FAST (Future Academic Scholars in Teaching) Fellowship Program Symposium-May 1, 2012

2011-2012 FAST Fellows and Agenda:

9:00-9:20  Jennifer Kelly
9:25-9:45  Cameron Whitley
9:50-10:10 Chris Richardson
10:15-10:35 Kathy Walsh
10:40-11:00 Nick Ballew
11:05-11:25 Jasmina Jakupovic
11:30-11:50 Amanda Malefyt
11:55-12:15 LeighAnn Jordan
12:20-12:40 Lisa Rebenitsch
12:45-1:05 Mark Tran
1:10-1:30  Wenning Feng
1:35-1:55  Emily Norton Henry
2:00-2:20  David Achila

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Title: Developing critical thinking skills: a social constructionist perspective

Author: Jennifer Rebecca Kelly, Department of Sociology

Mentors: MSU CIRTL Steering Committee

Abstract:
Scholars and educators alike understand the importance of critical thinking skills, yet implementing such skills into course objectives and design, while assessing whether or not such skills have been learned, have proven to be a challenging task. Using tenets of the How People Learn Framework in my online course design, I investigated, in what ways does a series of semester long iterative writing processes enable students to develop learning comprehension of key concepts related to International Development and Social Change? To answer this question, I identify the critical thinking skills, via Bloom’s taxonomy, students’ achieved in their final writing assignments. Content analysis of these papers suggests most (89%) students were able to synthesize course content. This aligns with the learning objectives as students were asked to use course content to expand, reflect and build on pre-existing knowledge as well as connect and meld insights. Findings also suggest students used other critical thinking skills: apply (19%), analyze (75%) and evaluate (31%), even without being prompted. My findings highlight a close relationship between analysis and synthesis. Moreover as students draw connections between material and knowledge, they may also begin to break down the problem. The data also illustrates, with clear direction, iterative writing assessments may help students develop all of their higher order thinking skills. Implications of this research suggest when instructors provide students with clear direction and description on expectations of a particular higher order thinking skill and students are able to practice the skill with ongoing feedback from the instructor and peers, there is a high success rate of that skill being used and learned. Further, my findings suggest the use of a social constructionist pedagogical perspective, where students develop their understanding of knowledge individually, may be a useful tool for student development of critical thinking skills.
Title: A picture is worth a thousand words: applying image-based learning to online course design

Author: Cameron T. Whitley, Department of Sociology

Mentors: Dr. Toby Ten Eyck, Department of Sociology, MSU
Dr. Eleanor Hubbard, Department of Sociology, University of Colorado-Boulder (retired)

Abstract:
As budgetary concerns continue to impact higher education, larger classes and online platforms are seen as long-term solutions. At the same time, research suggests that critical thinking skills among college graduates are declining. Drawing on literature from teaching and learning and concepts found in visual sociology, the author creates an online course structured around image-based learning, with the objective of increasing critical thinking skills through competency level assessment from Bloom’s Taxonomy of Educational Objectives. Findings reveal that the use of image selection, posting, and critique with the application of pre and post-course personal meaning maps did increase competency levels, demonstrating critical thinking development. Additionally, 101 out of 106 students (95 percent) reported learning more in the imaged-based online course compared to other college courses.
Title: Investigating the social interactions of genders in the introductory physics classroom

Author: Chris Richardson, Physics and Astronomy

Mentor: Dr. Brian O'Shea, Physics and Astronomy, Lyman Briggs College

Abstract:
The introductory physics course gender gap is a multifaceted, complex problem defined by performance in standardized testing, student attitudes and beliefs, and by the number of physics majors or degrees (females being the minority). Previous research has shown that there is a performance gap in Force Concept Inventory (FCI) post-test scores in the Lyman Briggs College introductory physics classroom. In this study, we address two questions: (1) What are the gender differences in social interactions between students and their peers, and students with faculty? (2) How can we use this information to narrow the gender gap?

We have addressed these questions by distributing a Likert scale survey asking students to identify ways in which they interact with peers and their instructor, and how comfortable they are with this interaction. Similarly, we have investigated their confidence in expressing their ideas and whether there is a gender preference in their interactions. We have complemented this survey with observations to determine gender distribution in groups and the nature of discussions between same gender and mixed gender groups.

