kinds, and learn what it would take to do the more formal education research. If one cannot do the harder education research on ones own, what would it take to present education research so that is palatable to other fields (such as education) and - even better -

to collaborate with people in the education, sociology, or psychology fields to produce rigorous results?
Second, should teacher training at the school level involve learning to do CAR? It is currently not in the Illinois standards for Masters of Teaching programs, yet teaching itself can be improved if teachers evaluate their teaching more rigorously. Is that too much to add to already busy programs?
Finally, a major difficulty I continue to face is that exactly the part that I think I can contribute the most to, and in a novel way – the part on explicit conceptualization and critical thinking, including in novice learners – is also the part that is not typically part of the training of the scientists (mostly biologists) that would potentially be my initial target audience. What are some possible ways to obviate this problem? What are some people that can support this effort?

Assignment #4: Annotations

The focus of my literature search was on the following two issues important in my teaching and proposed research:

1) Approaches in teaching thinking skills (especially explicitly), transformative learning and related issues of critical thinking in novice learners

2) Approaches to assessing learning, especially for thinking skills and for real-life application

I also wanted to look at a variety of perspectives, including philosophical and psychological.

I recommend studying the ERIC Thesaurus descriptors and their interrelationships - it was very helpful not just for the ERIC search, but for learning about the conceptualizations used in the field of education, which will allow further study of the issues of interest.

Sanz de Acedo Lizarraga, M.L., Sanz de Acedo Baquedano, M.T., Goicoa Mangado T., Cardelle-Elawar, M. (2009). Enhancement of Thinking Skills: Effects of Two Intervention Methods. Thinking Skills and Creativity, 4 [1]: 30-33

The authors conducted three quasi-quantitative studies in Spanish Secondary Schools of two different intervention methods aimed at enhancing thinking skills. One was an infusion method, where the thinking skills are taught within the classes, and the second was an “instrumental enrichment program”, where the thinking skills are taught in a separate course. The authors found that both programs, but especially the infusion method, increased both thinking skills and subject competency, as judged by several different assessment instruments.

This is a great example of both methods and quasi-quantitative assessment for critical thinking. I was impressed that both methods used – successfully - an explicit (to the students) approach to teaching critical thinking. Method-wise, I would like to learn more about different assessment instruments, and which ones are appropriate for the college level (e.g., one of the tests used is designed for 8-15 year olds).

De Wever, B.; Van Keer, H.; Schellens, T.; Valcke, M. (2009). Tagging Thinking Types in Asynchronous Discussion groups. Journal of Computer Assisted Learning, 25 [2]: 177-188

The authors assess the value for improving critical thinking processes by having students use DeBono's "thinking hats". As students posted to an online discussion, they had to identify what kind of contribution they are making – what kind of "thinking hat" they are using. For example the white hat identifies the problem (an early stage of critical thinking, according to Garrison's framework), while the black hat evaluates different possible solutions (a later stage). The study found that using the thinking hat conceptualization increased critical thinking in general, and problem identification and exploration in particular.

I was attracted to this study again because it uses a method where the teaching of critical thinking is explicit, as in my own teaching. It is also valuable in that it aims to evaluate critical thinking ability, with painstaking grouping and evaluation of online discussion inputs into critical thinking categories, representing to me an alternative assessment approach.

Sadler D.R. (2009) Indeterminacy in the Use of Preset Criteria for Assessment and Grading. Assessment & Evaluation in Higher Education, 34 [2]: 159-179

The author identifies problems with the widespread grading practice of open-ended and complex assignments using preset and explicit (to the students) criteria. One such problem is the conflict between this kind ("analytic") of grading and a more holistic approach and the problems stemming from a grader's effort to resolve this conflict. He identifies the major reason for the problems with preset criteria as due to indeterminacy, a condition where the proposed method (here, preset criteria) is insufficient to give complete solutions to the problem (assessment of complex work). Considering also the problems with holistic approaches, his proposed solution is active student engagement in the process of evaluation, with anonymous peer grading and exposure to multiple examples of peer work along with instructor evaluation.

The ideas in this paper are directly related to my interest in promoting and assessing critical thinking. It is curious that the proposed solution further increases the students higher level thinking and metacognition, with some observed benefits such as becoming self-critical and developing the ability to self-monitor – and so can be an example of another potentially successful explicit approach to teaching critical thinking.

As none of the studies I found this week (as in references 1-3 above) compare using an explicit approach to teaching thinking skills to an implicit one, I hope to find such studies in the future.

Rowbottom D.P. (2007). Demystifying Threshold Concepts. J. Phil. Educ. 41 (2): 263-270

The author points out problems with the current definition of "threshold concepts" [TC] and issues in applying the idea of TC to teaching and assessment, in particular the consideration that what may be a TC for one person may not be for another, and that learning a TC is not sufficient for acquiring a concept as an ability.

The importance of this article to me was to remind me of the value of philosophy, in particular the clarification it can bring, even though the short length of this article did not allow the author to sufficiently defend some of his arguments and as a result the article was frustratingly unsatisfying.

In the future, I would like to see if there are any studies of the effectiveness of teaching using TC. The literature I have seen and active learning seminars I have attended operate on the notion that it brings something new and that it is efficacious.

The Difference that Inquiry Makes: A Collaborative Case Study of Technology and Learning, from the Visible Knowledge Project. Reprinted from the January 2009 issue of Academic Commons on "New Media Technologies and the Scholarship of Teaching and Learning," edited by Randy Bass with Bret Eynon (http://www.academiccommons.org/issue/january-2009). Retrieved July 2, 2009, from the Visible Knowledge project website https://digitalcommons.georgetown.edu/blogs/vkp/2009/02/20/bass/

This publication is a compendium of the research of several groups as part of the Visible Knowledge Project, which aims to capture "invisible learning", the invisible intermediate processes of the learning process, including both its cognitive and affective components.

Most striking is the finding that technology can be used to engage novice learners in expert thinking. This is a difficult task that technology may be particularly suited to as it allows access to sources of "undigested" and complex information, and allows one to move at one's own pace, while focusing on analysis and on the creative, rather than the memorization of material pre-processed by an instructor.

It would be interesting to find out whether there have been efforts like this one in the biological sciences. I would also like to learn whether there are other educators that explicitly think about different paths from novice to expert, in particular whether the time can be shortened through approaches aimed at improving metacognition and the use of explicit conceptualization of field-specific material.