Our survey has shown that females feel less confident than males in course material, asking questions to their instructor during lecture, and expressing their ideas to their neighbors (p < 0.05). Females also find discussing “clicker” questions more helpful than males (p < 0.05), and would rather work in groups during “clicker” questions while males would mostly prefer working alone (p < 0.01). Our observations have shown that in same gender groups, the nature of the discussions is evenly split between student questions and explanations. However, in groups where both genders are equally represented, females ask the majority of questions and males give the majority of the explanations. We will briefly outline further research ideas that could incorporate these findings to reduce the gender gap in introductory physics courses.
Title: Investigation of effects of mathematical preparedness on introductory physics problem-solving fluency

Author: Kathy A. Walsh, Department of Physics and Astronomy

Mentor: Professor Stuart Tessmer, Department of Physics and Astronomy

Abstract:
Anecdotal evidence strongly suggests that students who are mathematically underprepared struggle more in learning physics than do their peers. To aid in addressing the issue of mathematical underpreparedness in physics learning, this investigation considers the extent to which particular indicators of mathematical preparedness predict the ability of students to solve online homework problems in a fewer number of attempts. Problem-solving fluency is assessed in this work by analyzing the number of submitted attempts students required in order to answer LON-CAPA homework problems correctly. This analysis focuses on a sampling of quantitative homework problems assigned throughout the semester.

In an endeavor to increase the mathematical preparedness of an introductory physics class, a classroom intervention was implemented, consisting of an explicit review of vector operations and trigonometry at the beginning of the semester. Additionally, problems which dealt explicitly with these mathematical concepts were added to the first homework assignment to provide practice. In order to ascertain the effectiveness of this mathematical review, the performance of students in the intervention class on homework problems was compared to that of students in a control class taught by the same professor in the previous semester. The students in this study were in second-semester, non-calculus physics for non-physics majors. Implications of this work for the incorporation of mathematical reviews in physics courses will be discussed.
Title: The effect of an MSU undergraduate education on a student’s ability to think analytically

Author: Nicholas Ballew, Department of Zoology and Ecology, Evolutionary Biology, and Behavior Program

Mentor: Dr. Julie Libarkin, Center for Integrative Studies in General Science

Abstract:
Students who complete an undergraduate degree program at Michigan State University are expected to demonstrate an enhanced ability to think analytically. While the development of this ability is a primary learning goal in almost every class at MSU, most classes do not actually focus on developing analytical thinking. Thus, the aim of this study was to assess the effectiveness of an MSU undergraduate program at enhancing analytical thinking. Students in an integrative studies-biology class (ISB 208) served as the study population. Students in ISB 208 were chosen as the study population because the students enrolled in ISB 208 cover numerous majors and all stages of an MSU undergraduate education, from first year to fourth year. Analytical thinking was assessed by administering a survey on Angel. Students were asked to self-report their G.P.A, credits earned and major unit, in addition to other information about their background. They were then presented with a limited amount of information about two hypothetical colleges. Students were asked to make a decision about which college they would attend based on the information presented. Students were then asked to evaluate how reliable each piece of information was and to infer how relevant each piece of information was to the decision to be made. The evaluations of the reliability of information and the inferences made on the relevancy of information were used as the measure of analytical thinking. I found no effect of an MSU undergraduate education on evaluation or inference making skills. However, I did find a significant positive relationship between evaluation ability and G.P.A. My results indicate that an undergraduate degree program at MSU may not have the desired effect on student analytical thinking. Thus, it may be beneficial to alter the MSU undergraduate curriculum so that it focuses more on developing analytical thinking.
Title: Comparing effectiveness of online to in-class learning formats in an upper-level, elective pharmacology course PHM431

Author: Jasmina Jakupovic, Neuroscience Program

Mentor: Dr. James Galligan, Neuroscience Program and Department of Pharmacology and Toxicology

Abstract:
Studies have shown that online learning can be as effective if not better than in-class learning, depending on the type of class. In this study, we compared the effectiveness of online learning to that of in-class learning in an upper-level, elective course, “Pharmacology of Drug Addiction” (PHM431). We had the following three objectives: 1. Compare students’ overall performance in the two learning formats, 2. Determine if one learning format is more conducive to learning a particular set of cognitive skills, and 3. Identify subgroups of students that perform better or worse in one learning format compared to the other. We collected final course GPA and students’ performance on two multiple choice exams (% of students that answered each question correctly) in each learning format with questions clustered by the level of cognitive skills that they test; lower order (LO): knowledge and comprehension and higher order (HO): application and analysis. There were no differences in mean and median GPA, or in the distribution of the students’ grades between the two learning formats. Likewise there were no differences in students’ performance on exam questions clustered by the level of cognitive skills that they test (LO vs. HO). Unfortunately, not enough data was obtained on students’ gender, ethnicity, major, year in school and overall GPA to determine if these factors affect students’ performance in the two learning formats. The online and in-class versions of PHM431 were equally effective in delivering content, teaching and assessing students on both lower and higher order cognitive skills. Future studies should compare these factors in lower-level, pre-requisite courses that contain a large, diverse student population.
Title: Discussion of real-world qualitative examples to introduce concepts in material balances of multiphase systems

Primary Author: Amanda P. Malefyt, Department of Chemical Engineering and Materials Science

Secondary Authors/Mentors: Tim A. Whitehead and S. Patrick Walton
Department: Chemical Engineering and Materials Science

Abstract:
Material and Energy Balances, ChE 201, is a sophomore-level, introductory course for chemical engineering majors. The main encompassing learning objective is to introduce students to chemical engineering and fundamental principles of chemical process analysis through applying problem-solving techniques in a variety of process-related problems. One area of this course in which students consistently struggle is dealing with multiphase systems. The goal of this project was to compare students’ ability to meet learning objectives in this area upon improvements to the learning objectives, assessment alignment, and incorporation of relevant qualitative examples to the lecture. At the same time, it was believed these changes would increase student engagement and interest in the classroom. The new structure was tested during the Spring 2012 semester and compared to data previously collected during the same course from the Fall 2010 semester. Upon the development of detailed learning objectives, discussion of relevant qualitative examples, and improved alignment of the assessment question, the average score on a related test question was 74%, a significant improvement over 59% from the Fall 2010 course. While some students preferred the new teaching method more than others, the results suggest incorporation of concept questions to introduce new material may be beneficial. Additionally, this project provided the instructor with new and improved ideas for presenting lecture material in future teaching assignments.
Title: How does structure of recitation affect performance in a general chemistry course for non-majors?

Author: LeighAnn Jordan, Chemistry Department

Mentors: Dr. Amy Pollock, Wendy Tsuji, and Steve Poulios, Department of Chemistry

Abstract:
Approximately 3000 students enroll in CEM141 each school year and attend weekly 50 minute sessions. These teaching assistant (TA) run sessions are an opportunity to ask questions and discuss course material. The recitation is structured around a worksheet; to ensure each recitation covers the same material and hopefully provides the students with equal opportunity to learn material. Student feedback and observations of recitations exposed differences in structure of these recitations; group work, interaction with each other and the TA varied. Literature suggests that a more interactive environment and the use of effective group work enhance learning. It was hypothesized that more interactive recitations would enhance learning and performance in the course.

An analysis of Fall 2011 CEM141 grades and recitations attended revealed grades of students attending specific recitations, 7 of the 18 different TA lead recitations, had significantly higher or lower grades than the overall class average. Recitation structure analysis and controls for other factors contributing to performance in the class were employed for the more intensive analysis in the Spring. Two independent observers attended recitations and analyzed the structure of each TA's recitation. Spring 2012 students were surveyed and controls included homework, math-pretest & ACT scores, recitation attendance, gender and tutoring; among many others.

Average percent on three exams were compared only for those students that completed more than 80% of the homework, recitations and did not have a tutor. The most apparent difference between the recitations with the highest and lowest averages was group-work. If it not used effectively, averages were lower than those who did not employ group-work. The difference between Fall and Spring could be contributed to the different student body and TA experience. The study will continue and an additional session during TA training hopefully include a “how to” session on effective group work.
Title: Investigation of effects of computer science group project structures

Author: Lisa Rebenitsch, Department of Computer Science

Mentor: Dr. Owen, Department of Computer Science

Abstract:
Group project in computer science add unique difficulties for the students mainly involving the intangibility of the code. Due to this, conventions for group project in other disciplines may or may not apply. To determine potential good group project designs, course project descriptions for 300-400 level CSE courses will be analyzed to determine their effect on the individual student. A project may increase the students’ course grades for the class as a whole, decrease the student’s course grades as a whole, have little effect as a whole, or have an undistinguishable or “switching” effect when compared to the student’s individual work grades. After the course level effect of the project is determined, the description is further analyzed to determined is certain aspect or convention will produce a course level grade effect in greater frequency.
Title: The effectiveness of group discussions in undergraduate biology education

Author: Mark Tran, Department of Zoology

Mentors: Dr. Richard Hill, Department of Zoology
Dr. Gail Richmond, Department of Teacher Education

Abstract:
Group discussions are valuable cooperative learning tools for use in undergraduate biology classrooms. Discussions provide students with an avenue to express their ideas and opinions in a non-threatening environment, and can serve to actively engage students in their own education. However, the effectiveness of group discussions is often difficult to gauge, particularly when discussion topics are focused on complex scientific concepts. While many students report that they enjoy group discussions, the degree to which discussions enhance their knowledge of course concepts remains largely unknown. The objectives of this study were to (i) gain insight into what upper level undergraduate students know about fundamental biological concepts, (ii) understand student opinions of scientific literature, and (iii) quantify how student knowledge and opinions change after participating in a discussion based course. To accomplish these objectives, ZOL483 (Environmental Physiology) students were given pre- and post-semester assessments/surveys through ANGEL, on which they were asked a number of questions to assess their opinions of scientific literature and group discussions, as well as their knowledge of fundamental biological concepts. These concepts were specifically geared around evolutionary processes because (i) past experience has shown that students struggle with these fundamental topics and (ii) pre-existing knowledge of evolutionary processes is crucial for understanding ZOL483 course material. Results from the pre-semester assessment/survey showed that students struggle to define basic evolutionary terms. Because of this inability to define basic terminology, students struggle to answer more complex questions. Qualitative results indicate that biology students may struggle with defining evolutionary terms because these terms are commonly misused in non-scientific speech. Analysis of post-semester surveys is currently ongoing, so it remains unknown whether group discussions were effective at enhancing students’ knowledge of these concepts.
Title: A study of the effect of the instant hand-on experiences in the introductory statistics course for the undergraduate students

Author: Wenning Feng, Department of Statistics and Probability

Mentor: Dr. Dennis Gilliland, Department of Statistics and Probability

Abstract:
In the recent years, the idea of active learning has been broadly discussed and used in the modern education for a better learning environment construction. In statistics education, the hand-on experience is one of the effective and ideal active learning techniques. However, in the survey of statistics course, the hand-on experience implementation hasn’t gained its popularity due to the confliction with the intensive lecture schedule. In this paper, we conducted an experiment to study the importance of the in-class hand-on experience implementation under the whole sequence of lecture topics in an introductory level statistics class. By analyzing the survey data and students’ test performance, we are able to see students’ strong subjective demand and the significant learning outcome improvements due to the hand-on experiences under each particular topic. Furthermore, we classify all the activities according to the Bloom’s Taxonomy and use the Structural Equation Modeling to study how the activities at a given knowledge level can improve the students’ learning outcome for the knowledge at other levels. Finally, we give some practical guidelines for organizing the activities in a one-semester introductory statistics course for undergraduates.
Title: Using human medicine-based case studies to improve student learning of and attitudes toward statistics in an introductory biology lab

Primary Author: Emily Norton Henry, Department of Fisheries and Wildlife

Secondary Author and Mentor: Dr. Kendra Spence Cheruvelil, Department of Fisheries and Wildlife and Lyman Briggs College

Abstract:
Statistical knowledge is an integral part of conducting and interpreting biological research and, thus, is a necessary tool for virtually any career in the biological sciences. However, undergraduate biology students may fail to make this connection between statistics comprehension and their own lives and career interests. Using statistical analyses to explore more relatable, real-world scenarios, such as the relationships between human health and environmental or socioeconomic factors, may be one way to create such connections in the classroom. In this study, we used case studies based in human medicine to teach specific statistical techniques (i.e., correlation, regression, interpreting p-values, t-test, and ANOVA) in an introductory organismal biology laboratory course. We then evaluated student attitudes toward the importance of statistics and student learning gains in statistical knowledge for the five statistical techniques. We found a significant increase in statistical knowledge for two of the statistical techniques: t-test (p<0.0001) and ANOVA (p<0.05). There was no significant change in learning gains for the remaining three techniques (i.e., correlation, regression, and interpreting p-values). Student attitudes toward statistics were generally more positive after completing the case study exercise, though these results were not statistically significant. Interestingly, students agreed that statistics were important for biologists in the survey yet responded with significantly greater rates of disagreement that statistics were important for their future careers (p<0.0001) or for their daily lives (p<0.0001). Human medicine-based case studies have the potential to increase student understanding of and attitudes toward statistics, but further instruction is needed to demonstrate the importance for biology students, as future science professionals, to understand these statistical techniques.
Title: Impacts of peer discussion on student performance on in-class concept questions

Author: David Achila, Department of Biochemistry and Molecular Biology

Mentor: Dr. Jon Stoltzfus, Department Biochemistry and Molecular Biology

Abstract:
Several research findings have shown that peer discussion enhances student performance on in-class conceptual questions. Biochemistry classes at Michigan State University are mostly large and the current curriculum of BMB462 does not allow much time for in-class learning activities. Clicker questions and peer discussion are occasionally used in BMB462. One way to improve this may be to incorporate more learning activities and boost interaction among students by posing clicker questions that stimulate peer discussion. This has been show to also improve student engagement. Using isomorphic clicker questions, we investigated the impacts of peer discussions on student performance on in-class concept questions. We also conducted a survey to establish students’ opinion on their satisfaction, enjoyment and perceived benefits of clicker questions and peer discussions in BMB462. Our preliminary survey results show that majority of students view in-class peer discussions favorably and agree that clickers questions and peer discussions enhances their understanding of concepts. Our finding is consistent with published data and can be viewed as a pointer to alternative ways to make biochemistry classes more interactive and give students opportunities to sometimes explore concepts on their own with guidance from the course instructor.